Arthur D Little

Viewpoint

Petroleum refiners and shippers struggle over marine fuel

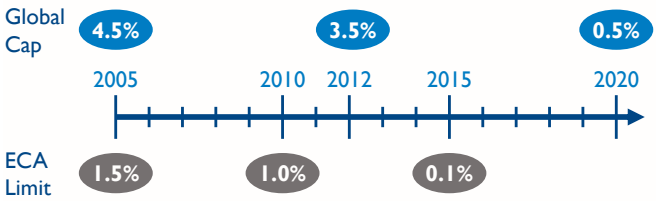
Tighter marine pollution regulations force marine-fuel value-chain players to rethink industrial and business models in order to maintain their competitive positions after 2020

The marine-fuel sector is facing lower-sulfur-content specifications, with the major change taking place in January 2020. Both petroleum refiners and ship owners could contribute to close the supply-demand gap, but all players' contributions will depend on each other's, in both impact and timing.

A new schedule for sulfur content

In October 2016 the International Marine Organization (IMO) committee set January 1st, 2020 as the starting date for the new MARPOL[1] regulation. The regulation caps sulfur marine-fuel emissions, limiting sulfur levels to of 0.5 percent (mass over mass) in marine fuels outside of the already-much-stricter emission-control areas (ECAs). Current marine-fuel regulation demands a maximum of 0.1 percent sulfur content inside ECAs and 3.5 percent outside them.

Marine-fuel sulfur-content limit – % m/m



Source: Arthur D. Little

Dealing with stricter fuel specs

From 2010 on, the most viable solution for vessels navigating through ECAs has been to run on marine diesel oil (MDO) or low-/ultra-low-sulfur fuel oil (LSFO/ULSFO) for as short a time as possible through these areas and switch to high-sulfur fuel oil outside them. This approach will no longer be possible after 2020, when higher-than-0.5-percent-sulfur-content fuels will no longer be an option on their own.

Upcoming regulations will negatively impact high-sulfur residual-fuel demand, and the price penalty it incurs against lighter and cleaner fuels will increase. Non-compliant refineries and most of the current shipping fleet will face negative economic impact if the supply-demand imbalance expected for 2020 is not closed.

The answer may not come as a unique choice, but as a combination of approaches. Marine fuels will have to be desulfurized or blended with lower-sulfur components to enable them to meet the new specifications, but the incorporation of new shipping technology will play its role as well, especially exhaust-gas scrubbers and built-in liquefied natural gas (LNG) systems.

Marine refined products' supply-demand imbalance

Fuel oil has been centrally involved in marine propulsion since the early 20th century, and its application is now being challenged.

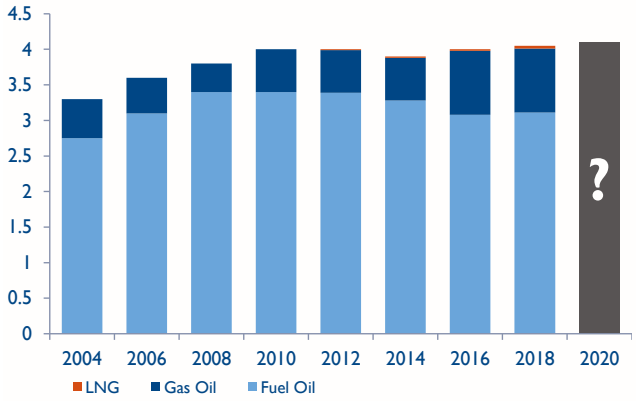
In the last years, more than 40 percent of total fuel-oil production has been absorbed in supplying marine-fuel demand, which may no longer be the case beyond 2020.

Demand for refined products and crude refining throughput will continue growing and, consequently, so will fuel-oil production.

Since the majority of current fuel oil does not meet the 2020 standards, low-sulfur fuel oil and other distillates, such as MDO, will see demand increased.

1 MARPOL: Marine Pollution, the International Convention for the Prevention of Pollution from Ships

Marine fuel consumption to 2020 – MMbpd



Source: IEA, Arthur D. Little

The current global average of sulfur content in heavy fuel oil (HFO) is above 2.5 percent, and with the new regulation, at least 80 percent of this will have to be removed, or a way must be found to dilute it with very low-sulfur-content fuels.

From the processed feedstock side, the refining sector can do little in relation to the available crude global sulfur content.

Accordingly, greater volumes of low-sulfur distillates will need to be diverted to the marine-fuel production pool, displacing high-sulfur residuals. This will have a significant impact on the regional and global fuel oil-supply balance, as marine propulsion is its main application.

How to close the specs gap

Even though the new regulation involves some major challenges, the solutions for these should be expected to come as a combination of the following approaches:

- Inland fuel-oil desulfurization
- Inland/refinery fuel blending to meet specifications
- Greater use of MDO/marine gas oil (MGO)
- Greater use of non-oil-refined products
- Ship onboard desulfurization

Each approach requires investment and higher operational costs, or the use or sacrifice of high-value products to comply with the specifications.

Refiners' perspective

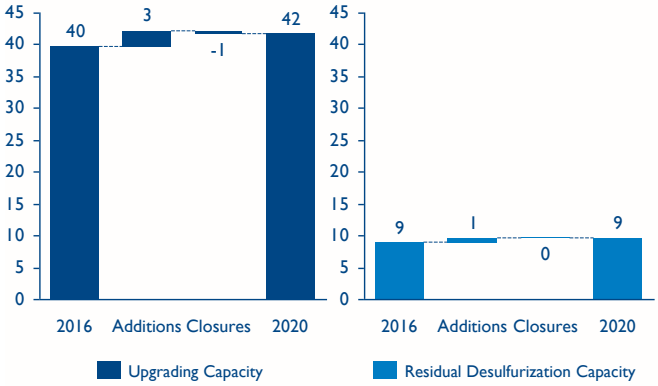
In general terms, the marine-fuel scenario will erode the current competitive position of those refineries processing sour crudes with low residue conversion and limited desulfurization capabilities. For them, it will be tougher to produce compliant marine fuel, and their residual fuels will be even more penalized under the future fuel-demand mix.

High-sulfur residual producers struggle to allocate their output in nearby markets and will be forced to compete in a shrinking high-sulfur fuel-oil market.

In a global context in which some refining capacity is expected to close in any case, for many low-complexity refineries industrial reconfiguration will be the only way to stay in the market.

Planned coker-capacity additions will struggle to absorb the residuals surplus, and planned desulfurization-capacity additions will be insufficient to turn remaining residual fuel into compliant volumes.

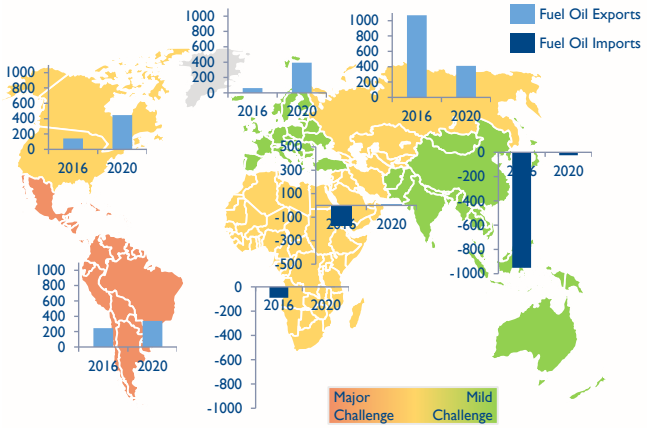
Projected refining and upgrading capacity to 2020 – MMbpd



Source: OPEC WOO, Arthur D. Little

As a result, blending higher quantities of distillates for fuel-oil production appears to be a temporary alternative, but there will be reluctance to sacrifice middle distillates by diverting them to the fuel-oil pool.

Fuel oil 2016-2020 balance – kbpd



Source: IEA, Arthur D. Little

In this context, the relative price of MDO is expected to rise, price spreads between intermediate fuel oil (IFO) and MDO are likely to grow larger, and the resulting compliant marine fuel-blend price should position itself somewhere between these two. Hence, coking-versus-cracking refining margins' spread is

likely to increase if no significant additional conversion projects are executed.

Meanwhile, higher-complexity refineries may enjoy increased distillate spreads, which will increase their refining margins, at least until residual-processing-capacity supply can meet demand.

Whether refiners opt to go for hydrocracking, coking or hydrodesulfurization units will depend on their current configurations, crude oil-supply quality and output-mix demand. However, investment will only be repaid if marine-fuel demand is not hindered by another technology.

Vessel owners' perspective

Availability of heavy compliant marine fuel will be tight, especially in the first years of regulation, and even more so in regions with limited refinery complexity and light sweet-crude supply.

Shippers should expect compliant marine-fuel prices to rise, but increased prices will become more common in the shipping industry.

MDO and blended 0.5 percent sulfur fuel will be the easiest options to resort to, but since their price premiums will be very high, shippers will probably think about retrofitting vessels.

Scrubber installations in both new and existing ships will be increasingly considered as an alternative to continuing to burn non-compliant, low-demand and cost-efficient, high-sulfur fuels.

On the one hand, scrubbers are a relatively fast-adapting technology, and may enjoy temporary advantages when compliant-fuel prices suffer a major rise.

On the other hand, equipment is expensive (up to 4 MM USD CAPEX, depending on the vessel) and voluminous, taking up a portion of the cargo capacity. Installation feasibility will also depend on the type of vessel. Furthermore, with a proper scrubber and feed-quality combination, SOx emission can be maintained under permitted levels, but may not be sufficient for NOx and PM emissions.

LNG-fueled vessels, together with LNG-ready ones (retrofitted), are a viable approach to the challenge, but would initially have fairly low penetration in the shipping industry.

LNG is a competitive fuel alternative and will reduce freight costs compared to low-sulfur fuels. However, LNG equipment is also expensive (around 5 MM USD CAPEX, depending on the vessel) and large, again taking up a portion of cargo capacity. Another hindering factor for LNG-fueled-vessel deployment is the need for LNG terminal structures at ports, which are yet to be extensively developed.

There were only about 90 LNG-fueled ships globally as of 2016 and about 100 more on order globally. Around 70 more LNG-ready ships will join the fleet, and there are more than 300 ongoing scrubber projects.

Whether one option or another among those mentioned will be chosen will depend on vessel route, the permanence at ECAs, price spreads between the different fuels, technical feasibility and the cost of the technologies. No universal recipe will be optimal, and solutions will have to be tailor made.

Nevertheless, retrofitting a vessel is a faster process than reconfiguring a refinery, and shippers will be able to take a spectator role and watch for outcomes before reacting.

The 2020 outlook

Even though LNG will take a share of the marine-fuel market, oil will continue to be predominant for marine propulsion.

Scrubbers will enable high-sulfur fuel to persist in the mix, but only to a modest degree, since a limited portion of the world's fleet will invest in its installation.

Price spreads between sour and sweet fuels will directly drive adverse refining margins for low-complexity refineries, and consequently it is expected that additional coking capacity will be announced. Expansion-feasibility studies will be favored by crude oil, versus sweet products' growing spreads, especially due to middle distillates being demanded as marine fuel. Nevertheless, there will be reluctance to sacrifice middle distillates by diverting them to the fuel-oil pool.

Both LNG-vessel and scrubber penetration will strictly depend on economics – when operationally feasible – and, thus, price spreads between sour and sweet fuels will be key to ensuring investment repayment.

Economics for residue desulfurization favors investment in large-scale refinery units over onboard vessel scrubbers, and we expect that this fact, combined with the long-term objective of petroleum refineries to produce cleaner fuels independently of the evolution of the marine fuel-oil market, will drive refiners' investments. The timing for adapting vessels for onboard scrubbing is shorter than that for refineries, so refiners should react first. They cannot wait to see how much the shipping segment would facilitate the regulation compliance on its own.

A rough estimate shows that removing excess sulfur from non-compliant marine fuel will require an investment of ~25 Bn USD, while installing scrubbers in technically and economically feasible ships will entail investing ~50 Bn USD. Still, the largest portion of the global shipping fleet (the non-feasible portion) will have no other option than to run on more expensive fuels since feasibility depends on vessel size, the most navigated routes and remaining lifetime.

A large number of refineries were already challenged by the low value of the residue before the IMO decision, with many postponing conversion projects of about 1 billion dollars each, to

avoid production of high-sulfur fuel oil. Those projects are more attractive now, considering the price discount that residues in general and high-sulfur fuel oil in particular would have when compared with crude and other products.

Economics of refining projects are impacted by the IMO decision. Back in 2010, one of our Middle East clients suggested we use zero value for high sulfur fuel oil (HSFO) after 2020 when developing its refining industrial strategy. That suggested hypothesis represented an extreme view at that time, but would be about the right value to consider in some markets and under some special conditions for a conversion-project evaluation.

Overall, we foresee a key role for refining in adapting itself and the shipping industry as price-takers with relative reluctance to invest in compliance.

Insight for executives

- Marine-fuel regulations limiting marine fuels' sulfur content to 0.5 percent outside ECAs in 2020
- Impact on heavy and sour refined product balance and all its value-chain participants
- MDO and blended compliant fuel will increase their participation in the marine-fuel market, and retrofitted LNG-fueled vessels will take their piece too, but mild penetration is expected
- Refiners should react immediately to stay in the 2020 game, competing with the foremost complexity refineries
- Early arrivers will definitely enjoy economic advantages driven by refining margins, as clean- versus residual-fuel price spreads are likely to rise in the first years of the regulation

How can Arthur D. Little support key players?

- Refining industrial and commercial strategy
- Investment-feasibility analysis
- Refining-margins impact analysis
- Refineries reconfiguration recommendations

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Arthur D. Little

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