Crude oil and Refining Market Outlook

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Key Messages

- IHSM projects a long-term Brent forecast of $70, as a result of the influence from growth of unconventionals (tight oil), geopolitical turmoil continue to impact the short-term outlook.
- US tight oil growth has exceeded expectations, but current infrastructure constraints limit growth in the near-term.
  - US crude exports approaching 2 MMBPD
- Canada Oil Sands to see two more years of large production gains remain on the horizon for Canada and its oil sands, before it settles in for a period of slower growth.
- The implementation of 2020 IMO bunker fuel specification is expected to have a profound effect on the light / heavy differential and refining margins.
Oil prices to stay loftier for longer, sustained by geopolitical risks to supply

**Assumptions**

- **World demand.** World liquids demand growth stays robust this year, at 1.9 MMb/d, fueled by strong non-OECD Asia refined product and US NGLs demand gains. Growth eases to 1.5 MMb/d in 2019, in part as growth in global NGLs demand slows.

- **OPEC production.** The Gulf-3, led by Saudi Arabia, maintain output restraint through 2019, while output from the rest of the group falls because of involuntary losses, especially from Venezuela and Iran.

- **US production.** With annual WTI prices averaging above $60/bbl, US crude output rises at a blistering annual pace of 1.2 MMb/d in 2018 and 1.1 MMb/d in 2019.

- **Global liquids balance.** Lower OPEC output and strong world demand growth help tighten the liquids balance in 2018, even as US supply rises rapidly.
World oil demand growth remains robust

- World liquids average demand growth is expected to again approach 2 MMb/d this year, underpinned by the strongest global economic fundamentals in a decade.
- While there are many headlines about automaker plans for new EV models and advances in driverless technology, at least for the time being the world economy continues to consume ever-more oil.
- Drivers of demand growth in the near term are an acceleration in demand from Middle East, Russia and Latin America, as well as a recovery in Indian demand growth.
- Oil demand growth has been depressed in major oil-exporting countries as the 2015-16 slump in prices weakened their economic growth.
- OECD demand has been a key pillar of support for global demand growth in recent years.
  - In 2017 OECD liquids demand grew by a combined 560,000 b/d, propelled by strong NGL demand growth and the ongoing tailwind of relatively low pump prices for consumers.
  - We expect OECD demand will eventually resume its structural downward slide by 2020, as fuel efficiency standards outpace any increase in aggregate miles driven.
Strength in oil demand growth continues

Changes in oil (liquids) demand by region (volume change from previous year in million barrels per day)

Notes: Mexico is included in Latin America. Data in table may not add up due to rounding. Source: IHS Markit

Global liquids demand growth (MMb/d)

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD</td>
<td>0.6</td>
<td>0.5</td>
<td>0.2</td>
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<tr>
<td>Non-OECD</td>
<td>1.2</td>
<td>1.4</td>
<td>1.4</td>
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<tr>
<td>Total world</td>
<td>1.8</td>
<td>1.9</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Notes: Mexico is included in Latin America. Data in table may not add up due to rounding. Source: IHS Markit

Note: Upper end of the scale for each region is 0.5 MMb/d with the exception of China, for which it is 0.6 MMb/d.
OPEC production restraint needed in 2018-2019

Non-OPEC crude production, excluding US

Gulf 5 crude production to 2023

Source: IHS Markit © 2018 IHS Markit
Venezuela and Iran declines to counter blistering US supply gains

### Annual change in crude oil output for large global producers, 2018–19

<table>
<thead>
<tr>
<th>Country</th>
<th>2018</th>
<th>2019</th>
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<tbody>
<tr>
<td>United States</td>
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<tr>
<td>Canada</td>
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<tr>
<td>Brazil</td>
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<tr>
<td>Russia</td>
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<tr>
<td>Saudi Arabia</td>
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<td>0.0</td>
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<tr>
<td>Nigeria</td>
<td>-0.5</td>
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<tr>
<td>Kazakhstan</td>
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<td>Iraq</td>
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<td>Kuwait</td>
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<tr>
<td>United Kingdom</td>
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<td>Norway</td>
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<td>UAE</td>
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<tr>
<td>Mexico</td>
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<tr>
<td>China</td>
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<td>0.0</td>
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<tr>
<td>Iran</td>
<td>-2.5</td>
<td>-2.5</td>
</tr>
<tr>
<td>Venezuela</td>
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<td>-2.5</td>
</tr>
</tbody>
</table>

**Note:** * indicates OPEC member

**Source:** IHS Markit

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For US supply, it’s onwards and upwards with annual WTI prices above $60/bbl

- US oil supply will respond to higher prices this year and next—helping offset the expected loss of Iranian barrels.
- On an annual average basis, we project US crude production to rise by 1.2 MMb/d in 2018 and 1.1 MMb/d in 2019.
- IHSM expects US crude output to rise from about 10 MMb/d in January 2018 (the latest historical data point) to 11.0 MMb/d by December 2018 and 12.2 MMb/d by December 2019.
- Logistical constraints will limit production to a degree
- Notably, US crude production could surpass our current expectations if producers spend more of the “windfall” from higher prices on drilling new wells, as opposed to returning cash to shareholders or buying back equity, than we currently assume.
US producers have passed the “tight oil test” by adjusting costs to lower prices

Median break-even prices for five key US oil plays, 2014–17

Notes: The break-even price is the WTI crude oil price required for the project to cover all of its estimated capital and operating costs and generate a 10% rate of return. Data are through 3Q 2017.
Source: IHS Markit Performance Evaluator

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US incremental output increasingly dominated by super-light crude

- Most incremental US crude production has been tight oil and therefore light and sweet. However, an increasingly large portion of US crude production growth is coming from the “super-light” (45-50 degrees API) and condensate (50+ API) categories.

- Most of the growth in the “super-light” category is coming from the Wolfcamp Delaware play in West Texas and New Mexico, although the Bakken, STACK play in Oklahoma and Niobrara play in Colorado are contributing to the growth.

- Light quality oils will move to the export markets.

- USGC limited by naphtha yields, lights ends of super light crudes.

- Likely destination market is Asia - a huge market, with growing light sweet imports of 4 MMb/d, plus another 15 MMb/d combined of light sour, medium sweet and medium sour imports.
US crude exports continue to ramp up as exportable surplus grows

- US crude and condensate exports averaged about 1.6 MMb/d in February, almost 500,000 b/d higher than year-ago levels. Preliminary weekly estimates for March and April show exports at even higher levels. The latest weekly figure indicates exports hit an all-time high of 2.33 MMb/d.

- WTI’s discount to benchmarks Brent and Dubai has returned to a widening trend, and should be supportive of continued export arbitrage economics.

- Asia took its largest volume to date in February, importing about 640,000 b/d from the US. Asia will continue to be the key market for incremental US crude exports, as its refining capacity is growing and its light crude production is declining.

- US crude exports will likely need to average around 1.7 MMb/d or higher this year to keep the US system balanced (prevent net crude oil stock builds). We assume that US refiners are at or near the limit of their ability to economically process light shale crude and that incremental US production will need to seek international markets.
Venezuela’s oil production is “slow-moving disruption”

- Venezuela’s oil production is falling, as declining investment in producing fields and heavy oil upgrading units, amid a collapsing economy, take their toll. Venezuelan crude output averaged 1.75 MMb/d in fourth quarter 2017, down 350,000 b/d from the same period in 2016.
- Production has declined by more than 600,000 b/d since 2015.
- The impact of this decline on global oil markets has been blunted by a associated decline in domestic refining runs, as domestic demand fell and the government sought to shore up exports (and thus hard currency revenue).
- Steep declines in Venezuelan production and more modest declines in Mexican output open the door for increased flows of Canadian heavy crude to the US Gulf Coast.
US Heavy Crude Imports
Traditional supply being substituted by Canadian, Iraqi crudes
Major United States refinery projects focus on increasing tight oil runs...

- **Channelview, TX (Targa Resources)**
  + 35,000 b/d condensate (2018)

- **Laurel, MT (CHS)**
  + 10,000 b/d crude (2019)

- **Beaumont, TX (ExxonMobil)**
  + 40,000 b/d hydrotreater (2018)
  + 360,000 b/d crude (2022)

- **El Dorado, KS (HollyFrontier)**
  + 25,000 b/d hydrotreater (2018)

- **Whiting, IN (BP)**
  + 92,000 b/d hydrotreater (2021)

- **Trainer, PA (Monroe)**
  + 60,000 b/d hydrotreater (2018)

- **Port Arthur (Motiva)**
  + 20,000 b/d hydrocracker (2018)

- **Galveston Bay (Marathon)**
  + 40,000 b/d crude (2020)
  + 11,000 b/d hydrocracker (2020)

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  + 40,000 b/d crude (2020)
  + 11,000 b/d hydrocracker (2020)
Oil sands capacity under construction by year.

**Committed oil sands capacity under construction by year**

- **Deferred construction**
- **Under construction**
- **Committed to future construction**

Source: IHS Markit

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A few years of large supply additions still remain on the horizon in western Canada

Year-over-year change in Canadian oil sands and conventional oil Production

Source: IHS Markit, Q4 2017 Canadian Fundamentals
Costs have fallen in the oil sands

- **Capital cost.** Since 2014, the cost to construct a new mine or SAGD facility fell 9% and 11% respectively.

- **Operating costs.** Average weighted operating cost of mines has fallen 33% and SAGD are down nearly 49% since 2014 in Canadian basis.
Crude by rail remains a source of future price uncertainty in western Canada (IHS Markit current outlook is for rail to persist until 2021)
Constrained pipeline and rail takeaway contributed to steep discounts for western Canadian heavy oil producers.

**WTI Cushing less WCS Hardisty**

Estimated transport costs based on historical cost structure; current and future rates may vary
Source: Argus Media, IHS Markit
The IMO Regulation is approaching quickly
The four main options remain for shippers, and likelihood is that a combination will be implemented

- Installation of Exhaust Gas Cleaning Systems (EGCS or ‘scrubbers’) to remove sulphur oxides from the exhaust on board

- Switching away from high sulphur fuel oil grades to low-sulphur fuels, based on gasoil, low sulphur residuals, or hybrids

- Switch to alternative fuel sources, notably liquefied natural gas, which requires vessel modifications

- Non-compliance, either sanctioned due to acknowledged supply-side difficulties (transitional, category-based exemptions, local non-availability etc.), or grey area noncompliance (i.e. malicious intent)
Massive shift in fuel quality and source within bunker supply chain. Scarcity of 0.5%S fuel oil in 2020 will drive demand for gasoil and global refining margins.

**ASW 2018 global international bunker demand**

Global adoption of 2020 IMO standards: Gasoil market share increases from 22% in 2018 to 51% in 2020 (+1.4 mmb/d)

Scrubber uptake: Desulphurised residue to 0.50%S bunkers. More blending as refiners/traders get “creative.” Adoption of scrubbers reduces gas/diesel oil market share to 25% by 2030

Initial adoption of scrubbers:
- Hybrid fuel penetration
- Blending into 0.50%S bunker fuel
- Sanctioned or Unsanctioned Non-compliance

Source: IHS Markit
HSFO consumption increases rapidly with Scrubber adoption

- Currently, there is still no economic incentive for ship owners operating outside ECAs to pre-invest in scrubbers, and the initial capital inlay is sizeable.
- The ECA change that occurred in 2015 indicated that ship owners will likely wait until after the change before reacting.
- IHSM assumes a slow initial ramp up of scrubbers before 2020 of ~ 100 scrubbers per year.
- At forecast price spread between low sulfur and high sulfur bunkers, emerging scrubber financing schemes would support increased uptake.
- By year 2021, we expect there will be ~ 2000 less scrubbers installed than previous forecasted due to reluctant adoptions, limits on scrubber installation capacity, and reduced payback on scrubbers.
Low sulfur bunker fuel implementation date to 2020 has acute impact on products and crude differentials
Refining margin outlook – A large spike for heavy crude refiners is forecast in 2020

• 2018 margins will be tempered downward due to inventory levels near 5-year averages (crude and refined products). Crude prices will face downward pressure as a result of global crude oversupply as a result of robust US light/sweet tight oil production.

• By 2019, refining margins are expected to improve significantly as the industry approaches the IMO compliance requirement in 2020.

• Refining margins are forecast to realize a substantial change from 2019 to 2020 as a result of IMO implementation.

• IHSM projects long term refining margins will have a long, steady decline after the IMO transition period and shock (2020-2024) as global products demand growth slows from the impacts of transportation efficiency gains and alternative fuels use.

Long term price and margin outlook:
• Period 1 - Refining margins will be moderate down from 2017 which was unusually high level as a result of unplanned refiner outages (Hurricane Harvey). Stable product demand and lower inventories will keep cracks elevated but below 2017 highs
• Period 2 - Implementation of the IMO MARPOL Annex VI marine vessel emissions rule, with a reduced impact on the L/H spread
• Period 3 - Gradual decline in refinery margins as demand peaks and creep capacity will meet the long term demand