# “Base oil, base oil everywhere, nor any drop to buy”*

** With apologies to Samuel Taylor Coleridge, and his epic poem “The Rime of the Ancient Mariner”*

## The curious case of how coronavirus created a **lubrication crisis**

By Ian Moncrieff, Vice President, Energy

## Introduction

Since the onset of coronavirus in early 2020, the base oil business has been thrown into disarray. While crude oil prices have increased modestly, with Brent around $55/Bbl in February 2020 and now in the low $60 range, base oil prices have mushroomed. In February 2020, European Group I export spot prices were in the low-mid $600/ton range between SN150 and brightstock. Today, solvent neutral cash market prices are double, and brightstocks almost triple, their levels of just a year ago.

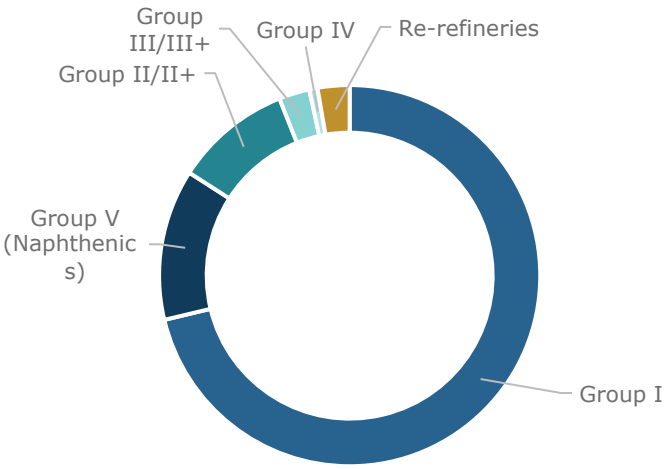
The causes of such an explosion in base oil prices are not obvious and go beyond the confines of the base oil business itself. This paper is an attempt to rationalize the complexities.

## How the Blissful Base Oil Business Boomed

Base oils have been in existence for more than 100 years as the basic building blocks of lubricants. During that time, the processes for manufacturing base oils have become necessarily more complex, driven by the need for ever more high-performance lubricants. As a result, base oil processes that were mainstream 50 years ago have become largely obsolete, replaced by more efficient, more economic, or more environmentally acceptable alternatives.

A particular example can be found in Group I paraffinic base oils which, with naphthenics, dominated the landscape in 2000, together accounting for 84% of installed global base oil capacity (see Figure 1).

**Figure 1: WORLD BASE OIL CAPACITY, 2000 (976 KB/SD)**



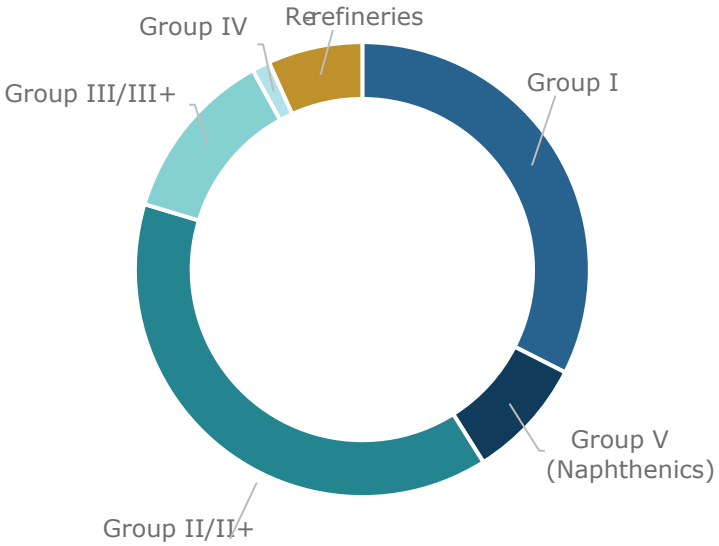

Source: Kline

Only 20 years later, installed operable Group I and naphthenics capacity has fallen by more than half, to 41%. Conversely, capacity growth from 2000-2020 in higher quality Group II and III base oils quadrupled its share of global capacity, more than offsetting the ongoing closure of 50 Group I and naphthenic base oil facilities over that same time (Figure 2).

Operable base oil capacity not only increased by 244 KB/SD between 2000 and 2020, but the quality of base oils improved markedly. There will still be niches where the solvency and broader viscosity range of Group I and naphthenic base oils enable them to remain competitive, but their mainstream positioning, particularly vis-à-vis Group II, continues to erode.

But while all this capacity expansion and quality upgrading was happening between 2000 and 2020, did demand for base oils increase commensurately? Not nearly enough, in fact. Worldwide consumption of lubricants, as measured by Kline, rose slowly from 38.2 million tons in 2000 to 40.7 MMT in 2019. Despite the long-standing evidence of fundamental stagnation in global lubricants markets, investors outside the OECD continued to add new capacity, particularly after 2010, perhaps assuming higher demand growth and/or accelerated closures of marginal Group I and naphthenic base oil assets. The impact on operable base oil capacity utilization has been significant, dropping from 90% in 2000 to 78% in 2019. Capacity under-utilization is never good for capital-intensive plants and, until March 2020, global base oil markets exhibited the classic symptoms of over-supply — low margins and, hence, ROIs, increasingly global arbitrage, and continuing closures of under-performing assets. While the base oil world was resigned to a position of fundamental overcapacity, it was — barring such unforeseen events as fires, floods, hurricanes, and other natural causes — fairly predictable. Base oil prices could be projected with a reasonable degree of certainty based on fundamental algorithms linked to crude oil prices, capacity utilization, arbitrage costs, and process economics.
Then COVID-19 changed everything.

**Figure 2: WORLD BASE OIL CAPACITY, 2020 (1,220 KB/SD)**



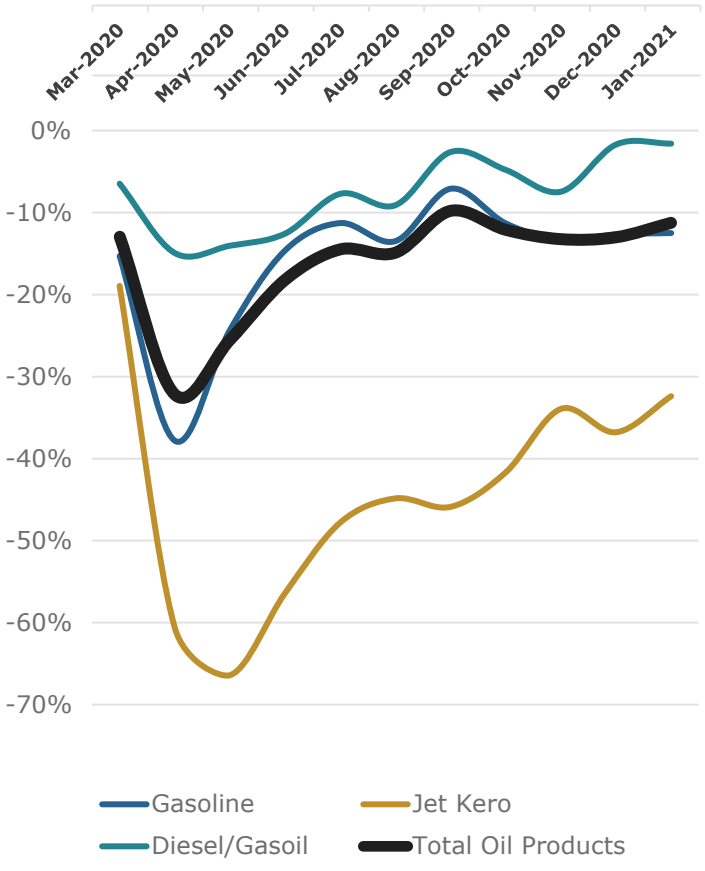

Source: Kline

# The Coronavirus-Created Challenges in Oil Markets

We are now a little over one year removed from the onset of COVID-19, unofficially established in the West on March 13, 2020. The impact on oil markets was immediate and profound (as illustrated for the U.S. in Figure 3).

Stay-at-home mandates, with their collateral impact on travel, severely impacted transportation fuels, and those impacts linger. Of the major fuels, diesel and related middle distillates have been impacted the least, presumably because of the displacement of in-person retailing by online retailing, which enhanced the need for commercial distribution logistics.

**Figure 3:** MONTHLY CHANGES IN U.S. FUELS CONSUMPTION VS. SAME MONTH IN 2019

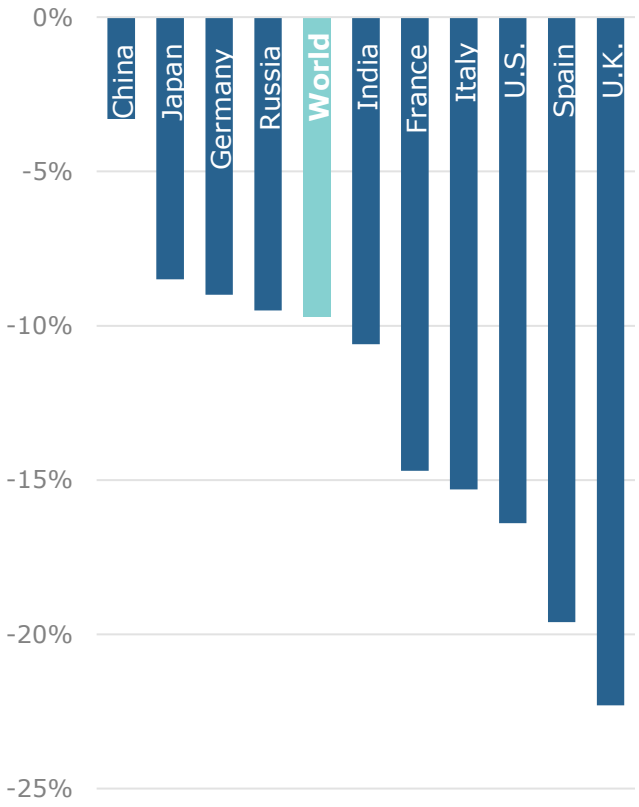



Source: U.S. EIA

Overall, U.S. oil consumption in 2020 was down 16.4% from 2019. World oil demand fell by slightly under 10%, from 99.8 million B/D in 2019 to 90.0 million B/D in 2020. All but a tiny handful of countries around the world saw declines in oil consumption between 2019 and 2020, though the impact of COVID-19 on their oil economies varied (Figure 4).

Mitigating factors included the speed and effectiveness of central coronavirus management responses, community cultures and personal norms, and the underlying strength of their national economies.

**Figure 4:** DECLINES IN OIL PRODUCTS CONSUMPTION, 2019 TO 2020




Sources: OPEC, IEA

A reduction of almost 10% in world oil demand between 2019 and 2020 has hit the refining sector hard. Refinery runs are down, along with capacity utilization as a result (Figure 5).

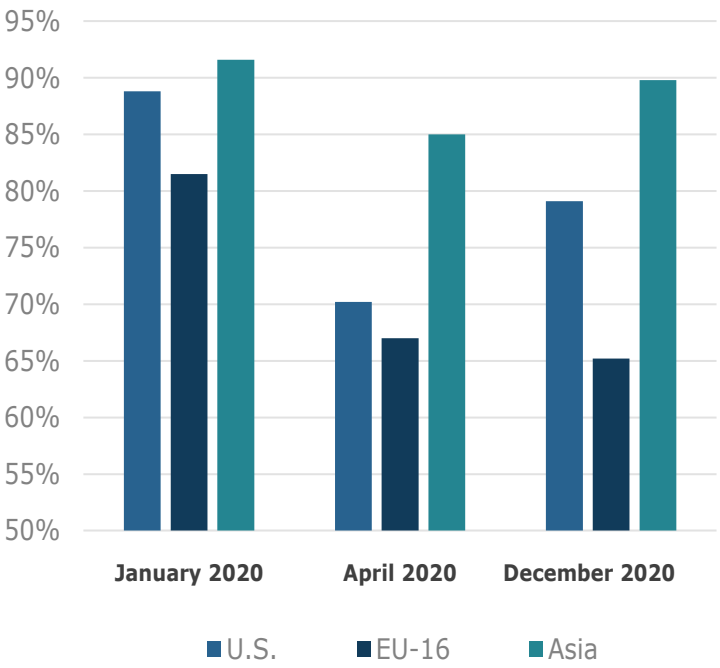
Particularly impacted has been the European refining industry, which suffers from relatively small scale and lower Nelson Complexity compared to its peers in North America, Asia, and the Middle East. The rising cost of tanker transportation has made inter-regional arbitrage more challenging.

Illustrative of the impacts of COVID-19 on refinery performance, Figure 6 depicts the margins of three major refiners since Q1, 2019. Exceptionally low margins, such as those exhibited during the pandemic, are not sustainable, and refiners have responded with a series of measures to curtail damage to their balance sheets, including:

- Refinery closures, either temporary or permanent
- Running at lower levels of throughput, consistent with unit turndown constraints
- Advancing maintenance and turnaround programs
- Reducing exposure to low-margin business and products

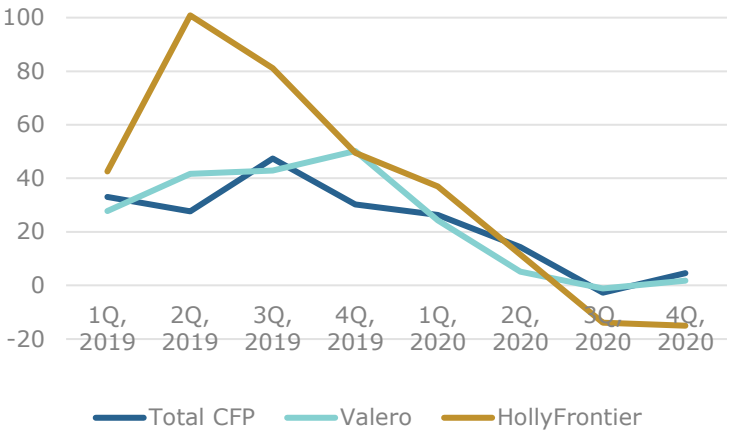
While it appears that the nadir was reached in late 2020 and early indicators are that refinery margins have improved slightly in Q1 2021, the refining industry is still seriously challenged.

**Figure 5: OPERABLE REFINERY UTILIZATION IN 2020**




Sources: U.S. EIA, OPEC

**Figure 6: CASH MARGINS OF SELECT REFINERS ($/TON)**




Sources: Company financial reports

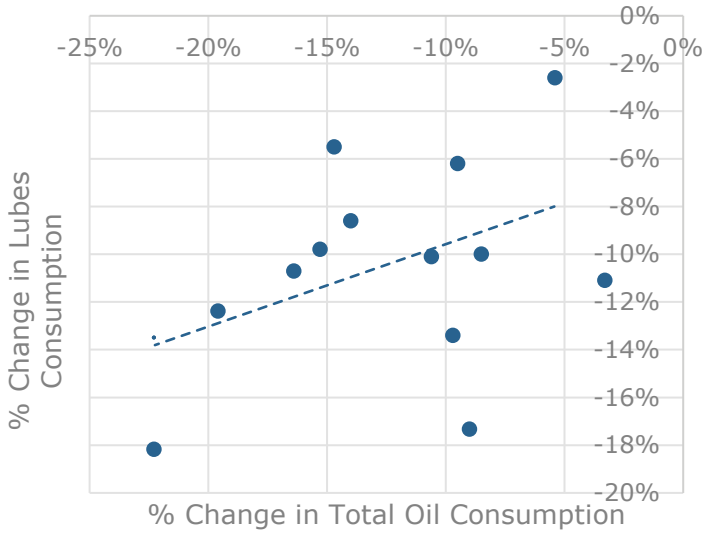
# COVID-19's Impacts on Lubricants Demand

Data on short-term lubricants consumption trends is sparse. Only a dozen countries publish monthly estimates of lubricants consumption, and the reporting time lag is often several months. Moreover, due to the challenges of measuring lubricants consumption at the end-user level, lubricants consumption is either determined by the "domestic disappearance" of base oils or is based on lube blender/marketer data provided to national industry associations or government agencies. Despite the paucity and limitations of the data, it is possible to compose a picture of how lubricants consumption in some key consuming countries reacted to COVID-19 based on monthly reporting from those sources.

While there are no precise leading indicators of lubricants consumption, oil demand is a reasonable proxy, because fuels are used in transportation and industrial applications which parallel lubricant use. Figure 7 depicts the changes between 2019 and 2020 in both total oil products and lubricants consumption for 12 leading economies and the world. While there is considerable scatter in the data, due to a variety of reasons, Kline has found no evidence of a major country market whose lube consumption grew in 2020. Overall, Kline estimates that global lubricants consumption in 2020 was 35.3 million tons, a decline of 13.4% from 2019.

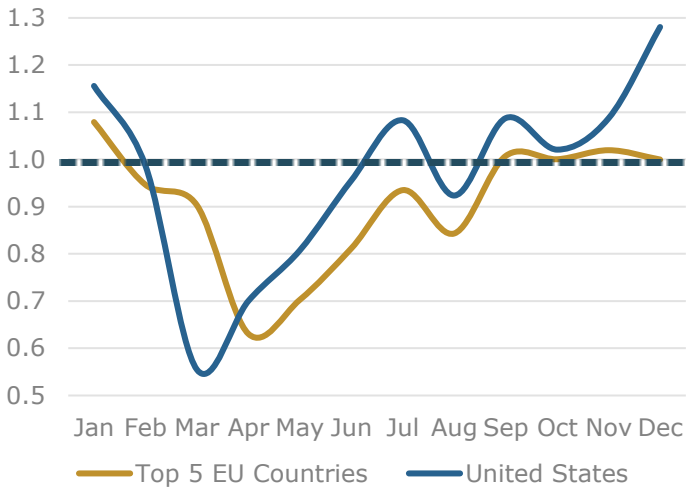
How did COVID-19 impact lubricants demand in 2020? Kline's research has focused on comparing actual monthly reported consumption with estimated demand, based on historical trends in lubricants use and seasonal factors, such as lower levels of lubricants use during vacation seasons (notably in Southern Europe) and traditional end-year destocking. The evidence, as summarized in Figure 8, shows an immediate and significant impact on lubricants demand. In both Europe and North America, lubricants consumption in March/April 2020 fell by approximately 40% from expected pre-COVID levels. By May, the initial shock had worn off and lubricants demand began to recover. By the third quarter of 2020, lubricants consumption in these major consuming blocs had, to all intents and purposes, returned to pre-COVID expectations.

**Figure 7:** DECLINES FROM 2019 TO 2020 IN TOTAL OIL PRODUCTS VS. LUBRICANTS CONSUMPTION




Source: Kline

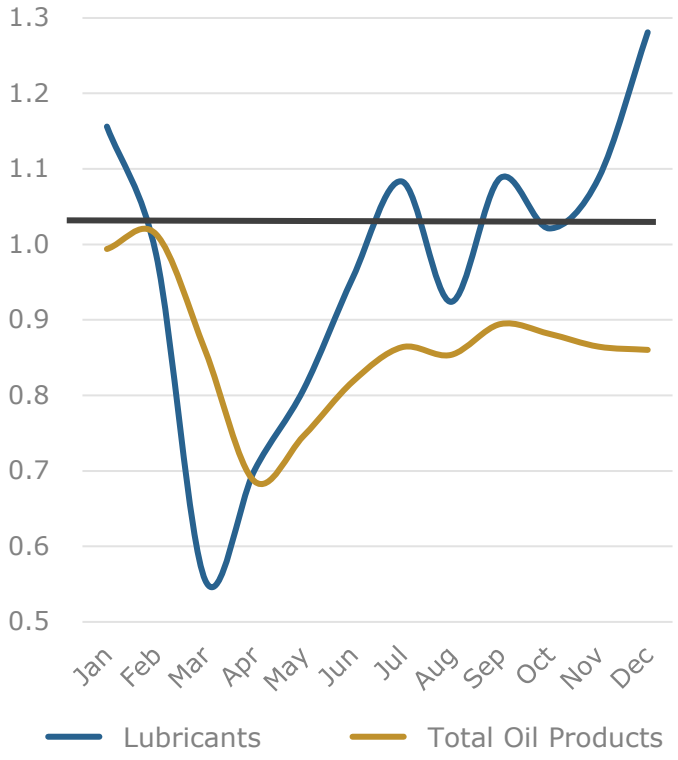
**Figure 8:** RATIO OF ACTUAL TO PREDICTED MONTHLY LUBRICANTS CONSUMPTION IN 2020




Source: Kline

Perhaps even more importantly, the relative impacts of coronavirus on lubricants and petroleum products over time are instructive. Figure 9 shows the actual versus expected consumption of lubricants and total oil products in the United States by month during 2020. While lubricants were immediately hard-hit, consumption returned to pre-COVID norms by mid-year. Fuels, conversely, were less impacted immediately but continue to suffer the lingering effects of coronavirus, with demand still at 10% or more below pre-COVID expectations. Could this relatively rapid rebound in base oil demand be a contributing cause for the price explosion which has occurred over the past nine months?

**Figure 9: RATIO OF ACTUAL TO PREDICTED U.S. MONTHLY LUBRICANTS AND TOTAL OIL PRODUCTS CONSUMPTION IN 2020**



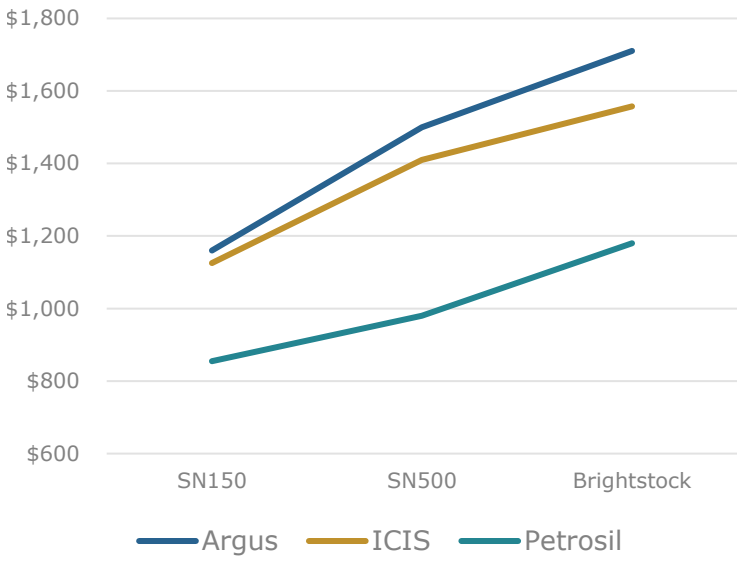

Source: Kline

## COVID-19 and Base Oils

Base oils are an enigma to refiners. The feeds to base oil plants are derived from refineries, and in the great majority of cases, those feeds are transferred "across the fence" to a physically integrated base oil facility. Byproducts from base oil production are generally re-absorbed into the parent refinery. This physical integration permits refiners to optimize the values of intermediate products and byproducts through process unit and blending flexibility. In theory, then, it should be possible to optimize in real time the product slate for maximum profitability. This is where theory and the real world separate. First, unlike major oil products, price discovery in base oils is not instantaneous, nor can base oils be hedged on exchanges. Standardization of base oil products is challenged by differences in quality, approvals, and brand support, making exchanges and arbitrage more difficult. These complexities introduce transactional "noise" into base oils which does not exist among mainstream fuels. So, base oils are not pure commodities; in consequence, have base oil markets been impacted

differently by the pandemic compared to mainstream commodity fuels? The evidence would suggest that the answer is yes.

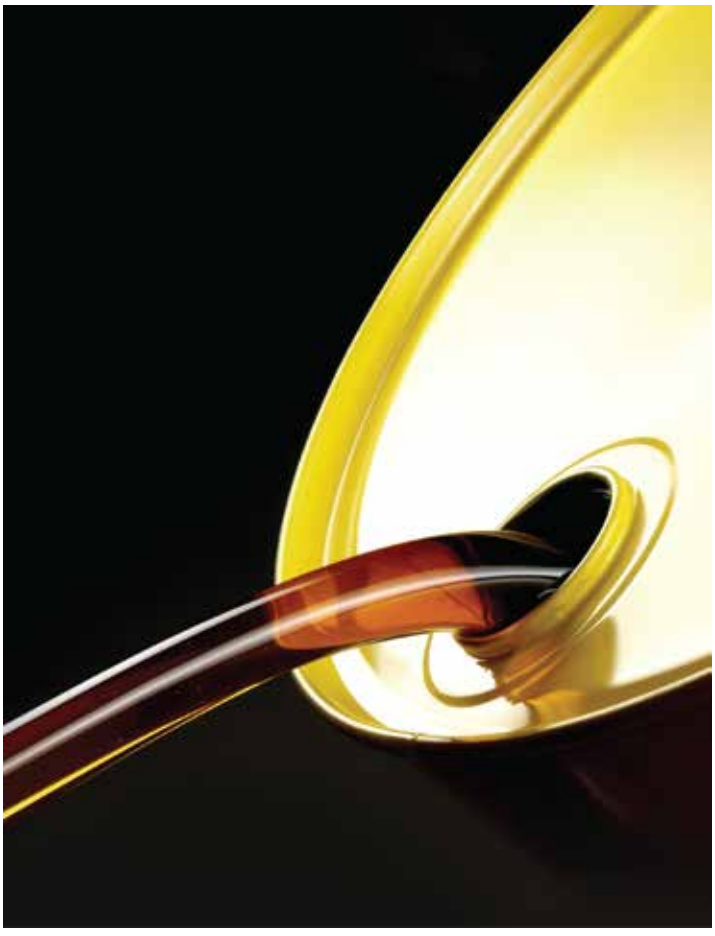
**Figure 10: EUROPEAN BASE OIL MIDPOINT "SPOT" EXPORT PRICES AS OF APRIL 1, 2021 ($/TON)**




Source: Pricing services

Feeds to base oil units can include hydrocracker bottoms and vacuum bottoms, but the great majority of refinery feeds consists of vacuum gas oil (VGO), which can be employed in process schemes to produce Group I-III paraffinic, as well as naphthenic, base oils. Historically, pricing of VGO closely, and instantaneously, tracks movements of crude oil on commodity markets. Thus, a simple indicator of the profitability of base oil production can be derived by measuring the gross and net margins over VGO feed at any point in time. But this is where the second divergence from reality occurs. Because base oils are not commodities, and pricing is not transparent nor immediately reactive to changes in crude oil prices, market participants often rely on third-party pricing intelligence services (including ICIS and Argus, among others) upon which to base their commerce. While their data-collection protocols differ, all of these third-party sources are reliant upon a combination of confirmed trades and market sentiment. But what happens when trade dries up, as in the immediate aftermath of COVID-19's onset in March/April 2020? Or, more recently, when shortages of product are driving base oil prices to irrational highs? A recent indication of the disarray in base oil market prices can be gauged from Figure 10, which compares data from three independent sources of European export cash market prices for Group I products on April 1, 2021. When markets are unbalanced, as they have been for months, fundamentals no longer drive buy/sell decisions. The price inelasticity of lubricants demand creates a shortage mentality, leading to the unpredictable crisis pricing of today's markets.

It must also be noted that the trades used as a basis for spot market indices represent only a tiny fraction of base oil commerce. Outside North America, however, a significant proportion of term business is indexed to those same spot market indices, and so the influence of indices is more pervasive. Only in the U.S. do base oils march to a different drummer…posted prices. Postings are set by the producers and not by the market, and may bear little or no resemblance to the cash market. Wide variations in contemporaneous postings can exist between suppliers for the same products, which are resolved through various forms of discounting. Interestingly, the posted prices of major U.S. suppliers have risen by around $1/gallon (roughly $300/Ton) between the end of 2019 and the present, far less than the increase in cash market prices. While some of this disparity can be attributed to the removal of TVAs, it would appear that contract customers are benefitting from current market conditions, providing they are not on allocation.



Despite these uncertainties in the reality of current base oil pricing, one thing is certain. Base oil prices have risen to all-time high premiums in relation to the price of VGO. In other words, gross margins on base oil production are at unprecedentedly high levels (Figure 11), with ample evidence of panic buying as demand exceeds supply.

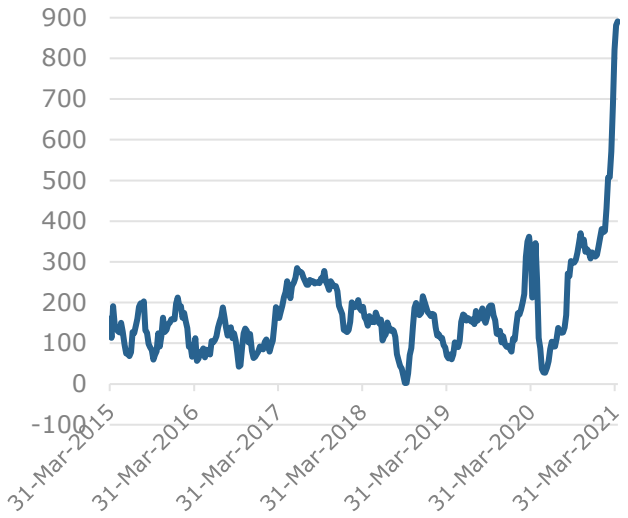
But why?

**The Answer Lies in Refinery Economics, or Does It?**

Conventional gross margins (cracks) of key refined products over VGO have remained not dissimilar from their pre-COVID levels, though gasoline cracks vs. VGO and vs. middle distillate fuels (ULSD and jet fuel) have improved markedly in Q1 2021, as reflected in the recent upturn in refinery margins (Figures 12 and 13). But all fuel cracks over VGO remain vastly below the cracks of base oil relative to VGO. At the time of this writing, in mid-April 2021, Group II N220 spot export prices on the U.S. Gulf Coast exceed spot gasoline, ULSD, and jet fuel prices by $690, $815, and $825/ton, respectively. And so the obvious question is: *"With base oils in such tight supply, and with huge margin incentives to modify refinery operations to make more base oils at the expense of fuels, why aren't refiners responding?"*

The answer: There's no simple answer…

**Figure 11: U.S. GULF COAST GROUP II N220 EXPORT BASE OIL PRICE CRACKS OVER LSVGO ($/TON)**



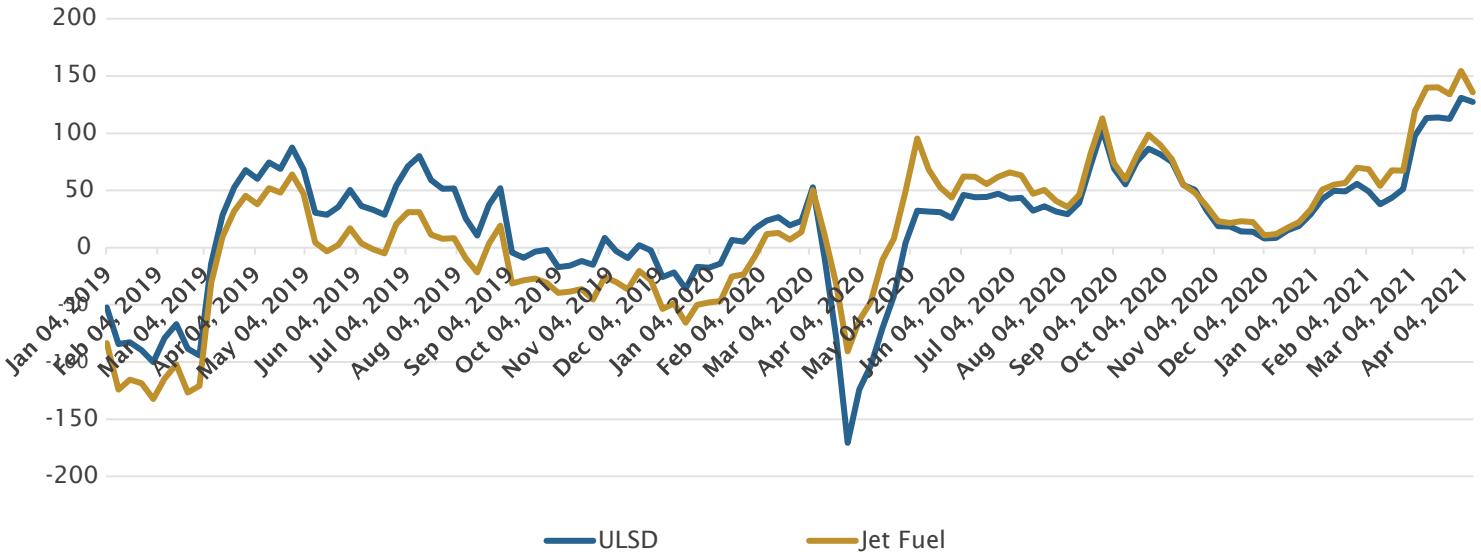

Sources: ICIS, Kline

When refineries become unbalanced in their yield structure vs. expected demand, an immediate question becomes, "How sustainable is this imbalance?" Refiners cannot change process operations instantaneously, and if their expectation is that markets will return to pre-COVID norms within a matter of a few weeks or months, they may be willing to live with short-term market inefficiencies.

**Figure 12: U.S. GULF COAST REGULAR GASOLINE CRACKS OVER LSVGO ($/ton)**


Sources: U.S. EIA, ICIS, Kline

**Figure 13: U.S. GULF COAST GASOLINE CRACKS VS. DISTILLATES ($/ton)**




Sources: U.S. EIA, Kline

If refineries are running at below-normal operating rates, they may face turn-down constraints on certain units which may complicate the ideal operation of the overall refinery and inhibit the maximization of margins. The major decline in jet kerosene demand will have caused more kerosene-range light distillates to remain in the diesel pool, necessitating the use of heavier distillates, such as VGO, to control ULSD specifications. Contractual commitments also play a role in how individual refiners optimize their operations but, as a generalization, it's the fuel dog that wags the base oil tail, and not vice versa.

But what if COVID-19 continues for more than a couple of quarters, or will the "new norm" of post-COVID oil consumption differ dramatically from the past? Base oil refiners are making hay while the sun shines, but for how long will the sun shine? We can only speculate, even after living with the pandemic for more than a year, about how long its impacts will be felt. But if the societal changes that it may bring about will eventually result in continued lower levels of oil consumption, refinery margins will be challenged and the specter of continuing closures looms. Some of those closures will take base oil plants with them, but not all, and so the tug-of-war for access to VGO between base oil plants and their parent refineries is likely to continue. Under those conditions, recent market experience would suggest that "crisis pricing" of base oils could continue for longer than we might imagine.

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