

Refining reoriented

Disruptive changes to the global oil and refining industry beckon as a result of IMO 2020. S&P Global Platts Analytics examines how refining economics is likely to be affected.



Rick Joswick

*Head of Oil Pricing and Trade Flows
S&P Global Platts Analytics*

Global bunker specification changes in 2020 require large-scale shifts in refinery operations and will be very disruptive, both within the industry and more broadly.

From a refining standpoint, there will be a major switch in the blendstocks used for bunker fuels, initially creating a huge disposition issue for roughly 3 million b/d of high sulfur fuel oil. That volume will be replaced by marine gasoil and various low sulfur blends of gasoil/residuals. Prices for marine gasoil and the new blended fuel are expected to rise sharply, while HSFO prices will fall.

Relatively expensive steps will be required throughout the refining circuit to rebalance products, resulting in much wider price spreads for all middle distillates compared with HSFO. At times in 2020, the refining circuit may need to run additional crude to make sufficient compliant marine fuel, and

may not have the capability to completely destroy the surplus high sulfur fuels, forcing them to price lower into power generation or storage. Diesel and jet cracks will soar. Gasoline cracks may also see support, as yields shift towards middle distillates. The price of the new 0.5% sulfur fuel will initially be close to marine gasoil. Refinery operations, crude oil and product trade flows will change dramatically.

However, all these initial price effects will dissipate over the following few years as refinery conversion capacity expands and ships add scrubbers.

Key refining implications include:

- High crude runs in 2020 and a broader set of refineries seeking light, sweet crude. Likely bullish market sentiment for sweet crude will drive overall prices higher for key sweet benchmarks, such as Brent and WTI.

GO DEEPER

S&P Global Platts Analytics provides analysis on every aspect of the global oil market, including demand, inventories, refining, infrastructure and trade flows to help improve market transparency and your understanding of emerging trends.

To learn more visit:

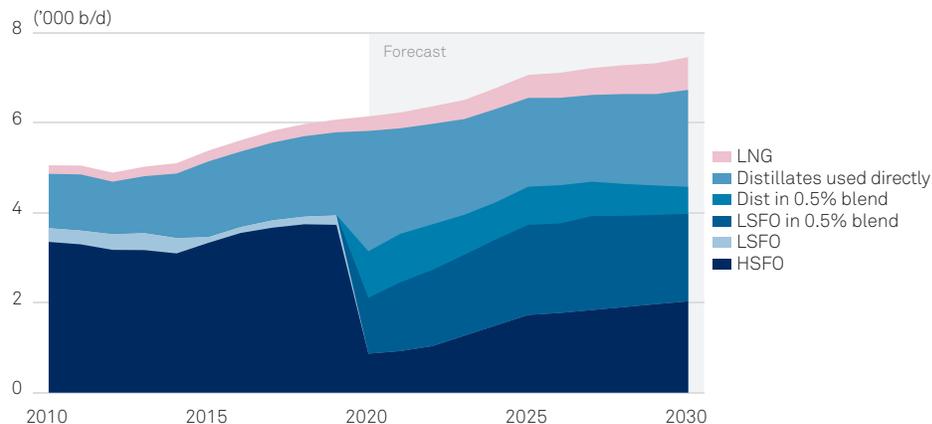
spglobal.com/platts/en/products-services/market-insights-and-analytical-tools

- Middle distillate cracks will increase in 2020 from current levels, before declining during 2021-23. Gasoline cracks will also see strength, but much less so compared with distillates. HSFO cracks will fall in 2020 and HSFO absolute prices may approach low levels at times, with increased use in power generation.
- Clean-dirty product spreads will widen from current levels, driven by marginal refinery economics. At times, spreads could widen even more than typical refinery-driven spreads if HSFO disposal requires lower pricing to compete outside of baseload power generation.
- Crude quality differentials will widen dramatically in refinery parity with light-heavy and sweet-sour product spreads. Refineries with deep conversion will see very strong margins.
- Medium conversion refiners will also see substantial margin improvement, especially in 2020.
- Reforming margins and utilization rates should strengthen, due to lower gasoline production from fluid catalytic cracking and a need to backfill from the virgin naphtha pool. This will also pull up naphtha prices. On the margin, this shifts petrochemical feed preferences towards LPG/ethane.

Global crude quality getting lighter, sweeter helps, but is not enough by itself for 2020

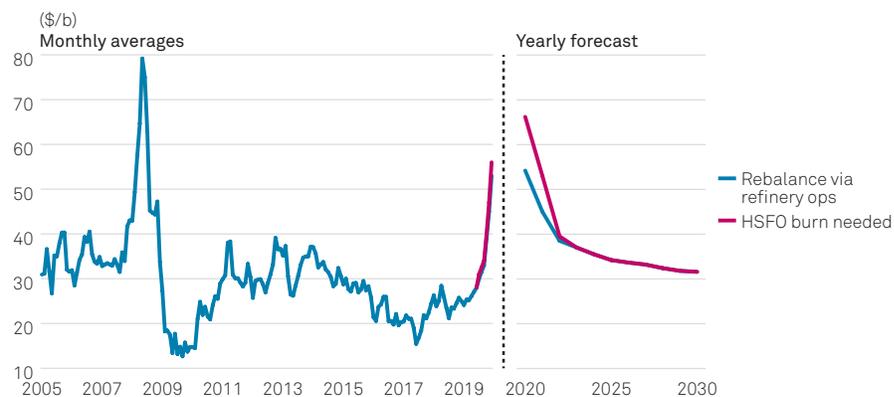
On average, global crude quality has been getting lighter and sweeter since 2005. Initially, this was due to a sharp slowing in the growth of heavy sour crudes, while medium grades continued to expand. Beginning in roughly 2010,

GLOBAL BUNKER FUEL DEMAND



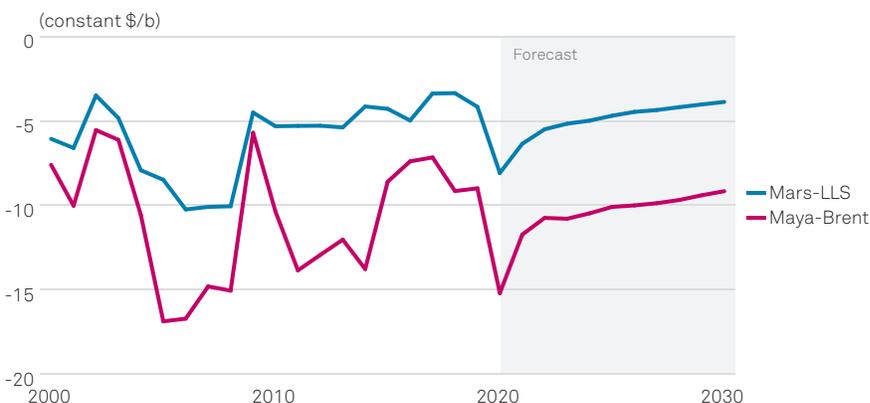
Source: S&P Global Platts Analytics

GASOIL - FUEL OIL PRICE SPREAD



Source: S&P Global Platts Analytics

CRUDE PRICE DIFFERENTIALS



Source: S&P Global Platts Analytics

Refining reoriented

this was followed by explosive growth in US light sweet shale crude and condensate production.

With a rapid increase in average API gravity and a consequent decrease in average residual fuel oil content, the total volume of 650 F atmospheric resid contained in crude runs has effectively leveled off since 2016, despite the growth in total runs.

New refinery capacity helps, but is not enough by itself for 2020

Planned refining facilities starting up by 2020 will also play a large role in helping to destroy surplus HSFO. Conversion capacity additions are averaging around 1 million b/d per year, split among coking, hydrocracking, and cat cracking. The geographical distribution of the new capacity will also be a factor, with many of the conversion additions occurring in China and some in other countries that are not normally bunker supply hubs. Although they may be a sink for higher sulfur resids, they will not necessarily be a source for lower sulfur residual bunker blend components.

Additions of heavy oil desulfurization facilities will also help, 70% of which will be atmospheric resid desulfurization – with the remainder VGO desulfurization. Most of these new facilities are in Asia. However, they may not all directly contribute to solving the bunker spec transition problem. They were all planned before the IMO's decision to implement the bunker spec change in 2020. As such, they probably have other processing objectives or requirements – for instance, to help meet FCC feed sulfur specs – and may not be able to readily shift operating modes.

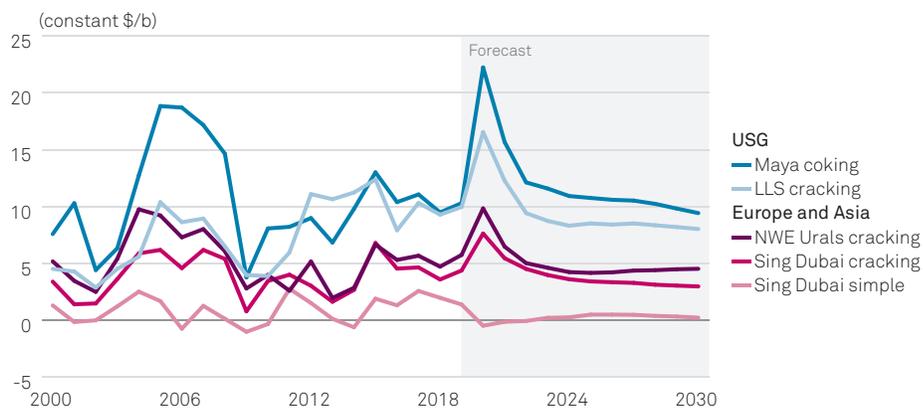
Steps needed to close the balance in 2020 will be increasingly expensive

Consequently, given the size of the change, there will not be enough deep conversion available for HSFO initially to clear in conventional refining steps. This first tranche of HSFO destruction corresponds roughly to a \$30/b gasoil-HSFO spread in Europe. Subsequent processing layers for HSFO destruction require the price of HSFO to fall further to incentivize less attractive refining options (about a \$30-\$50/b spread) and a third tranche involves incremental consumption in land trade, backing out other fuels (high sulfur crude burn, coal or gas), implying even wider gasoil-fuel oil spreads, depending in part on the absolute price levels of oil and competing fuels. Our reference case corresponds to pricing in the second tranche, while a possible high impact case corresponds to the third tranche. In both cases, while differentials may be very wide initially, investments in scrubbers and refinery conversion capacity will drive differentials narrower and likely into the first tranche over 2021-23.

Total global demand for major petroleum products produced from refining – excluding products such as biofuels and NGLs – is expected to continue to grow around 1.0-1.4 million b/d per year, which implies a comparable level of refinery runs growth. Included in this demand is baseload HSFO in power generation, representing new plants in Saudi Arabia and Bangladesh (see page 28). Incremental crude runs are effectively from US low sulfur crude and condensate, as reductions in Venezuelan and Iranian production are effectively backfilled by growing US production. After factoring in new refining facilities by 2020 and incremental asphalt and power plant demand, roughly 2 million b/d of HSFO can be destroyed. This is still nearly 1 million b/d short of the HSFO destruction required. Production of middle distillates, including jet kerosene as well as gasoil, will also be well short of its required target. Strong middle distillate demand will require further substantial yield shifts above what has been achieved to date, also reducing gasoline production.

Even after these changes, some additional refining steps will be needed. One step, for example, will be to

REFINERY MARGINS



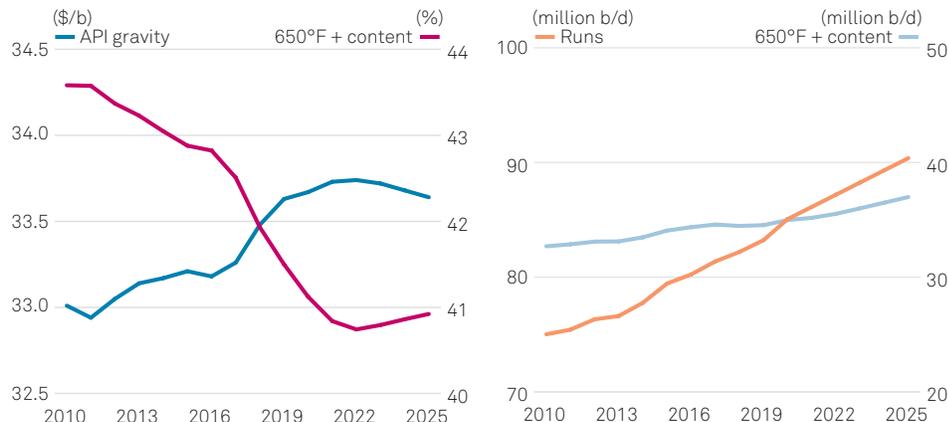
Source: S&P Global Platts Analytics

increase coker utilization rates. US data shows that recent utilization rates (of about 89%) are lower than the very high utilization rates (above 94%) seen historically. If all cokers globally raised their utilization rate by 4% – and the incentives should certainly be there – that would reduce HSFO production by another 350,000 b/d.

Other stretch refining steps, such as deeper vacuum distillation cut points and some substitution of high sulfur resid for low sulfur resid in resid FCC, primarily in the US and Europe, could provide additional flexibility – albeit with some FCC capacity or other debits – assuming environmental restraints on FCC emissions are not violated. Better segregation or optimized blending could also free up some LSFO at the expense of HSFO, and there will be incentives to store HSFO – particularly in 2020, when the market will likely move strongly into contango.

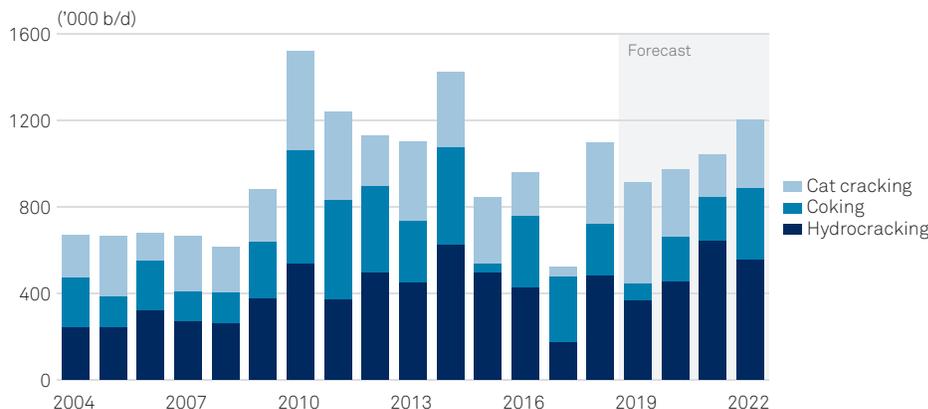
However, changes in the supply/demand balance of only a few hundred thousand b/d could have rather substantial price implications – for instance, by raising the diesel-fuel oil spread above \$50/b. The severity of price effects is set on

GLOBAL CRUDE QUALITY



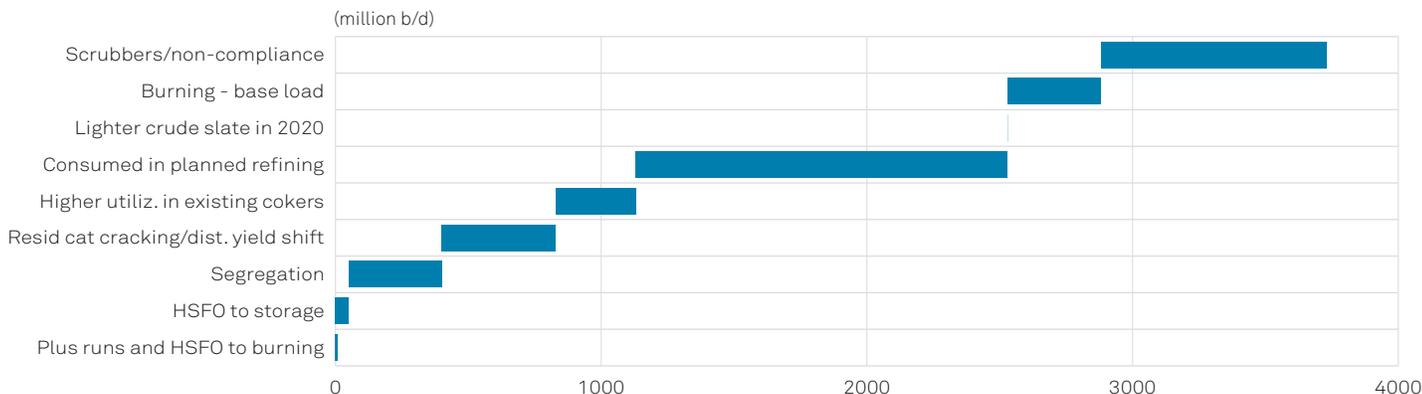
Source: S&P Global Platts Analytics

CONVERSION CAPACITY ADDITIONS



Source: S&P Global Platts Analytics

HSFO BALANCE IN 2020



Source: S&P Global Platts Analytics

Refining reoriented

the margin in rather thin rebalancing tranches. If scrubber assumptions are too optimistic, if more shippers choose marine gasoil instead of the new 0.5% fuel oil, or if cokers cannot be utilized at higher rates, then such a high impact case could result.

Outlook after 2020 is more manageable

After 2020, additional refinery facilities are already planned that will destroy HSFO, and other projects and operational adjustments are likely to be initiated. And ships will continue to add scrubbers, especially for new vessels. Our assumption is that the total scrubber-equipped fleet reaches several thousand vessels in 2025, consuming 1 million-1.5 million b/d of HSFO. Consequently, the HSFO destruction issues that refiners are expected to face in 2020 will be much more manageable in subsequent years and should be essentially resolved by 2025.

Product prices, crude differentials, and refinery margins will see disruptive changes in 2020 before reverting to trend in later years

As already noted, wider spreads between light, sweet products and heavy, sour ones will be required to allow more expensive rebalancing steps to be carried out economically. For 2020, the situation looks similar to 2008 in some ways, in that conversion capacity will be straining to balance. But in other ways it will be different from 2008, as absolute price levels will likely be much lower and absolute demand growth for all products, including gasoline, will likely remain fairly healthy – whereas demand for gasoline collapsed in 2008-09.

Furthermore, the shortage of low sulfur bunkers is likely to steal low sulfur VGO from conversion feeds, which is exactly the opposite of what occurred in 2008.

The price effects will be widespread:

- Middle distillate cracks will all increase sharply in the second half of 2019, peak in 2020, and then start to ease. The peak may not be at the start of the year, as enforcement will tighten with a March 1 HSFO carriage ban, while inventory levels of previously-stockpiled low sulfur fuels will be gradually worked off.
- Gasoline cracks will also see support, although not as much as for middle distillates. Catalytic cracking units will likely be operated differently in order to consume high-sulfur feeds and increase distillate production. This will lower gasoline production and should increase emphasis on reforming operations to backfill gasoline.
- HSFO cracks will be the inverse of middle distillates, getting quite weak in 2020.
- Low sulfur-high sulfur fuel oil spreads will widen sharply.
- Crude quality differentials will move with products, also getting very wide in 2020. Discounts for medium sour and heavy crude will be much deeper relative to light, sweet benchmarks.
- Low sulfur VGO will become more expensive relative to crude and products, as it is a cheaper blending component for low sulfur bunkers than using gasoil.
- Light cycle oil will become more valuable. Normally, LCO has a relatively lower value as it cannot easily be desulfurized to 10 ppm for use in road diesel, but lower severity desulfurization will readily get it down to 0.5% sulfur. Furthermore, LCO is aromatic and thus may be useful in reducing compatibility issues when blending with resids.
- Higher freight costs will widen all inter-regional arbitrage differentials.



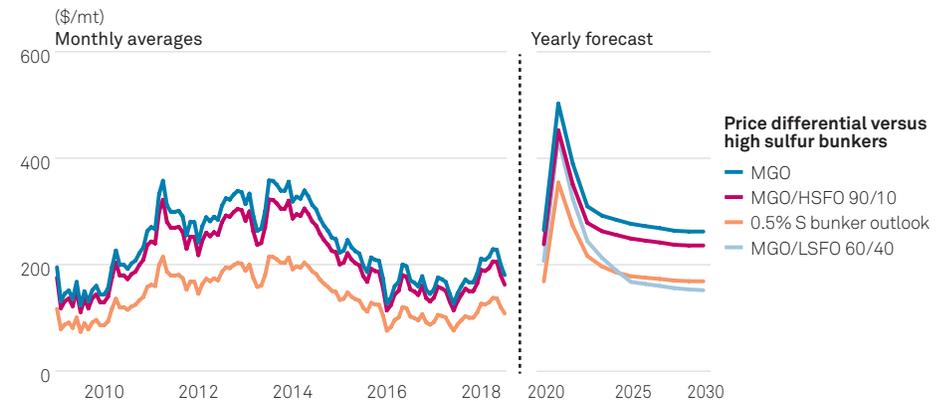
- Refinery margins for deep conversion facilities will increase dramatically as they produce essentially all light products and no fuel oil, and they can do that using cheap heavy, high sulfur feeds. Margins for medium conversion facilities, even when running sour grades, will also increase, but not by nearly as much. Total refinery runs will need to be maintained to satisfy demand for all products, which will help maintain margins, even for simpler or sour refiners.

The price for the new 0.5% sulfur marine fuel will likely be somewhere between a blend of gasoil with 1% sulfur fuel oil, and marine gasoil. Specifically, a price set at 60% marine gasoil/40% LSFO could be viewed as a lower bound, whereas a price set at 90% marine gasoil/10% HSFO could be viewed as an upper bound.

Since the market will initially be quite tight in 2020, we expect the price for the new 0.5% sulfur fuel to be close to the upper bound. Longer term, low sulfur bunkers will price near blending parity with 1% low sulfur fuel oil and gasoil – and ultimately lower as gasoil use is reduced, being replaced by 0.5% sulfur blends as shippers become more comfortable with the quality of these blends.

Light-heavy crude differentials will also widen, set by refinery economics on the margin. These price-setting layers are not deep conversion, but rather the more moderate layers, such as FCC or visbreaking in a European refinery exporting gasoline and fuel oil. That requires fairly wide light sweet versus medium sour spreads. For heavy sour, the competition is versus the sour straight run resid from medium sour crudes. Heavy crude discounts will nearly rival 2008, even though the absolute price levels are much lower.

LOW SULFUR BUNKER PRICE OUTLOOK



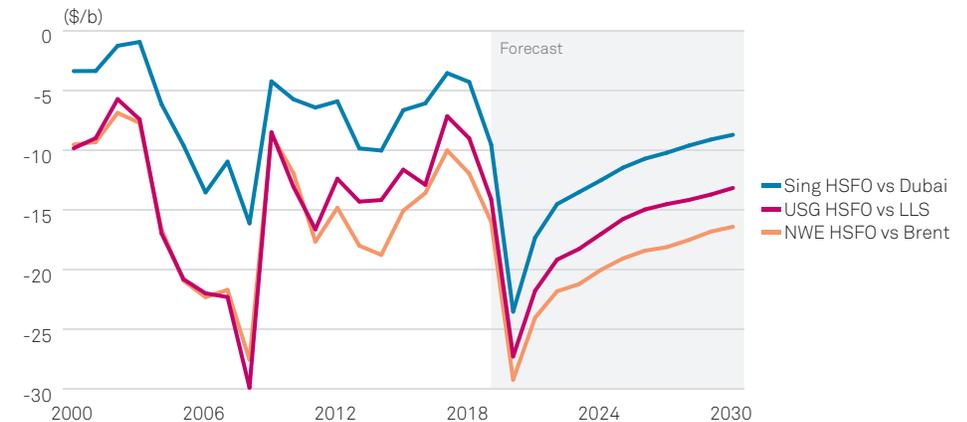
Source: S&P Global Platts Analytics

DIESEL AND GASOLINE PRICE CRACK SPREAD



Source: S&P Global Platts Analytics

FUEL OIL PRICE CRACK SPREAD



Source: S&P Global Platts Analytics