

Global downstream outlook to 2035

H1 2019



Energy Insights
By McKinsey

Market outlook summary



Overall

After a strong 2017, the global refining market in 2018 saw strong capacity additions but slow demand growth and declining margins—trends that we expect to continue to see moving forward. As more global capacity is added, we'll also see utilization rates slip as a result.

Looking ahead, Europe's utilization rates should dip below 70% by 2023 due to declining demand and the region's sensitivity to capacity additions in Africa, Asia, and the Middle East.

Asia's outlook is strong for the long term, but it will not be immune to sliding utilization rates. We expect its utilization levels to dip to 73% by 2023—almost as low as Europe's—but it should then steadily increase to the low- to mid-80s after 2030.

We'll see the strongest market conditions in the US Gulf Coast (USGC), where utilization rates will remain in the mid-80s thanks to refinery complexity, access to cheap natural gas, crude pricing at export parity, and strong demand for product exports.

Supply and demand

Global crude supply is growing at 0.2% per annum (p.a.) to 2035, with strong production increases in the Americas and Middle East offsetting falling production in Asia and Africa. However, the higher supply of non-crude-based material, particularly from biofuels, will reduce the need for refining, and we'll see demand growth slow from the current 1.2% p.a. to 0.5% p.a. until 2035.

The decline in demand will mostly be driven by road transport and power, with the biggest impact seen on diesel. Meanwhile, refining distillation capacity will grow by 1.2% p.a. in the next four to five years, adding almost 7 million barrels per day (MMb/d) of capacity, with most of the capacity additions in Asia and the Middle East.





Balances and flows

Continued capacity additions will lead to overcapacity in the near term, and we'll see lower utilization in Asia and Europe through 2024 as a result.

As far as changing product flows in the future, the majority will take place in Africa, South Asia, and Southeast Asia—fast-growing regions that will rely on imports to meet future product demand. Asia's crude slate will also become lighter as the region imports more light tight oil and replaces falling Russian and Asian crude supply with US and Middle Eastern crudes.

Prices and margins

In the future, MARPOL will be a key player as far as prices and refinery margins go, causing margins to jump initially before tightening markets lead margins to begin to fall.

MARPOL will also increase the light/heavy and diesel gasoline differentials by USD13-17/bbl and USD3-8/bbl, respectively, in 2020, but we expect to see them fall back to historical levels by 2022 as the resid market tightens again and results in a balanced diesel gasoline market.

In addition to products, MARPOL will also push sweet crudes to be priced higher relative to sour crudes from 2020 to 2022; after 2022, these premiums and discounts will revert back to historical levels.

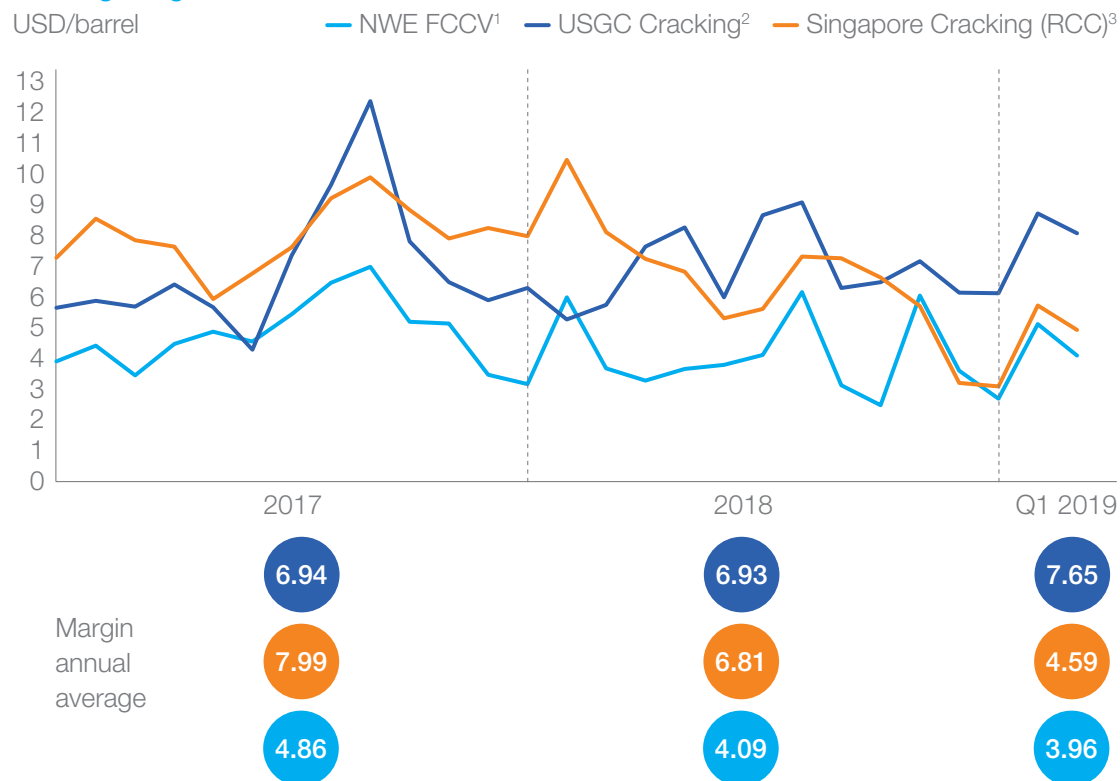


After a strong 2017, refining markets weakened slightly in 2018 in Europe and Asia

- After a relatively strong year in 2017, cracking margins fell on average by USD1.18/bbl and USD0.77/bbl in Asia and Europe, respectively
- The drop in margins came mostly in the second half of 2018, with Asia continuing to see falling margins into early 2019
- European margins remained flat for the majority of 2018 with a slow decline toward the end of the year
- The USGC also saw flat margins on average in 2018, and a slight increase in the first quarter of 2019

Refining margins across hubs: variable cash

USD/barrel



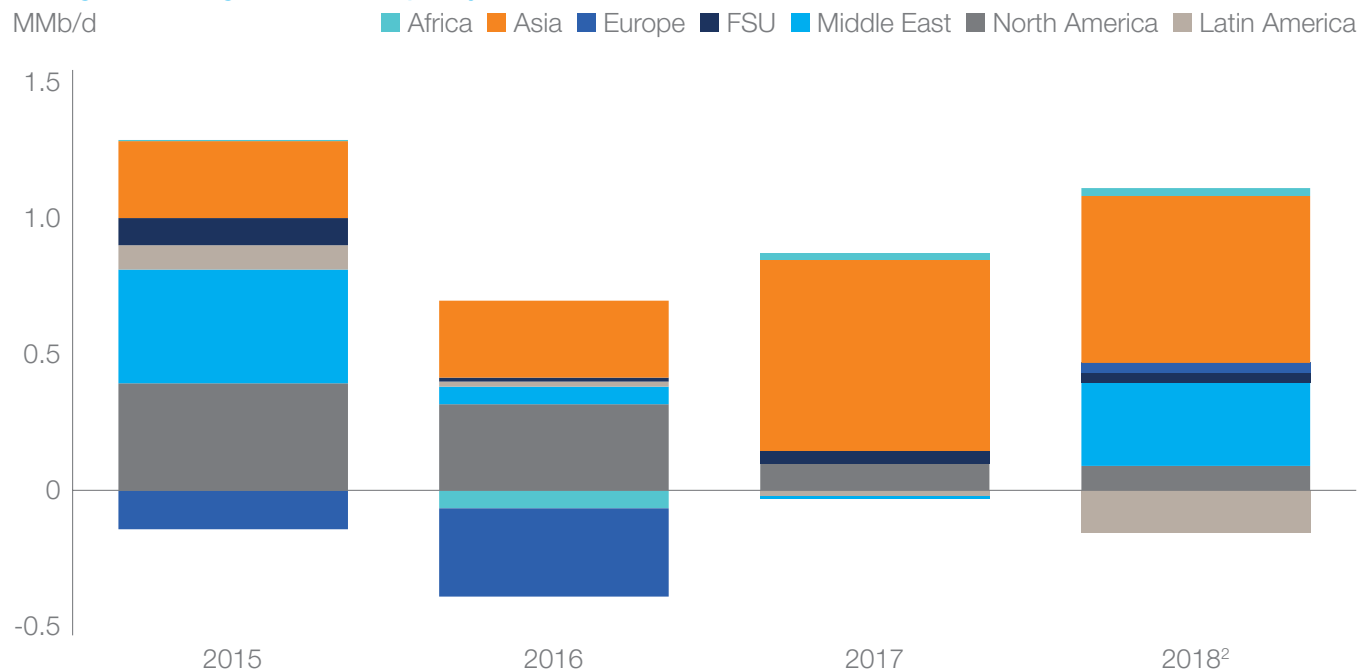
¹ Brent delivered to Northwest Europe; Fluid catalytic cracking + visbreaking (FCCV)
² WTI Magellan East Houston (MEH) in US Gulf Coast
³ Dubai delivered to Singapore; Residual catalytic cracking (RCC)
 Source: Energy Insights – OilDesk Model (June 2019), Platts

Global refinery capacity additions were strong in 2018, especially in Asia and the Middle East

- Net distillation capacity growth was strong in 2018, adding 950 Kb/d of capacity versus 835 Kb/d in 2017
- Asia was the largest contributor of capacity growth with over 600 Kb/d added in 2018, largely from expansion projects in China and India and Vietnam's new Nghi Son 200 Kb/d refinery
- The Middle East had over 300 Kb/d of additions, most of which came from two 120-Kb/d condensate splitters at Iran's Bandar Abbas refinery
- Distillation capacity in Latin America decreased by 156 Kb/d with the closure of the Point a Pierre refinery in Trinidad

Change in refining distillation capacity¹

MMb/d



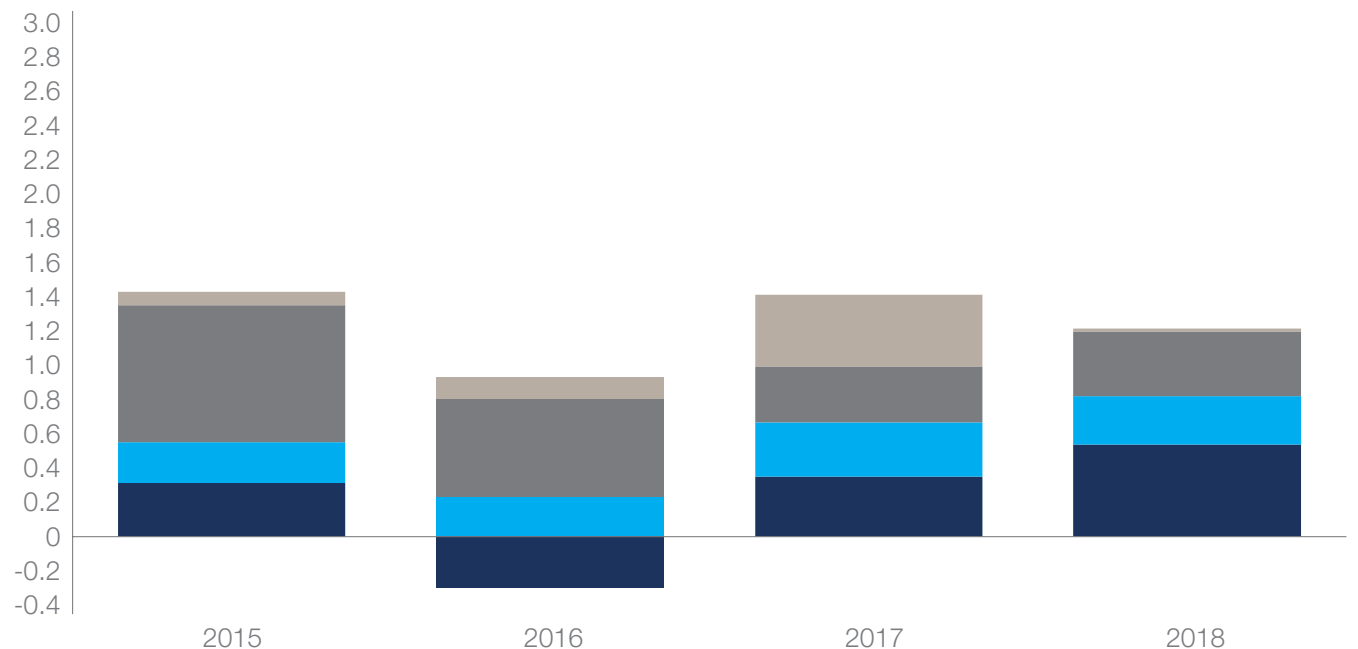
¹ Based on date of capacity start up ² Does not include partial capacity additions from Aliaga, Hengli, and RAPID assumed to come online partially in 2019, representing 325 Kb/d in Asia and 186 Kb/d in Europe
Source: McKinsey Refining Capacity Database

Globally, middle distillate¹ demand growth was stronger than gasoline range products in 2018

- Global light product demand growth was ~200 Kb/d lower in 2018, almost entirely a result of naphtha growth falling to ~0
- Diesel/gasoil demand grew the strongest, with 40% growth from both North America and Asia (largely driven by India)
- Jet/kero demand growth was in line with history, although ~40 Kb/d lower than in 2017, with most of the growth slowdown originating in North America
- Gasoline growth remained strong in 2018, with 25% of growth resulting from Europe's push toward gasoline-powered cars versus diesel
- Naphtha demand growth was marginal in 2018, mostly related to the relative pricing to propane as a chemical feedstock

Change in global light product demand, Year-over-year change

MMb/d



¹ Includes jet/kero and diesel/gasoil

Source: Energy Insights – Global Downstream Model (May 2019)

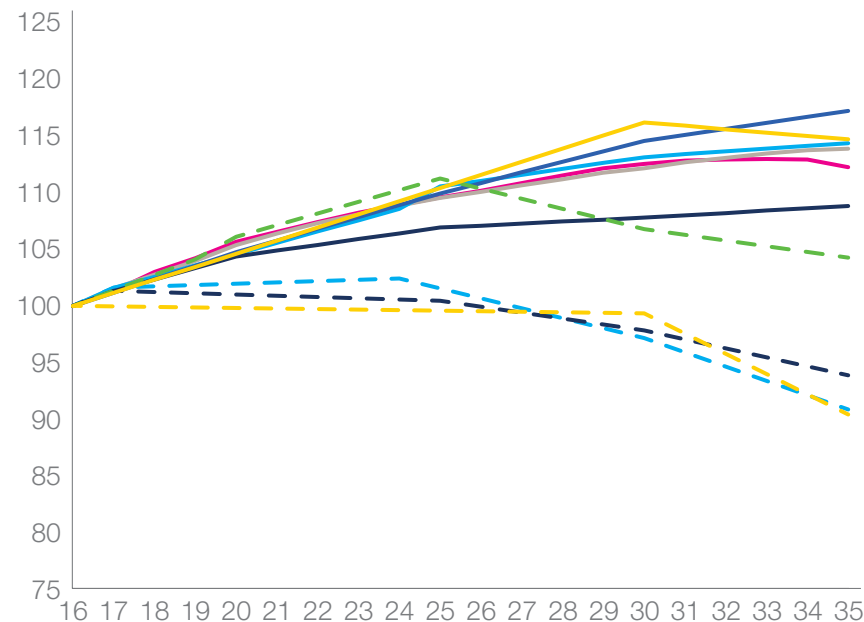
Global oil demand is projected to slow down and peak by the early 2030s, sooner than in most other sources

- Oil demand growth is expected to slow to 0.5% p.a. from 2018 to 2035 in our latest reference case. This represents a significant slowdown compared to the historical average of +1% p.a. over the last three decades
- Our outlook is within the range of other forecasts in the near term to 2030
- In the long term, we forecast an earlier peak in oil demand by the early 2030s compared to other forecasts. This is primarily due to a more bearish outlook for road transport demand due to growing penetration of electric vehicles

Global oil demand¹

Indexed to 100

— Reference case forecasts - - Sustainability cases



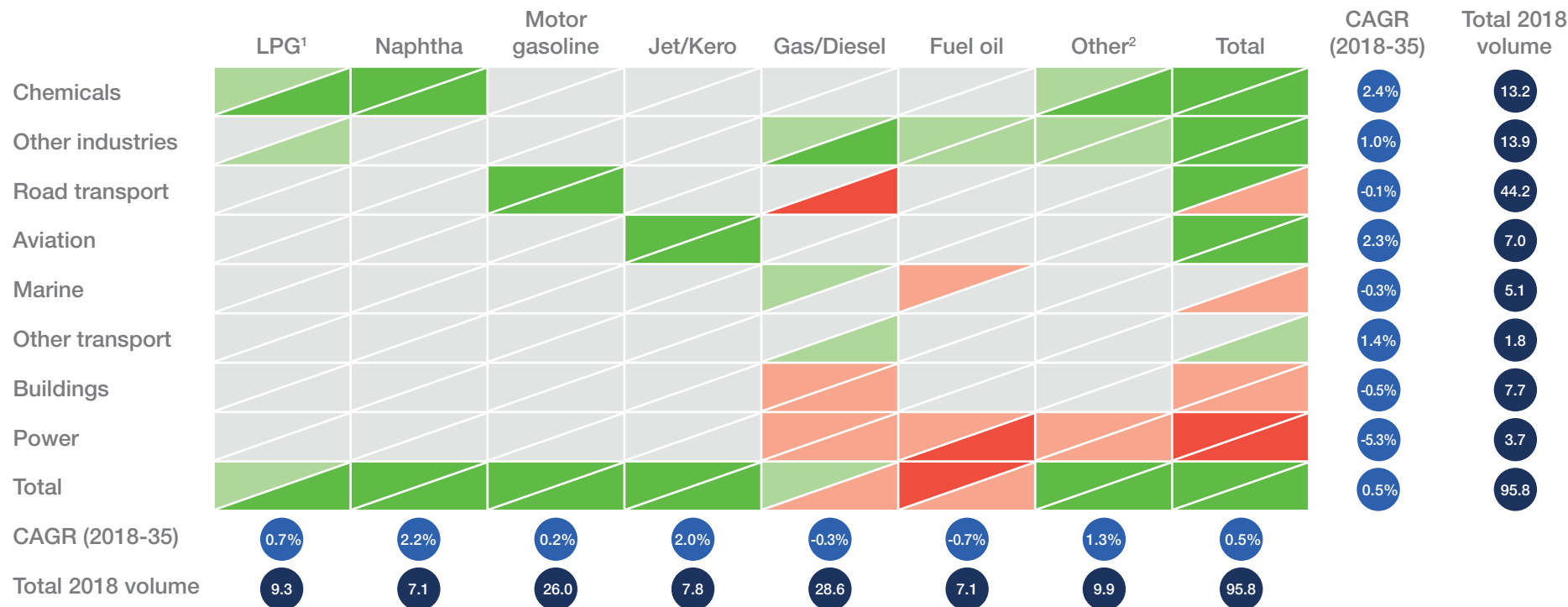
¹ The Global Downstream Model outlooks are based on our Global Energy Perspective Reference Case. Definition of products (e.g., ethane, refinery fuel) may not be consistent across all other forecasts. Source: Energy Insights – Global Downstream Model (May 2019), BP Global Energy Outlook (Feb 2019), ExxonMobil Outlook for Energy (Feb 2018), IEA World Energy Outlook (Oct 2018), Equinor Energy Perspectives (May 2018), Shell Scenarios (Apr 2018)

Chemicals and aviation are the main sources of long-term demand growth, while road transport and power have the biggest decline

Global liquids demand 2018-35

MMb/d

▢ 2018-25 (short term) ▵ 2018-35 (long term) 2018-35 delta MMb/d ■ >1 ■ 0.1 to 1 ■ -0.1 to 0.1 ■ -0.1 to -1 ■ <-1

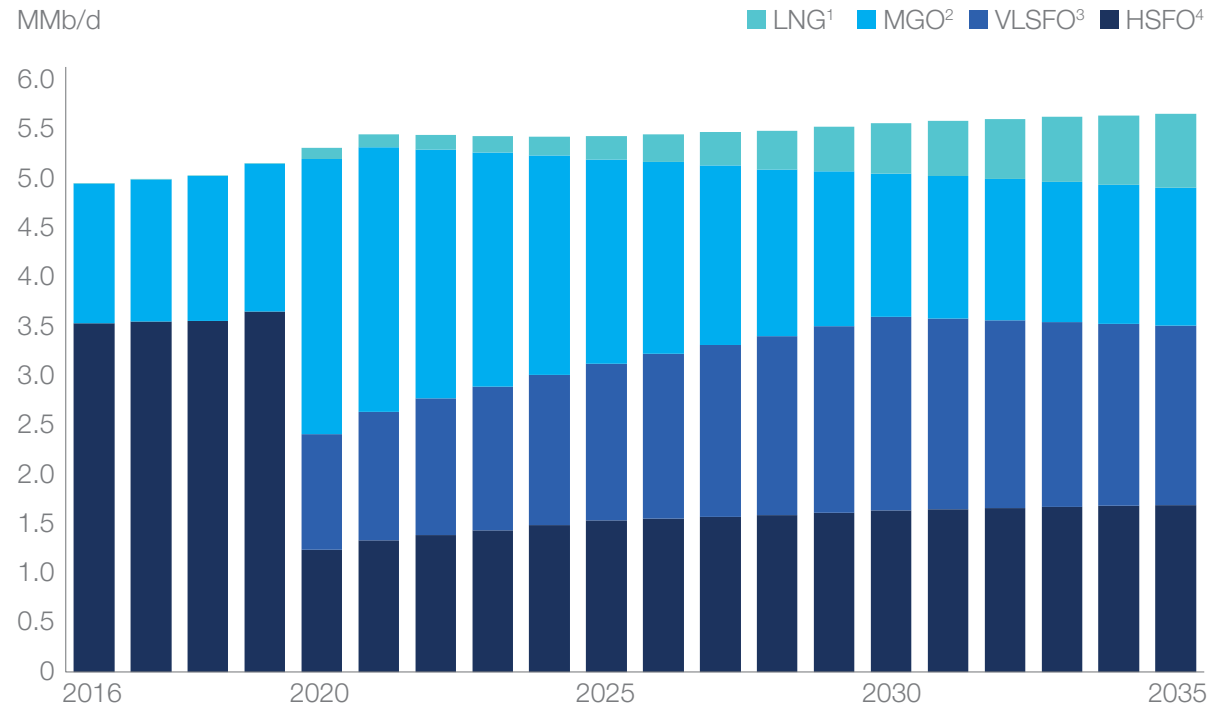


1 Liquefied petroleum gas
 2 Includes reformat BTX (feedstock into aromatics unit at refinery), bitumen, lubes, waxes, petcoke, and other oil products
 Source: Energy Insights – Global Downstream Model (May 2019)

MARPOL provides a temporary boost in gasoil demand in 2020, but gasoil will gradually lose market share to VLSFO and LNG

- The International Maritime Organization's MARPOL regulations on sulfur in global bunker fuel result in HSFO demand falling by 2.4 MMb/d in 2020 and being replaced by VLSFO and MGO
- Our reference case outlook assumes the mix of low-sulfur bunker fuels is split 50/50 between VLSFO and MGO initially in 2020 but then gradually reverts to VLSFO taking up all of the non-emission control areas share of MGO demand as refiners adapt operations to increase VLSFO production over time
- Scrubber installations are expected on at least 3,000 ships by 2020, up significantly from the previous year's estimates resulting in more HSFO retained in the bunker pool
- LNG begins to take market share from MGO and VLSFO after 2025
- MARPOL enforcement is still uncertain, but enforcement discussions and carriage bans encourage a lower non-compliance rate than previously expected (assumed to be 8% in 2020 and <5% in 2025+)

Global bunker fuel demand mix



1 Liquefied natural gas 2 Marine gasoil 3 Very low sulfur fuel oil 4 High sulfur fuel oil

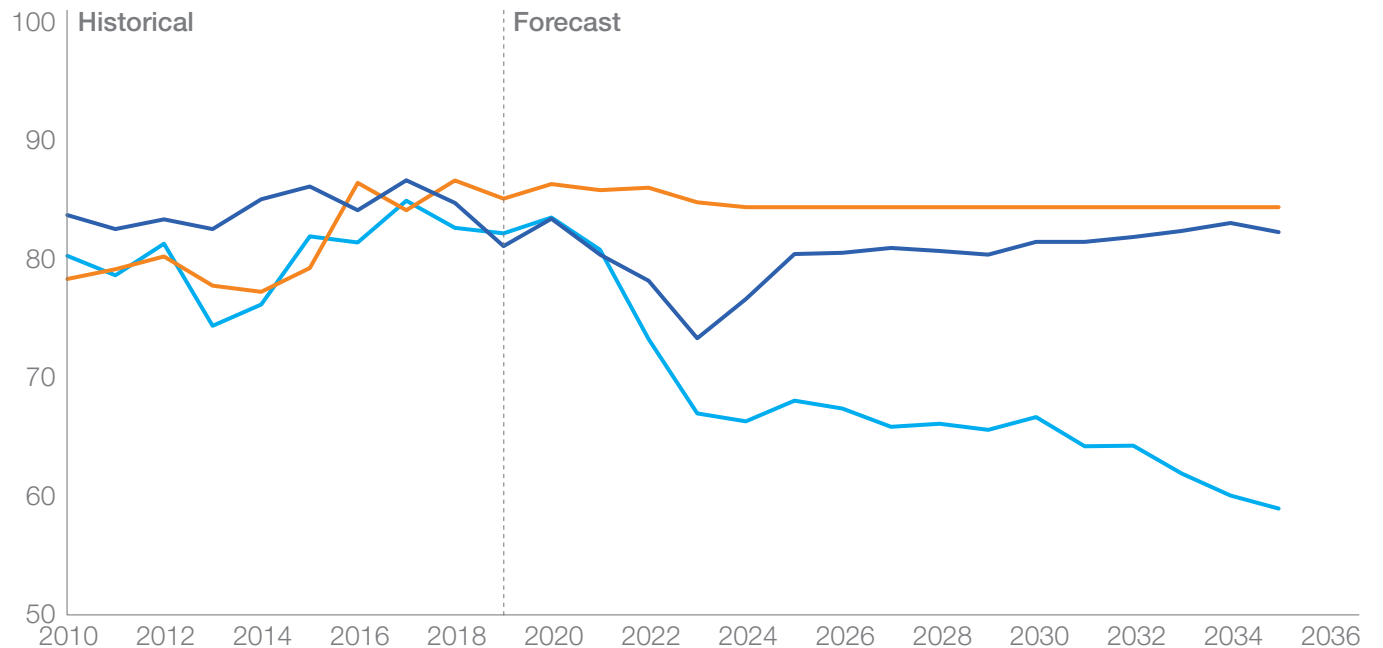
Source: Energy Insights – Global Downstream Model (May 2019)

North America and Asia stay at healthier utilization while Europe will decline steeply, likely requiring rationalization

- Refining overcapacity in the next 5-6 years will reduce hub refining utilization in both Asia and Europe, making the marginal configuration more complex
- Start-up of several large refineries in the Middle East and Africa will impact the Asian and European product markets while the US Gulf Coast's complexity and resource advantage keeps utilization high
- The start-up of the 500-Kb/d Nigerian refinery in 2023 drags European utilization down below 70%, and some rationalization of capacity is likely to happen but is not included in our forecast
- Asia gets tighter after 2025 as a result of growing product demand, and capacity additions will be required. The outlook assumes a new 300-Kb/d refinery addition in India in 2026 and another in 2030, and two 300-Kb/d condensate splitters in China in 2025 and 2027

Regional hub¹ refining utilization

Percent of stream day distillation capacity



¹ Asia: South Korea, Singapore, Taiwan; North America: US Gulf Coast; Europe: Belgium, Netherlands, the UK
Source: Energy Insights – Global Downstream Model May 2019

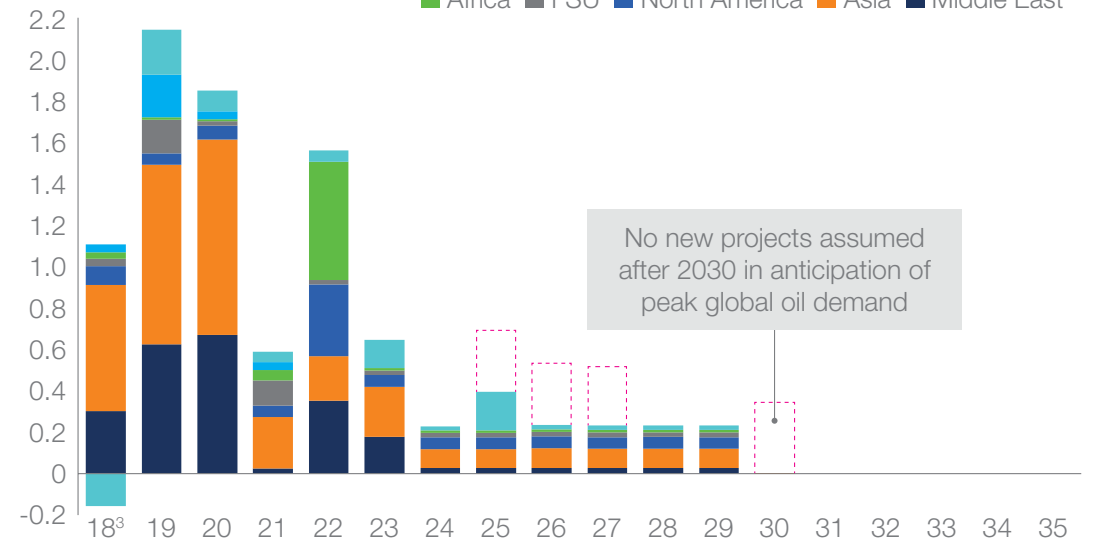
Capacity will grow over 6.8 MMb/d in the next five years, largely from projects in Asia and the Middle East

- Global distillation capacity is growing at 1.2% p.a. from 2019 to 2024 and slowing to 0.4% p.a. from 2024 to 2030, which is mostly creep
- A wave of new refining capacity additions led by greenfield projects in Asia and the Middle East are expected to put pressure on global refining utilization as early as 2019
- 2019 capacity growth in Asia will be the highest ever seen in one year in recent history and will disproportionately affect Asian hub utilization, with even more additions in 2020
- New projects in Europe, Africa, the Middle East, and the US will weigh on European and Asian refining utilization in the next five years
- In the long term, it is expected that India will add two 300 Kb/d refineries after 2025, in line with the historical trend of self-sufficiency
- To help meet naphtha demand, it is expected that China will add two 300-Kb/d condensate splitters after 2025
- There are no rationalization assumptions made in the reference case, although no creep is assumed in Europe after 2023; it is likely that rationalization will occur in the long run as utilization falls in Europe

Change in refining distillation capacity¹

MMbbl stream day capacity

Additional capacity required² Latin America Europe Africa FSU North America Asia Middle East



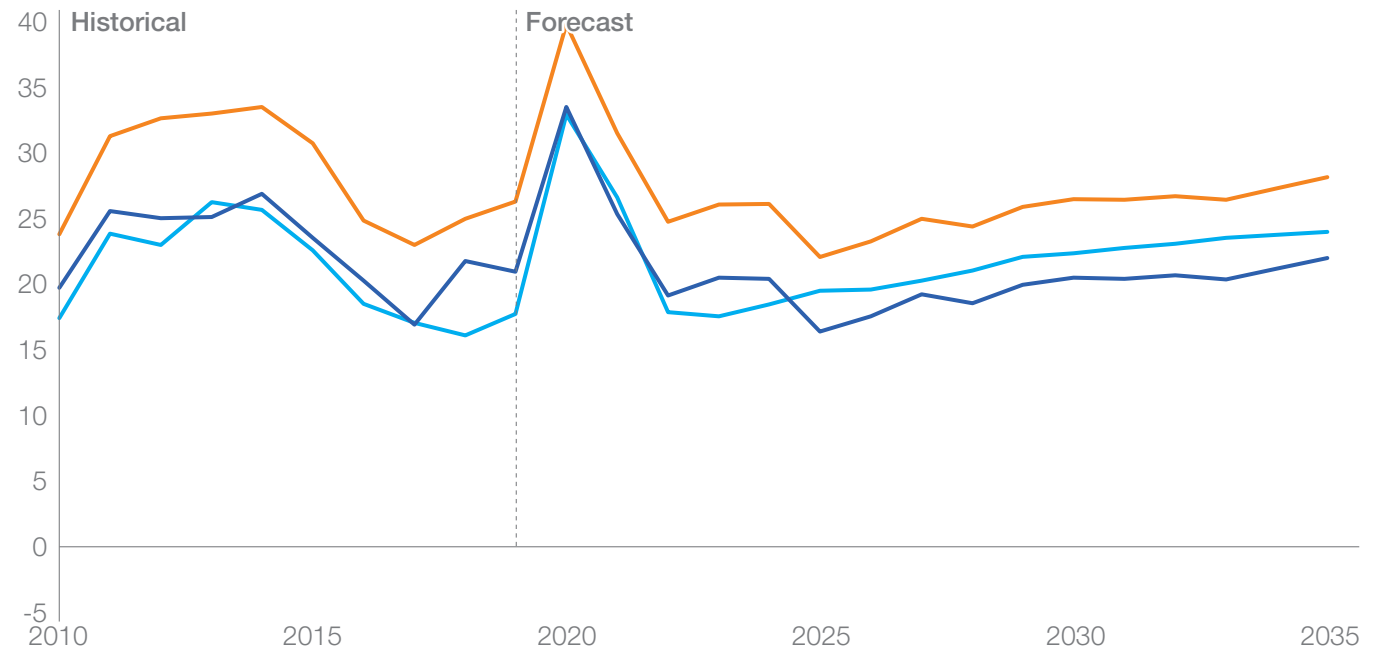
¹ Based on start-up date, as of Jan 2019, we assume 0.25% p.a. creep factor until 2030 for all locations except Europe, Japan, and Australia, where creep stops in 2023 ² New capacity will need to be added in Asia to meet growing demand ³ Does not include partial capacity additions from Aliaga, Hengli, and RAPID assumed to come online partially in 2019, representing 325 Kb/d in Asia and 186 Kb/d in Europe
Source: Energy Insights – Global Downstream Model (May 2019), McKinsey Refining Capacity Database, Capacity Additions Database

MARPOL will cause a spike in the light-heavy product differential, but market will return to levels similar to 2018 by 2022 and grow

- Light-heavy product price differentials will jump in 2020 on MARPOL implementation as a portion of resid fuels become displaced in bunker demand by low sulfur MGO and VLSFO
- The global excess in resid will depress resid prices to substitution levels, driving up the light-heavy differential across regions by as much as USD17/bbl
- By 2022, product differentials will fall back to 2017-2018 levels as ships install sulfur scrubbers and resid demand in bunker gradually recovers, bringing light-heavy differentials back up

Light-heavy product differentials¹

USD/barrel



¹ Average light product (diesel, gasoline) prices minus fuel oil (3.5% sulfur, 380 cst)

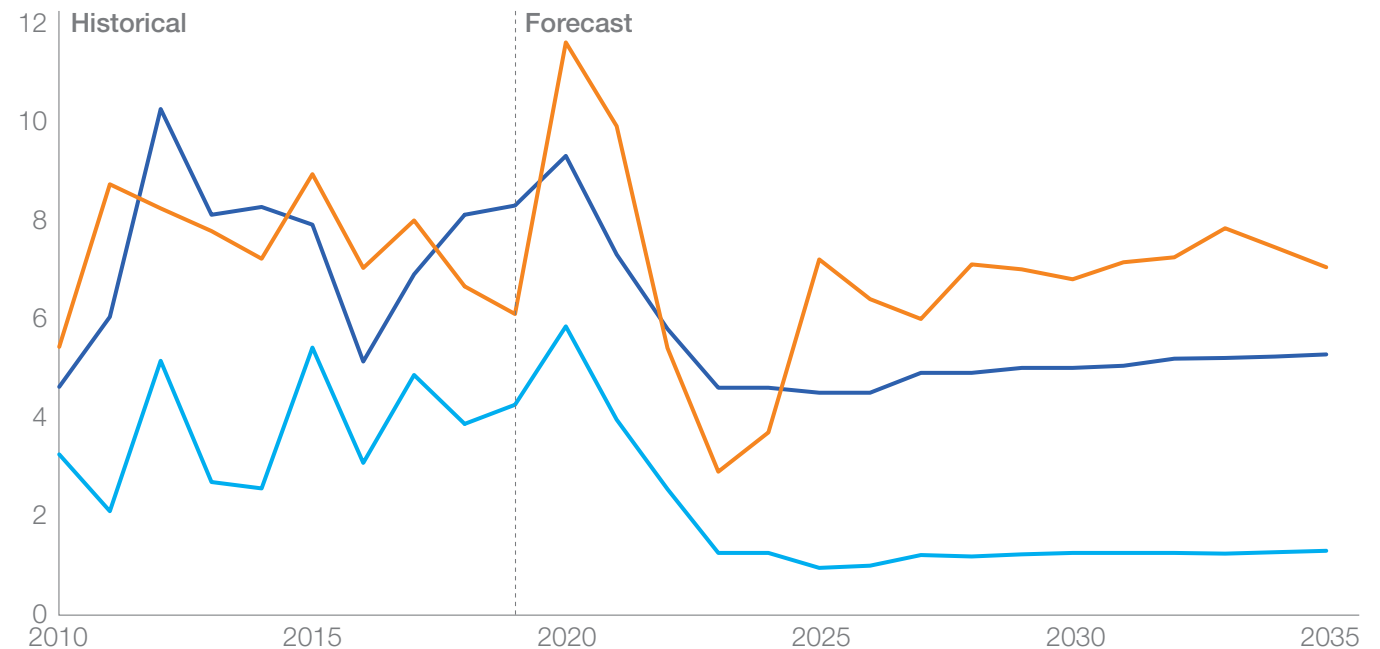
Source: Energy Insights – OilDesk Model (June 2019), Platts

Refiners will benefit from higher margins in 2020 as a result of MARPOL

- Cracking margins across hubs will see a boost in margins in 2020 due to higher distillate demand growth from MARPOL
- More complex configurations (such as coking) will see an even bigger boost in 2020 due to MARPOL
- Margins in hub markets will fall below historical averages following the lower utilization outlook in the near-term, driven by lower demand growth and capacity additions
- The sustained lower margin outlook in Europe after 2025 will likely result in an unknown level of refinery closures across various countries and result in margin cyclicity to levels closer to historical margins

Refining margins by hub (variable cash)

USD/barrel



¹ Brent delivered to Rotterdam ² Vasconia delivered to Houston; Fluid catalytic cracking and alkylation (FCCA) ³ Dubai delivered to Singapore
Source: Energy Insights – OilDesk Model (June 2019), Platts



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For more information about our global downstream outlook, please contact:
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