Asian Refinery Margin Index: Methodology

Abstract

When looking to reflect the refinery economic climate, the currently available Asian refinery margins, like those in Europe, may not be accurate. Refinery capacity in Asia has been growing and the landscape changing rapidly, making it even harder to represent the environment and fulfil the needs of the market. Therefore, Onyx would like to propose a solution for tracking and reflecting the dynamics of Asian refinery economics.

Introduction

The currently available refinery margins for reference need updating. Most mainstream techniques have been in place for many years and therefore are subject to legacy methodology that is not relevant to the current refinery economic climate. The refinery business in Asia has grown over the past 10 years, adding 33 new refineries and close to 7000 mbpd of refining capacity to the market, most of which has come from upgrading and installing secondary units.

In addition, refinery yields, especially in Asia, are still very much susceptible to the chemical make-up of the feedstock used in the CDU. Therefore, changes in crude flows into and out of Asia are particularly important for determining the benchmark crude quality used by Asian refiners. Furthermore, alternate refinery margin references are calculated as an estimated net margin, with associated operational costs and freight a component of the calculation. Whilst this might provide interest for economic health or lack thereof, it means the margin cannot be both referenced and hedged, or indeed trades on a speculative basis with exposures to each product clearly defined.

With Onyx Refinery Benchmarks - Asia, we aim to provide an index that more accurately reflects the current output of Asian refiners. In addition, Onyx have provided an index which is a gross refinery margin calculation constructed entirely from market prices. This in turn allows for the Onyx Refinery Benchmark to be used directly as a hedging solution or a speculative instrument.

Proposal

After investigating the refinery capacities and product yields in Asian countries, Onyx would like to propose the following yields for the Asian Onyx Refinery Margin Benchmark.

Product	Final Yield
LPG	7.33%
Naphtha	11.03%
Gasoline	25.51%
Jet Fuel	11.51%
Gasoil	34.21%
HSFO	7.02%
VLSFO	3.39%

Justification

The annualised rate of refinery throughput for Asia Pacific stands at 2.7%. Onyx will use the top 5 countries by total capacity in this benchmark as a reference for the whole of Asia.

Country	Total Capacity	Percentage	Cumulative Percentage
China	15027578	43.90%	43.90%
India	4563000	13.33%	57.23%
Japan	3631700	10.61%	67.83%
South Korea	2959000	8.64%	76.48%
Singapore	1699000	4.96%	81.44%
Thailand	1229000	3.59%	85.03%
Indonesia	1196700	3.50%	88.53%
Taiwan	1090000	3.18%	91.71%
Malaysia	880000	2.57%	94.28%
Pakistan	628400	1.84%	96.12%
Australia	472000	1.38%	97.50%
Vietnam	330534	0.97%	98.46%
Philippines	290000	0.85%	99.31%
New Zealand	105000	0.31%	99.61%
Sri Lanka	50000	0.15%	99.76%
Bangladesh	33000	0.10%	99.86%
Myanmar	31000	0.09%	99.95%
Brunei Darussalam	12000	0.04%	99.98%
Afghanistan	6000	0.02%	100.00%

Source: Refinitiv Eikon

By isolating the top 5 countries by capacity, Onyx can source a representative yield for the average Asian refinery.

Below, we have the top 5 countries by capacity's refinery yield based on the most recent data from various sources.

China:

Product	% Yield
Gasoline	28.0%
Naphtha	7.0%
Jet Fuel	5.0%
Kerosene	5.0%
Gas Oil	32.0%
Fuel Oil	5.0%
Bitumen	10.0%
LPG	8.0%
Total	100.0%

Source: China National Bureau of Statistics (2019)

India:

Product	% Yield
LPG	3.9%
Motor Spirit	15.3%
Naphtha	7.9%
ATF	5.8%
SKO	2.5%
Diesel	43.1%
Furnace Oil	4.1%
Bitumen	2.2%
Lube Oil	0.4%
Petroleum Coke	5.8%
Other	9.1%
Total	100.0%

Source: Open Government Data (OGD) Platform India (2017)

Japan:

Product	% Yield
Gasoline	28.4%
Naphtha	9.9%
Jet Fuel	8.4%
Kerosene	8.0%
Gas Oil	23.4%
Fuel Oil	17.3%
Lubricating Oil	1.4%
Asphalt	1.3%
Paraffin Wax	0.0%
LPG	2.0%
Total	100.0%

Data source: Ministry of Economy, Trade and Industry (2019)

South Korea:

Product	% Yield
Gasoline	13.1%
Naphtha	25.0%
Diesel	27.7%
Kerosene	1.5%
Fuel oil	5.4%
LPG	2.2%
Other	25.0%
Total	100.0%

Data source: Korea Energy Statistical Information System (2019)

Singapore yield 2012

Product	% Yield
LPG	4.1
Gasoline	19.52
Naphtha	6.5
Kerosene	13.46
Diesel	37.44
HSFO	15.63
LSFO	0
Other	3.35
Total	100

Data source: Methodology and Specifications Guide, Platts (2012)

Summary of product yields for 81.44% of Asian refineries as of 2019:

	China	India	Japan	South Korea	Singapore
LPG	8.0%	3.9%	2.0%	2.2%	4.1%
Naphtha	7.0%	7.9%	9.9%	25.0%	6.5%
Gasoline	28.0%	15.3%	28.4%	13.1%	19.5%
Jet Fuel	10.0%	8.3%	16.4%	1.5%	13.5%
Gasoil	32.0%	43.1%	23.4%	27.7%	37.4%
Fuel Oil	5.0%	4.1%	17.3%	5.4%	15.6%
Other	10.0%	17.6%	2.7%	25.0%	3.4%

Weighted average by capacity:

Product	Average Asia Yield
LPG	5.69%
Naphtha	9.39%
Gasoline	23.87%
Jet Fuel	9.87%
Gasoil	32.57%
Fuel Oil	7.13%
Other	11.47%

Do these yields need updating?

To see if we need to review any of the yields, Onyx will consider the changes in refinery complexity over the past 10 years, how the yield has changed, and how the crude slate used in refining has changed. From research, there are three conclusions we will look to prove in order to adjust the yield.

1. **The focus has been on installing and upgrading secondary units in 2019, creating lighter yields.**
2. **Light sweet imports have increased for importing countries globally for 2019, again creating lighter yields.**
3. **IMO 2020 regulation creates a higher low sulphur fuel oil yield.**

More complex

Refiners globally have been building secondary units that can further refine the residual fuel oil into products such as gasoline and diesel. Other upgrades include adding desulfurizing units.

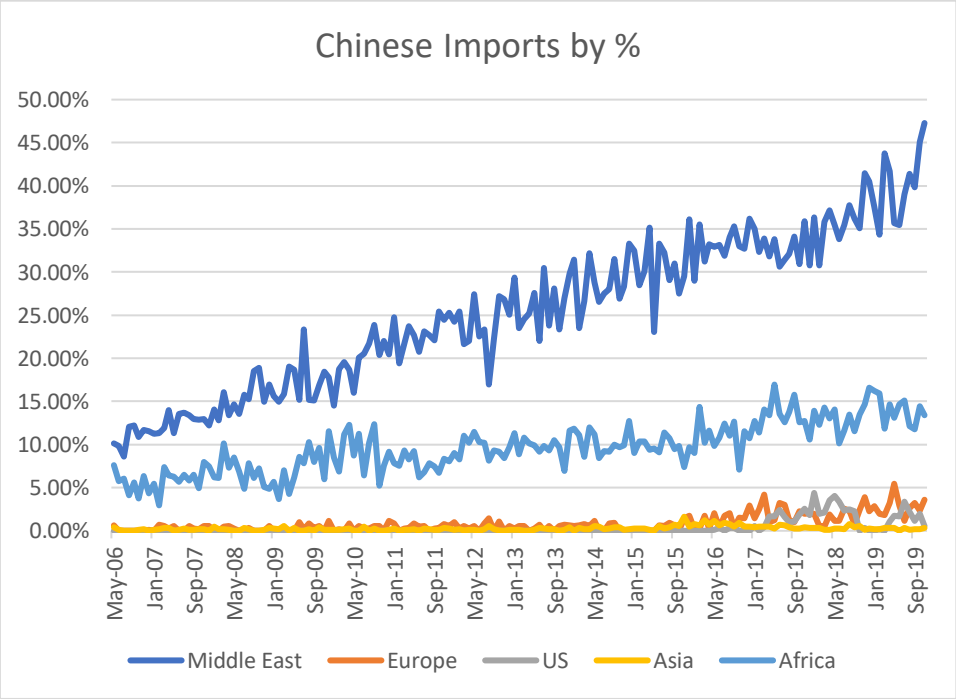
For example, South Korea's S-Oil Corp Onsan refinery has inaugurated its new residue upgrading complex and olefin downstream complex. The new facilities have raised S-Oil's "petrochemical portion from 8% to 13% and includes high-value products such as propylene and gasoline," Saudi Aramco said. Furthermore, ExxonMobil said it had completed an expansion of its Singapore refinery aimed at upgrading its production of Group II base stocks, which is "enhancing the integrated facility's competitiveness." Construction is due to start in the second half of 2019 with the start-up set for 2023. The expansion will add capacity to increase cleaner fuels output with lower sulphur content by 48,000 b/d.

The number of refineries undergoing upgrades is endless, which would suggest a small change to the weighting in light products over heavy products.

Import crudes

Asian refiners have typically had a very good relationship with Middle Eastern producing countries. By way of example, in 2017, South Korea imported about 3 million b/d of crude oil and condensate, making it the fifth-largest importer in the world. In the same year, South Korea depended on the Middle East for more than 82% of its yearly crude oil imports.

Since 2017, Asian refiners were expected to purchase more sweet crude over sour, as they adjusted to meet the rising demand for low-sulphur fuels in the shipping sector. "We're increasing the use of WTI (West Texas Intermediate) and WTL (West Texas Light) to produce VLSFO (very low sulphur fuel oil)" said a South Korean refining source. However, the reality is as below, demonstrated by China:



Source: General Administration of Customs of China

Furthermore, a large proportion of Asian refineries have some Middle Eastern investment, and it can be suggested they will look first to the Middle East for their imports over the rest of the world. For example, S-Oil is 63.4% owned by Aramco Overseas Co., a subsidiary of Saudi Aramco and thus sources much of their crude import quota from Saudi Arabia.

This would suggest that the increase in demand for crudes is being satisfied by Middle Eastern exports and there is no need to adjust the yields from an import basis because China's main import is still the heavy sour barrel, irrespective of IMO 2020 regulation.

However, it must be considered that this has been in a of geopolitical tension, most notably, the US-China trade war. Going forward one would expect US exports into China to rise further as ExxonMobil, and other large trade houses relationship with Asian trade houses improves.

Nonetheless, the increases in light sweet imports is expected to be marginal, and hence, we keep the product yield the same on this basis.

IMO 2020 regulation

Before the sulphur constraints on shipping fuels came into effect in January 2020, the demand for fuel oil from bunkering was best captured in the 3.5% HSFO (high sulphur fuel oil). Since then, with new IMO 2020 regulations 3.5% fuel oil is no longer an accurate representation of the fuel spec that refineries have adopted to produce.

Pre-IMO 2020, it was estimated that 5.5mm bbls of bunker demand was 70% made up of 3.5% fuel oil. Post-IMO 2020, it has been estimated that HSFO's share of the bunker pool will drop to 25%, with the balance being absorbed by compliant alternatives such as VLSFO and Marine Gasoil (MGO). Hence, we adjust the HSFO split into the individual fuel specs: HSFO, VLSFO and MGO.

For January 2020, the first month of compliance, Singapore Bunker sales were reported as the following:

17% HSFO vs. 28% in December 2019

71% LSFO vs. 59% in December 2019

12% MGO vs. 11% in December 2019

Hence, to allow for new regulations we introduce VLSFO to our benchmark.

Conclusion

We maintain the same light product yields as 2018 based on the evidence that change in light sweet imports is minimal but acknowledge the shift to produce more light and sweet products as there is heavy investment and installation of secondary units (desulphurisation and other secondary units).

Adjustments:

With the purpose of the Onyx Refinery Benchmark to accurately reflect current refinery output, it is logical to proportionately adjust the weightings to reflect the findings. In addition,

as stated in the introduction, we want the Index to be a true reflection of what can be hedged using the oil derivative market. We therefore have considered basis risk (accuracy of hedge vs physical price) and liquidity constraints on execution.

- Redistribution of product weightings 3.5% Fuel Product Weighting into HS, LS and VLSFO

We have redistributed all "other" across all tradeable products. 20% of the current fuel oil weighting into VLSFO, the other 80% is to remain as 3.5% fuel oil.

Product	Other distribution	Fuel redistributed
LPG	7.33%	7.33%
Naphtha	11.03%	11.03%
Gasoline	25.51%	25.51%
Jet Fuel	11.51%	11.51%
Gasoil	34.21%	34.21%
HSFO	8.77%	7.02%
VLSFO	1.64%	3.39%

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Final Yield

Product	Contract Name (ICE)	Contract Name (CME)	Yield	Conversion Ratio to barrel
LPG	Propane, Argus Far East Index (AFEI) Future	Argus Propane Far East Index	7.13%	12.4
Naphtha	Naphtha C+F Japan Cargo Swap	Japan C&F Naphtha (Platts) Futures	10.82%	8.9

Gasoline	Gasoline - Singapore Mogas 92 Unleaded (Platts) Future	Singapore Mogas 92 Unleaded (Platts) Futures	25.31%	8.33
Jet Fuel	Singapore Jet Kerosene Swap	Singapore Jet Kerosene (Platts) Futures	11.30%	7.88
Gasoil	Singapore Gasoil Swap	Singapore Gasoil (Platts) Futures	34.00%	7.45
HSFO	Fuel Oil 380 CST Singapore Swap	Singapore Fuel Oil 380 cst (Platts) Futures	7.02%	6.35
VLSFO		Singapore FOB Marine Fuel 0.5% (Platts) Futures	3.39%	6.35

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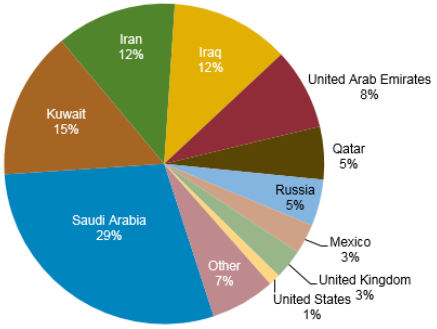
Figure 4. South Korea crude oil imports by source, 2017



eia Sources: Global Trade Tracker (accessed April 2018)

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