Despite decline, Group I is here to stay

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Over the next few years, the lubricant industry is anticipating a number of changes requiring lubricant manufacturers, and in turn base oil suppliers, to make adjustments as emissions regulations tighten around the world. As a result, there is an increasing need for higher quality formulations that continue to deliver performance benefits while effectively addressing environmental standards.

Base oils, which make up between 75-99 percent of finished lubricant formulations, are engineered fluids that have a significant impact on lubricants' physical properties and performance. To meet increasingly stringent specifications, formulators have turned to lower viscosity Group II and III base oils for a wider range of applications. Given this shift, the industry is already seeing changes such as Group I production rationalisations, Group II and III capacity increases, and supply and demand imbalances[1].

These factors have some in the industry questioning the viability of Group I base oils for the longer term. Still, Group I base oils provide essential benefits for specific key industries and will continue to remain valuable well into the future.

The Changing Base Oil Landscape

The base oil industry has been in transition for several years. Most notably, the automotive industry's demand for better fuel efficiency, longer drain intervals, as well as reduced emissions has led to evolving engine oil requirements that call for the use of Group II and Group III base oils given their lower viscosities, better oxidative stability and lower volatility.

Additionally, the implementation of International Maritime Organisation 2020 emissions standard, one of the biggest events to impact the refined product market since the introduction of the hydrocracker, has given a large advantage for Group II and Group III producers. As a result of the low sulphur by-products of production, Group II and Group III base oils will find higher value in the IMO 2020 pricing environment versus the high sulphur content byproducts of Group I production[2].

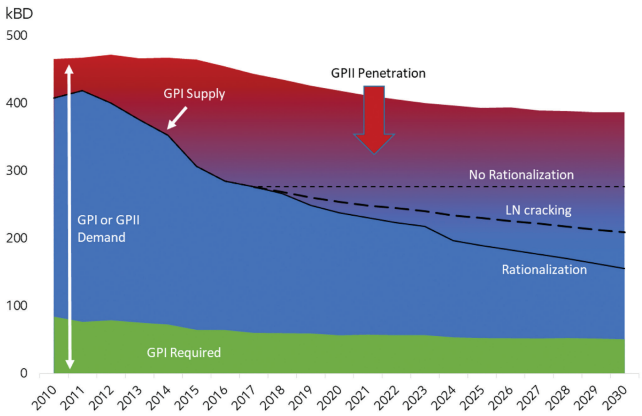

Figure 1: *Global GPI paraffinic base stock supply demand (Source: ExxonMobil assessment of publicly available information)*

This shift in conversion from Group I to Group II and Group III base oils in light of evolving automotive standards and the implementation of IMO 2020 have some questioning the viability of Group I base oils and whether or not its demand is declining over the long term – so much so that several Group I plants have already closed in response.

Over the last decade, the closure of less efficient Group I base oil plants has resulted in the overall decline in supply of Group I base oils leading to a sense of uncertainty about its future. ExxonMobil's Basestocks 2018 Industry Pulse Report confirmed these feelings of trepidation, as almost three-quarters (72 percent) of the respondents believe that Group I's decline has had a significant impact on the industry and many admit it has been difficult to adapt (50 percent).

1 ExxonMobil's Basestocks 2018 Industry Pulse Report
2 Based on ExxonMobil assessment of publicly available information

Global base stock demand (Paraffinic, Industry, in kbd)

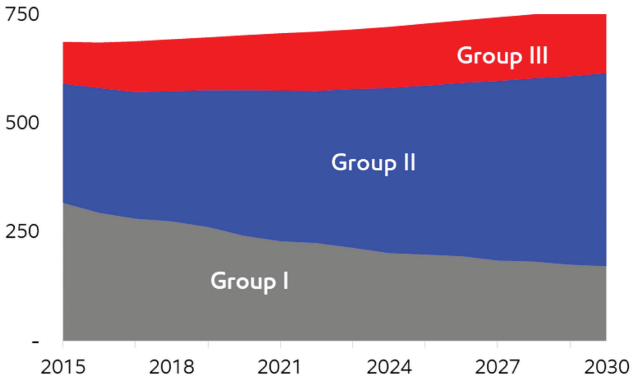

Figure 2: *Global paraffinic base stock demand (Source: ExxonMobil assessment of publicly available information)*

Additionally, concern of future Group I supply availability have led some customers to develop new formulations based on Group II base oils across several application areas, primarily automotive, but also for industrial and marine. While Group II base oils are expected to gain increasing traction in mainline applications through 2030, Group I base oils will remain relevant and valuable in the global market due to their higher solvency and wide viscosity range – particularly in emerging markets[3].

Group I Around the World

Demand for Group I base oils in emerging markets, including Africa, the Middle East, China, India and Southeast Asia is expected to remain strong due to increased industrialisation and continued use of monograde oils in the automotive sector. While Group I light neutral (LN) may be challenged due to eventual Group II penetration, it will be subject to price points and logistics in blending plants in each region.

In Africa specifically, Group I demand is expected to remain significant through 2023 due to macro drivers and constraints. Drivers responsible for continued Group I demand in African markets include:

- A sustained low motorisation rate (48 cars per 1000 inhabitants according to the report published by Mordor Intelligence market research from 2018)
- Heavy equipment growth because of continued investment into larger scale mining and construction initiatives (e.g. excavators, boring machines, crushers, bulldozers, loaders etc.)
- Increased electricity demand from industrial, consumer and domestic sectors
- Exponential growing need for mobility that can only be met with large influxes of used cars with older engines, therefore sustaining use of monogrades which are predominately Group I based

Conversely, the restraints responsible for continued Group I demand include an increase in indigenous automotive production, old car import bans, oil drain interval increases in engine and gear oils, adoption of electric vehicles and new car imports from China[4].

Figure 3: *Robust demand for Group I, particularly in emerging markets (Source: ExxonMobil assessment of publicly available information)*

3 Based on ExxonMobil assessment of publicly available information
4 ExxonMobil 2019 Outlook for Energy

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Group I technical demand in Asia-Pacific (AP) is also expected to remain robust through 2030, particularly driven by demand in emerging markets in China, India and South East Asia (e.g. Indonesia)[5].

Group I Properties and Producers

There are several technical reasons as to why Group I base oils are still highly valued in select industries and markets. Group I refining involves mainly physical separations through a combination of distillation and solvent extraction processes.

Group I base oils contain hydrocarbon chains which range from about C_{20}-C_{60}. They also contain some saturated ring compounds (napthenes) as well as aromatic compounds and molecules with heteroatoms.

Based on this chemical makeup, Group I base oils generally have advantages in solvency, and in attaining both low and high viscosities. However, Group II, III and IV base oils tend to better oxidative stability, as well as have better volatility and low temperature performance than Group I[6].

Group I remains advantageous in industrial, marine and chemical applications

Group I base oils have historically been the main stay for most lubricant applications, but the automotive drive to better fuel economy, higher temperature operations and longer life have changed that. However, the inherent properties of Group I base oils can make them advantaged in other applications such as industrial oils, marine lubricants and process oils[7].

Group I base oils' technical properties give it many advantages over Group II and III in certain applications, particularly in enabling lubricant marketers to produce optimised products in a cost-efficient way.

Applications and markets that value high viscosity and/or high solvency will continue to see value in using Group I base oils over other base oils, such as:

- **Greases:** Formed from a chemical reaction rather than through a blending process, greases are essential in industrial equipment. Base oils are used in greases as a medium to conduct the thickener formation reaction. The process by which the thickener is formed can dramatically impact the finished grease's performance. The base oil's solvency can significantly impact the thickener level, and thus influence various properties like a grease's water resistance, dropping point and tendency to harden. Since the thickener is the most expensive component of a grease, Group I base oils can be used to lower thickener content, and cost, and without sacrificing key grease structural properties.

- **Compressor, gear, bearing and metalworking fluids:** Fluids used in the industrial and marine industries require specific lubricant properties. While both Group I and Group II base oils can be used, Group I's higher sulphur content has an advantage in emulsibility.

  Additionally, Group I's high viscosity and solvency can provide lubricants with several advantageous qualities including sealing capability and materials compatibility. They also provide lubricants with an additive solvency that are targeted for surface protection.

- **Process oils:** Within the chemical industry, base oils are also largely used in process oils. Additive companies find diluent oils to be highly valuable in the manufacturing of additive components, in blending packages and controlling the viscosity level of modifiers. Group I base oil's high sulphur content can also help boost the extreme performance properties of gear oil packages.

Group I co-product – paraffin waxes – equally valuable

The overall decline in Group I production over the past 10 years has had a secondary impact on the availability of co-products derived from a Group I asset, namely paraffin wax.

While Group I decline has already impacted the market today, the change will be more pronounced in a few years. At the same time, global wax demand is growing at the rate of approximately 1.0% per year[8].

5 Based on ExxonMobil assessment of publicly available information
6 Based on ExxonMobil assessment of publicly available information
7 Based on ExxonMobil assessment of publicly available information
8 Assessment based on 2020 Kline report

Over the next decade, we estimate that there will be a sizable gap between supply and demand in the global wax market[9] - which will create an opening for alternative wax products.

Waxes are used to make various valuable, everyday products such as crayons, candles and hot melt adhesives. They are also used in materials such as packaging supplies, PVC piping, and other construction materials.

Although these products can be produced with alternative wax components such as animal, vegetable and synthetic, paraffin waxes have been widely available and used historically.

While the use of alternative wax sources has increased due to concerns of paraffin wax supply availability because of Group I rationalisation, paraffin wax will continue to supply the majority of the wax industry's needs.

Group I will continue to be beneficial

The global drive for greater fuel efficiency and extended service life is influencing finished lubricant markets, in particular automotive engine oils in North America and Northwest Europe, where Group II and III demand has increased relative to Group I.

The conversion from Group I to Group II and III base oil demand is adding significant pressure to the viability of some Group I assets, and has already resulted in the rationalisation of several less efficient Group I base oil plants, resulting in an overall decline in the supply of Group I base oils over the past 10 years.

This has also negatively impacted the availability of valuable co-products, such as paraffin wax, and additional rationalisation is expected in the future.

The concern of future Group I supply availability is causing customers to develop new formulations based on Group II across several application areas, primarily automotive.

However, even though Group II is becoming more prevalent globally, it is not always the best fit for applications.

Therefore, Group I will continue to be valued well into the future by applications that benefit from high viscosity and/or high solvency, particularly heavy neutral and bright stock used in marine, gear oils and greases.

Beyond technical and cost advantages, Group I production will continue to be critical in closing the supply-demand gap in the growing wax market, particularly for paraffin waxes, a co-product of Group I, which are expected to have high demand.

While some refiners have decided to rationalise due to decreasing Group I demand, ExxonMobil recognises its continued importance and remains committed to Group I long-term production.

ExxonMobil will maximise the value of all products from Group I assets to ensure long term competitiveness.

Group I base oils – and associated co-products – have unique qualities that are advantageous in various applications that value high viscosity and/or high solvency, particularly heavy neutral and bright oil used in marine, gear oils and greases.

A customer that requires the unique attributes offered by Group I base oils and its co-products should look for a supplier that will have the means to be successful in the long term – deep knowledge and expertise across the full value chain, access to advanced technology, as well as a strong global footprint and investment capability.

LINK
www.exxonmobil.com/basestocks

9 Based on ExxonMobil assessment of publicly available information