High-Sulfur Fuel Oil Competes With Crude

U.S. refiners process cheap fuel from overseas.

Morningstar Commodities Research
18 November 2019

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Data Sources for This Publication
CME Group

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Boosting Yields

An emerging U.S. refining trend of processing high-sulfur fuel oil as a feedstock is based on impending changes to ship bunker fuel oil regulations by the International Maritime Organization. Those regulations impose stringent 0.5% sulfur limits on ship fuel or bunkers, which will remove upward of 3 million barrels/day of demand for HSFO from the market. The IMO changes mean that refiners generally are reviewing feedstock choices to reduce HSFO output as its demand and value potentially plummet next year. Many refiners can't reduce HSFO output because their plants are less sophisticated. Complex refineries can process heavy fuel oil to extract lighter products. This note discusses how U.S. refiners can take advantage of cheap available HSFO to boost yields at refineries equipped with cokers.

Coking Capacity

Many U.S. refineries have coking capacity that breaks down heavy fuel residue remaining after primary and secondary distillation into lighter products and a solid carbon known as pet coke. Domestic refineries without coking capacity typically process lighter shale crudes that have very low sulfur levels. The low-sulfur fuel oil these refineries produce can be blended into IMO-compliant ship bunkers. Because of the abundance of domestic light sweet shale crude and the available coking capacity for processing heavy sour crude, U.S. refiners should face limited risk from lower HSFO values because they don't produce that much.

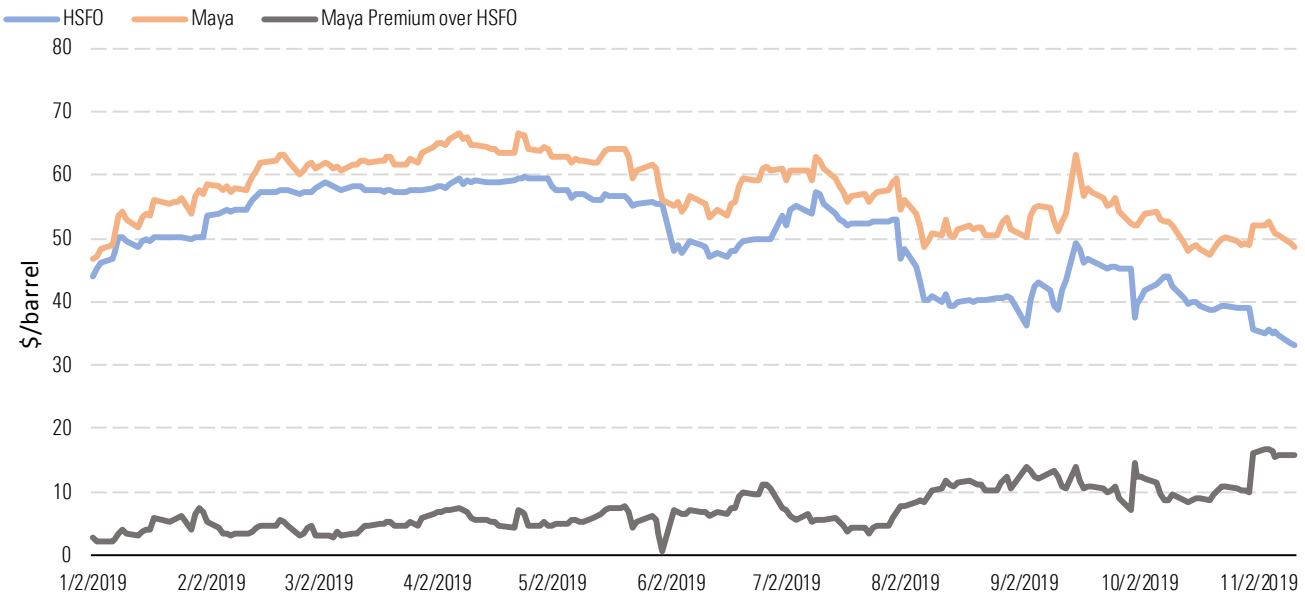
That's not the case in the rest of the world. For example, many refineries in former Soviet Union countries like Russia continue producing HSFO because their available feedstock is limited to domestically produced grades such as Urals, which is a medium sour crude. Until such refineries are retired or upgraded, their HSFO has diminishing value but still needs to find a market. One such market is an auxiliary feedstock for U.S. refiners to process through their coker units, and this appears to be happening. Evidence comes from at least two sources. First, a recent Reuters report cites shipping data indicating that imports of Russian fuel oil to the United States increased during October. Second, in an October earnings call, PBF Energy described how it is processing at least 50 thousand barrels/day of HSFO directly through the coker at its 182 mb/d Delaware City, Delaware, refinery.

HSFO Discount

Exhibit 1 shows prices between Jan. 2 and Nov. 12 for heavy sour Mexican Maya crude, which typically produces a 42% residual fuel oil yield from primary and secondary processing (orange line) and Gulf Coast HSFO (blue line). Maya is valued at a premium over HSFO throughout the period by an average $7.31/barrel (gray line), but the discount increases from an average $5.37/barrel between January and

June to an average $9.84/barrel between July and November. The rising Maya premium reflects two factors. First is the general strength of heavy sour crude prices in the face of lower supplies because of sanctions on Iran and Venezuela, OPEC cuts, and restrictions on flows from Canada. Second, HSFO prices are falling in the runup to IMO 2020. Once HSFO prices are heavily discounted to crude, then the option for refiners with cokers to process HSFO directly instead of or in addition to crude starts to make sense.

Exhibit 1 Maya and Gulf Coast HSFO



Source: CME Group, Pemex.

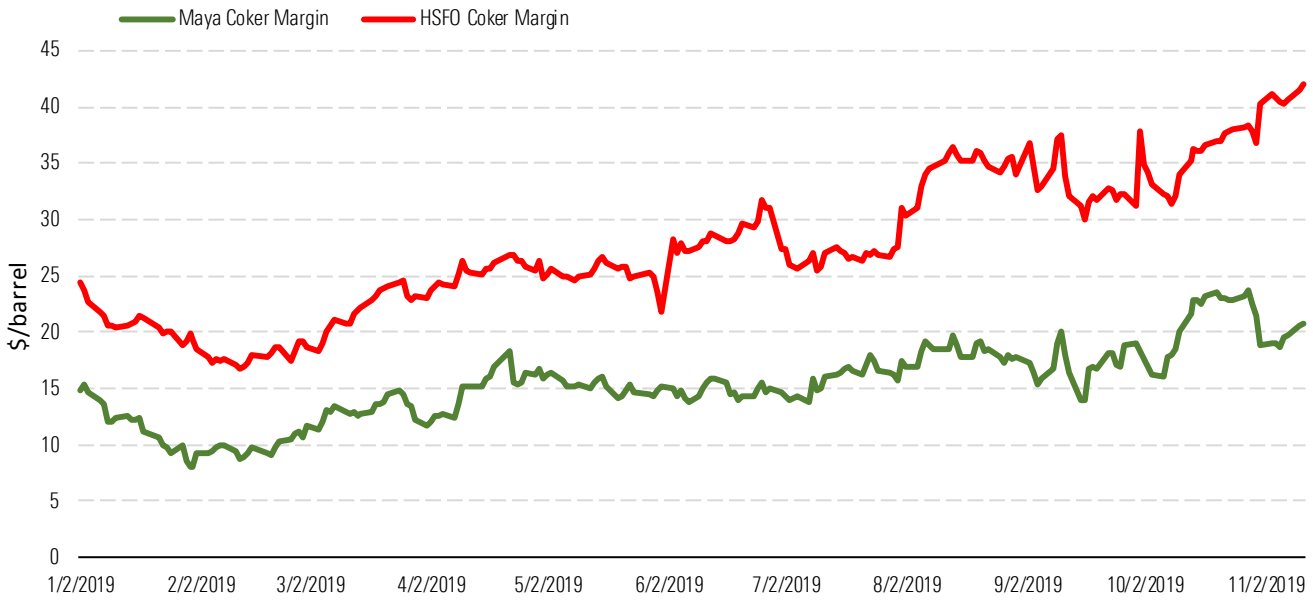
Uplift Economics

To get a rough idea of the economics, we ran an analysis to identify the potential uplift from running Gulf Coast HSFO straight to a delayed coker versus just running a heavy crude like Mexican Maya through all refinery processes. We calculated two margins for this analysis. The first was the refining margin for Maya run through a refinery equipped with delayed coking capacity. Our yield assumption for Maya was 41% gasoline, 38% ultra-low-sulfur diesel, and 16% pet coke. We calculated the Maya margin using daily Gulf Coast gasoline and ULSD prices as well as the historical formula price for Maya that we detailed in an October note (Pemex Updates Maya Formula to Reflect IMO 2020). We used an estimated price of $82/barrel for pet coke, which is primarily consumed in power plants or used to make aluminum. The margin calculation takes the refinery output (gasoline, ULSD, pet coke), multiplies it by the yields, and then subtracts the Maya price. The resulting Maya margin averaged $13.25/barrel between Jan. 2 and June 30 and $18.15/barrel between July 1 and Nov. 12.

Next, we estimated the margin for running HSFO direct to the coker by comparing our Maya coker yield with a Maya yield from a refinery without a coker to derive a coker uplift. Our estimate of that coker

uplift yield was 18% gasoline, 9% ULSD, and 42% pet coke from each barrel of HSFO. We then derived the theoretical HSFO margin by valuing the outputs using the same product prices referenced above and subtracting the Gulf Coast HSFO price. This HSFO margin averaged $23.35/barrel during the first half of 2019 and $33.21/barrel between July 1 and Nov. 12. The margin results are shown in Exhibit 2. The HSFO margin (red line) is higher than Maya (green line) throughout the year but is markedly better between July and November, when it averaged $15 /barrel above Maya versus a $10/barrel average premium between January and June.

Exhibit 2 Maya and HSFO Uplift Margins



Source: CME Group, Morningstar.

This analysis is a back-of-the-envelope calculation designed to indicate the margin uplift that a refiner might achieve by running HSFO direct to the coker. Assuming the yield assumptions we made are reasonable, the results show how falling HSFO values in the second half of 2019 increased margin opportunity for refiners with coking capacity.

Practicalities

However, like most things refining-related, the practicalities of just swapping feedstock in this manner aren't straightforward. As PBF discussed on its earnings call, refiners engage in a balancing act when they run third-party HSFO through their cokers. That's because using the coker capacity to process HSFO prevents them using that same capacity to process fuel oil produced from crudes that they ran through primary and secondary distillation to produce needed lighter products. We aren't refining experts, but it's safe to say that serious modeling is required to calculate an optimal feedstock mix of crude and HSFO that both produces refined products needed to meet downstream demand and improves overall margins. For example, running Maya through primary and secondary units produces a lot more gasoline and ULSD

than you get from running HSFO through the coker. But Maya also produces a lot of heavy fuel oil that still needs to run through the coker, reducing capacity available to run HSFO. Overall results would probably improve running a medium or light crude through the primary and secondary distillation that produced less heavy residual fuel, thereby freeing up coker capacity for HSFO.

Shale Crude

Now the option to run HSFO through the coker looks attractive for refiners that have the necessary tertiary capacity and can adjust their primary crude feedstock to optimize outputs. This advantage is likely to continue into 2020 if the IMO regulations further reduce the relative value of HSFO to crude. This may allow sophisticated U.S. refiners to run more light crude from shale in tandem with bargain-priced HSFO imported from Europe or Asia. That would benefit the U.S. crude balance by reducing refiner demand for more expensive imported heavy crudes and replacing those barrels with cheaper HSFO and domestic shale. Using more shale crude domestically would reduce the potential to export those barrels, but the higher value of refined products produced and potentially exported should offset that loss.

Market Impact

With less than two months before IMO 2020 regulations kick in, the market impact of this momentous change is still far from clear. However, it seems safe to assume that owners of the most sophisticated refineries will benefit most due to the flexibility of their assets to navigate changing feedstock costs.

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