THE THUNDER ROLLS – HOW IMO 2020 MAY IMPACT MARKETS AND CHALLENGE REFINERS AND SHIPPERS

November 25, 2018

The planned implementation date for IMO 2020 is still more than a year away, but this much already seems clear: even assuming some degree of non-compliance, a combination of fuel-oil blending, crude-slate shifts, refinery upgrades and ship-mounted "scrubbers" won't be enough to achieve full, Day 1 compliance with the international mandate to slash the shipping sector's sulfur emissions. Increased global refinery runs would help, but there are limits to what that could do. So, what's ahead for global crude oil and bunker-fuel markets — and for refiners in the U.S. and elsewhere — in the coming months? Today, we discuss Baker & O'Brien's analysis of how sharply rising demand for low-sulfur marine fuel might affect crude flows, crude slates and a whole lot more.

The International Maritime Organization (IMO), a specialized agency of the United Nations, in recent years has been implementing ever-tightening rules to reduce allowable sulfur-oxide emissions from the engines that power the 50,000-plus tankers, dry bulkers, container ships and other commercial vessels plying international waters. In January 2012, the global cap on sulfur content in bunker (marine fuel) was reduced to 3.5% (from the old 4.5%) and on January 1, 2020 — only 13 months away — it is set to be reduced to a much stiffer 0.5%. There are even tougher standards already in place in the IMO's Emission Control Areas (ECAs) for sulfur, which include Europe's Baltic and North seas and areas within 200 nautical miles of the U.S. and Canadian coasts. In July 2010, the ECA sulfur limit in marine fuel was reduced to 1% (from the old 1.5%), and in January 2015, the limit was ratcheted down again to a very stringent 0.1% — a standard that will remain in force within the ECAs when the 0.5% sulfur cap for the rest of the world becomes effective on New Year's Day in 2020.

RBN Energy's *Bad Moon Rising* series discussed the three primary options for shipowners to achieve compliance with the IMO 2020 rule: (1) continue burning high-sulfur fuel oil (HSFO; sulfur content up to 3.5%) and install an exhaust gas cleaning system (scrubber) to eliminate most of the sulfur dioxide emissions; (2) switch to marine distillates or low-sulfur bunker blends whose sulfur content is 0.5% or less; or (3) use alternative low-sulfur fuels like liquefied natural gas (LNG) or methanol. Then, most recently, in Won't Be Long, RBN noted that, with the long-scheduled IMO 2020 Implementation Day on the not-so-distant horizon, many refiners are making plans to adjust their crude slates to optimize their output of low-sulfur distillates and minimize their production of "bottom-of-the-barrel" residual fuel oil (RFO; also known as resid), the primary source of high-sulfur marine fuel. At the same time, U.S. midstream companies are gearing up to export more light, sweet crude from the Permian and other shale and tight-oil plays to simple refineries overseas that would no longer be able to get by refining primarily crudes that are more sour. Marine-fuel suppliers are testing various blends to see which might produce IMO 2020-compliant fuel at the lowest cost. As for shipowners, they're preparing for topsy-turvy bunker prices.

Today, we turn our attention to Baker & O'Brien's latest analysis of how things may play out under the current plan for IMO 2020 implementation. First of all, we assume that current global demand for high-sulfur bunker (HSB; up to 3.5% sulfur) is about 3.2 MMb/d (black bar to far left in Figure 1), and that come 2020 demand for the new shipping pool consisting of low-sulfur bunker (LSB;

0.5% sulfur or less) and HSB would be 3.4 MMb/d (dark green bar to far right) — assuming 100% compliance with IMO 2020 (more on this in a moment) — with the incremental 0.2 MMb/d of demand representing a combination of demand growth and the lower energy density/bbl of the lighter LSB blends. While there's a good bit of uncertainty around all this, we see seven primary factors --— plus the lower energy density/bbl we just noted — working in tandem to bring the bunker market into something approaching balance:

- Non-compliance
- Scrubbers
- Alternative fuels
- Blending of existing low-sulfur fuel oil with distillate
- Refinery upgrades
- Shifts in crude slates and crude oil flows
- Increased global refining throughputs

We'll discuss each of these in sequence (and from left to right in Figure 1), beginning with non-compliance. This analysis assumes some amount of non-compliant bunker fuel to be burned on the high seas, especially in the very early years of IMO 2020. This is attributable to several factors, but most notably a loophole of sorts that relates to fuel availability and a mechanism under the rule for using a "statement of non-compliance" if a shipowner can show that compliant fuel was not available. Estimates of non-compliance from other firms and agencies in 2020 have ranged from less than 10% to as high as 30%. For the purposes of our analysis, we have assumed non-compliance to be 20% in 2020, or just under 700 Mb/d (0.7 MMb/d) of HSB (red bar).

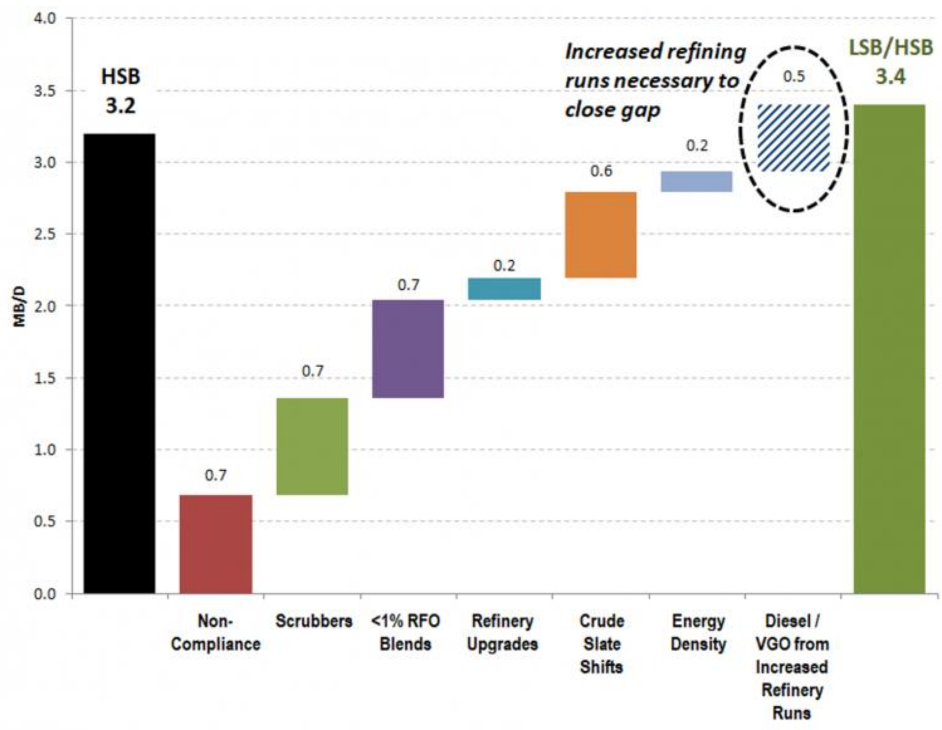

Figure 1. IMO 2020 Bunker Components. Source: Baker & O'Brien

Scrubbers are next. Installing a scrubber allows a ship to continue to use HSB; the scrubber reduces sulfur dioxide from the ship's stack emissions. This allows a shipowner to minimize daily fuel expenses for the trade-off of a relatively significant capital investment — generally estimated at $3 million to $5 million per vessel. If the price differentials between HSB and LSB are projected to be sufficiently wide and persist long enough to allow a reasonable return on the scrubber investment, scrubbers may well make economic sense, but there are practical limits (scrubber manufacture rate, ship dry-dock requirements, etc.) to the pace at which new scrubbers can be added to the world's shipping fleet. Similar to non-compliance, estimates for the impact of scrubbers on the 2020 bunker pool have been in the 5%-to-33% range. We assume scrubbers would mitigate demand for LSB on the order of 20% in 2020, or just under 700 Mb/d (0.7 MMb/d; light green bar).

Alternative fuels — especially liquefied natural gas (LNG) — offer promise for compliance in the long run, but it's likely that their impact would be negligible in the early stages of enforcement. We assume no material displacement of HSB in 2020 with alternative fuels (so this category doesn't get a colored bar in our graph).

Next up is blending of existing low-sulfur fuel oil with distillate. Certain low-sulfur crude oil refiners currently produce RFO (resid) with sulfur in the range of 0.6% to 1.0%. This fuel oil may be atmospheric ("long resid") or a combination of straight-run and cracked products, such as residuum, slurry from the fluid catalytic cracker (FCC), and distillate. For example, some refineries that do not have bottoms conversion capability (such as coking) process a premium crude slate, whereby a significant fraction of the residuum is cracked in the FCC. In those cases, RFO yield might be as low as 5-7% and volumes are manageable. (Other refineries without cokers that process higher-sulfur crude oils would produce significantly greater volumes of residual fuel oil at sulfur contents much higher than 1%.) The blue line in Figure 2 shows the amount of ultra-low-sulfur distillate (ULSD) required to blend one barrel of this relatively low-sulfur RFO into IMO 2020-compliant LSB. As you can see, it only takes about 0.5 barrel of ULSD (lower red arrow on y-axis) to blend 1 barrel of 0.7%-sulfur RFO (left red arrow on x-axis) into 0.5%-sulfur bunker, but it takes nearly 1 barrel of ULSD (upper red arrow on y-axis) to blend 1 barrel of 0.9%-sulfur (right red arrow on x-axis) into rule-compliant marine fuel. In short, RFO with higher levels of initial sulfur content require progressively more ULSD blending.

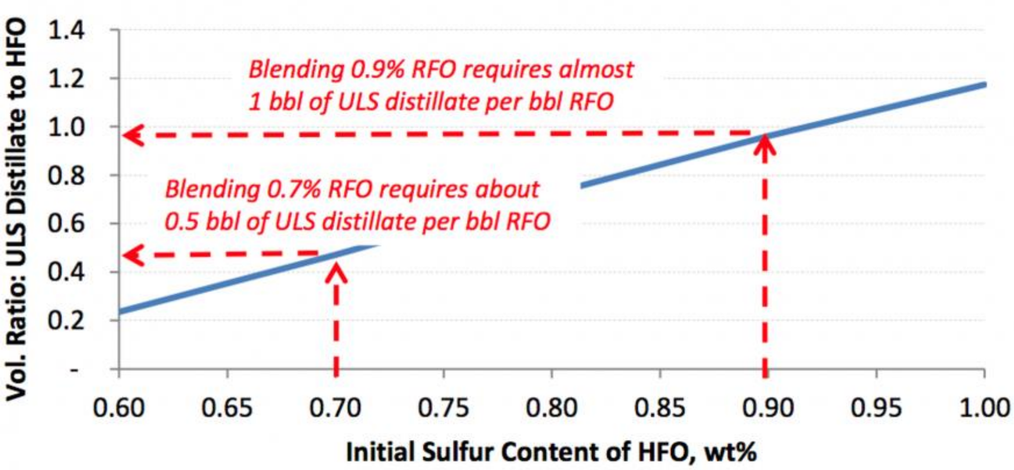

Figure 2. ULSD Needed to Blend Low-Sulfur RFO Into IMO-Compliant Bunker. Source: Baker & O'Brien

We estimate that there might be low-to-moderate-sulfur RFO volumes in the range of 10-20% of the total bunker pool that can be accessed and blended with ULSD distillate to produce rule-compliant LSB. If we assume that 15% (450 Mb/d) of 0.7% sulfur material is available, this would require an additional 225 Mb/d of ULS distillate and result in 675 Mb/d of LSB. (We round that up to 700 Mb/d or 0.7 MMb/d; purple bar in Figure 1).

Then there's refinery upgrades or, more specifically, upgrades to convert bottom-of-the-barrel residuum to high-value distillates like diesel and vacuum gas oil (VGO). A few notable projects are in progress, including the new, 50-Mb/d delayed coker just placed into operation at ExxonMobil's Antwerp refinery in Belgium. [Another recent announcement by Valero for a new, 55-Mb/d delayed coker at its Port Arthur (TX) refinery is likewise expected to remove HSB from the market and convert about 50% of its feed into light and heavy distillates, albeit start-up isn't expected until 2022.] Further, there are reports of new coking units planned for refineries in Russia, but we are not certain of the probability and timing for these projects. On top of that, new refining capacity coming on-stream between now and late 2020 will increase global refining capacity by 3 or 4%. Much of this new capacity will include deep conversion capabilities that will also work toward shifting higher-sulfur RFO to distillate. For example, in Asia, three large grassroots refineries with a total capacity of 1.1 MMb/d — two of them with resid hydrocrackers — have commenced operations or are in the process of starting up: Hengli (Dalian, China); Petronas-Aramco (Johor-Peng, Malaysia); and Zhejiang Petrochemicals (Zhoushan, China). In total, we estimate that up to 200 Mb/d (or 0.2 MMb/d; aqua bar in Figure 1) of "new" distillates produced from up to 400 Mb/d of residuum sources might be available from new conversion capacity (including new refineries).

That takes us to shifts in crude slates and crude oil flow (orange bar in Figure 1), an even more complicated topic that we'll discuss in depth in Part 2 of this blog series, along with the all-important increased global refinery runs (blue-and-white-striped bar) that would be needed to close the gap. Stay tuned!

"The Thunder Rolls" was a #1 hit single for country music star Garth Brooks in 1991. The song, off of Garth's No Fences album, was co-written by him and Pat Alger. It was originally recorded by Tanya Tucker, but her version was not released until 1995 as part of a self-titled box set.

Note: The article was authored by Amy Kalt of Baker & O'Brien and published on RBN Energy's Daily Energy Post on November 25, 2018.