

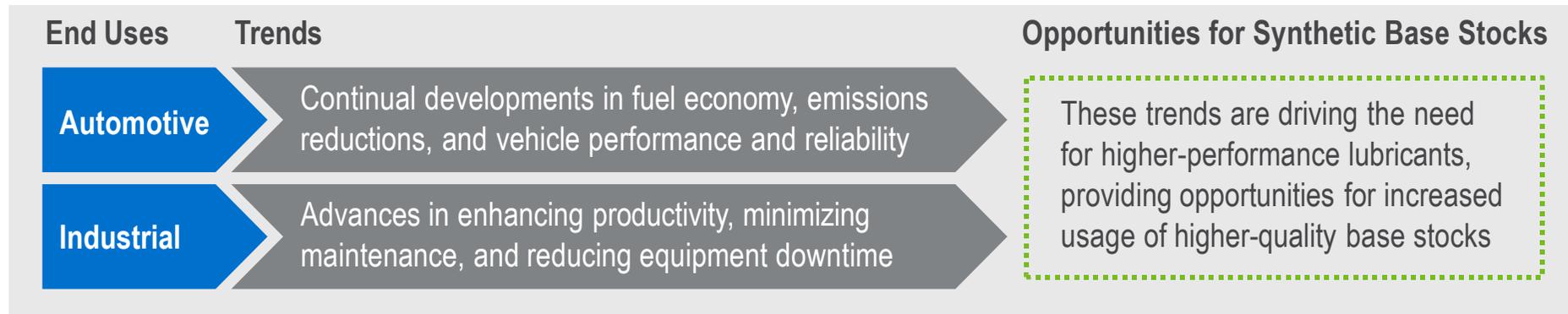


Special Report: Polyalphaolefins – Changing Market Landscape for Synthetic Lubricants

2021

Despite low growth in the overall lubricants industry, evolving trends are changing the market landscape for synthetic lubricants

Lubricant Industry Trends



- The conventional mineral oil market remains challenged by low growth in the lubricants industry, amid trends toward longer-lasting lubricants and efficiency improvements
- However, evolving trends in automotive and industrial end markets present opportunities for the growing use of synthetic base stocks
- These trends focus on key objectives in achieving greater energy efficiency and meeting tighter environmental standards, and drive the need for lubricants that can perform under more extreme operating conditions and extended service intervals
- Hence, formulators are continually challenged by the need to develop increasingly advanced lubricants while optimizing cost
- The use of synthetic base stocks extends formulators' capabilities to meet more demanding lubricant performance requirements

Automotive applications represent the major use of synthetic base stocks, and present key market opportunities and risks

Key Market Opportunities and Risks in the Automotive Sector

Opportunities and Demand Drivers

- Government regulations around the world progressively target fuel economy improvements and vehicle emissions reductions
- The automotive industry has responded with a host of developments, such as engine downsizing, turbocharging, gasoline direct injection, exhaust gas recirculation, and start- stop technology, which impact the performance requirements for lubricants
- In addition, the need to reduce hydrodynamic friction is driving a shift toward lower- viscosity oils. The use of SAE 0W grades is expected to increase in passenger cars
- Synthetic base stocks allow for the formulation of lower-viscosity oils while maintaining low volatility. Their properties also allow for performance over a wider temperature range and longer drain intervals while improving engine wear protection

Risks and Demand Constraints

- EV penetration is being supported by increased affordability, technology improvements, government policies, tax incentives, and greater environmental awareness
- Overall lubricant requirements for an EV are lower compared to a conventional ICE vehicle, although EVs also require certain additional high-performance lubricants
- This presents significant uncertainties for lubricant base stocks demand, also given the widely differing views of industry stakeholders on EV penetration over the long term

PAOs represent the major type of synthetic base stock, and barriers to entry in the PAO business are high

Overview of Lubricant Base Stocks

	Base Stock Category	Sulfur (%)		Saturates (%)	Viscosity Index	Application
Mineral Oils	Group I	>0.03	and/or	<90	80-119	Low-grade conventional lubricants
	Group II	≤0.03	and	≥90	80-119	Conventional lubricants
	Group III	≤0.03	and	≥90	≥120	Conventional or “synthetic” lubricants
Synthetic Base Stocks	Group IV	Polyalphaolefins (PAOs)				Synthetic lubricants
	Group V	All others not included in Groups I, II, III or IV				Synthetic lubricants

- Synthetic base stocks include Group IV base stocks (PAOs) and Group V base stocks, such as esters, polyalkylene glycols (PAGs), polybutenes, and alkylated naphthalenes
- The synthetic base stock market is dominated by PAOs and, to a lesser extent, esters and PAGs. Lubricant formulators with integrated base stocks generally manufacture mineral oils
- PAOs are produced using C₁₀, C₁₂, C₈, and/or C₁₄ linear alpha olefins (LAOs). In general, C₁₀ is the preferred feedstock, but historically the availability of C10 has also been limited
- New PAO investments are largely being undertaken by LAO producers. An investment wave in full range LAOs is currently underway

NexantECA's study will provide a detailed assessment of key end-use sector trends and the global market outlook for PAOs

- **Review end-use sector trends and the implications for PAO demand, including key government regulations for the automotive industry, developments in motor oil grades, and penetration of EVs**
- **Provide global PAO supply, demand, and net trade analysis in 2010-2040 by region (North America, South America, Europe, Asia, and Middle East and Africa)**
- **Evaluate key demand uncertainties by providing PAO demand sensitivities on multiple possible scenarios for vehicle ownership and EV penetration**
- **Develop price forecasts for low- and high-viscosity PAOs in key regional markets for multiple crude oil price scenarios, considering PAO re-investment economics**
- **Assess profit margins and the plant profitability outlook for PAO production in relevant regions**
- **Analyze production costs for archetype plants in different regions under multiple crude oil price scenarios, and evaluate the delivered cost competitiveness to major regional markets**

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The report will highlight key opportunities/drivers and risks/constraints in the PAO sector and how they influence the market analysis

Scope Clarifications

Report Section		Proposed Scope
Section 2: Introduction	Lubricants Industry Trends	<ul style="list-style-type: none"> Overview of lubricants industry, conventional base stocks, and synthetic base stocks Review of evolving trends that are changing the market landscape for synthetic lubricants
	Outlook for Synthetic Base Stocks	<ul style="list-style-type: none"> Overview of PAOs, esters, and PAGs, including properties, uses, and substitution trends Outlook for global synthetic base stocks demand and market growth, with breakdown for the main types of synthetic base stocks
Section 3: End-Use Sector Trends	Automotive Sector	<ul style="list-style-type: none"> Assessment of developments in fuel economy, emissions reductions, and vehicle performance and reliability that impact the outlook for PAO demand Analysis of key government regulations for the automotive industry, developments in motor oil grades, trends in vehicle ownership, and penetration of EVs
	Industrial Sector	<ul style="list-style-type: none"> Review of key sector trends relevant to PAO demand, including advances in enhancing productivity, minimizing maintenance, and reducing equipment downtime
	Emerging Applications	<ul style="list-style-type: none"> Review of smaller, emerging applications (including wind turbines, military uses, and other applications that NexantECA identifies during its research) and related sector trends that support the need for higher-performance lubricants and higher-quality base stocks

The market analysis will also include global PAO demand scenarios to assess the impact of trends in vehicle ownership and EV penetration

Scope Clarifications (Continued)

Report Section		Proposed Scope
Section 4: PAO Market Analysis	Global Demand by Application and Region	<ul style="list-style-type: none"> ■ Global PAO demand analysis in 2010-2040 by region (North America, South America, Europe, Asia, and Middle East and Africa) ■ Regional demand breakdown by major application and by PAO type (low viscosity and high viscosity)
	Global Supply and Net Trade by Region	<ul style="list-style-type: none"> ■ Global PAO supply and net trade analysis in 2010-2040 by region (North America, South America, Europe, Asia, and Middle East and Africa) ■ Firm and speculative capacities, production, operating rates, and net exports for each region ■ Capacity breakdown by PAO type (low viscosity and high viscosity)
	Global Demand Scenarios	<ul style="list-style-type: none"> ■ Assessment on the impact of vehicle ownership on the PAO demand outlook <ul style="list-style-type: none"> • Global PAO demand outlook for three potential scenarios for vehicle ownership ■ Evaluation on the impact of EV penetration on the PAO demand outlook <ul style="list-style-type: none"> • Global PAO demand outlook for three potential scenarios for EV penetration

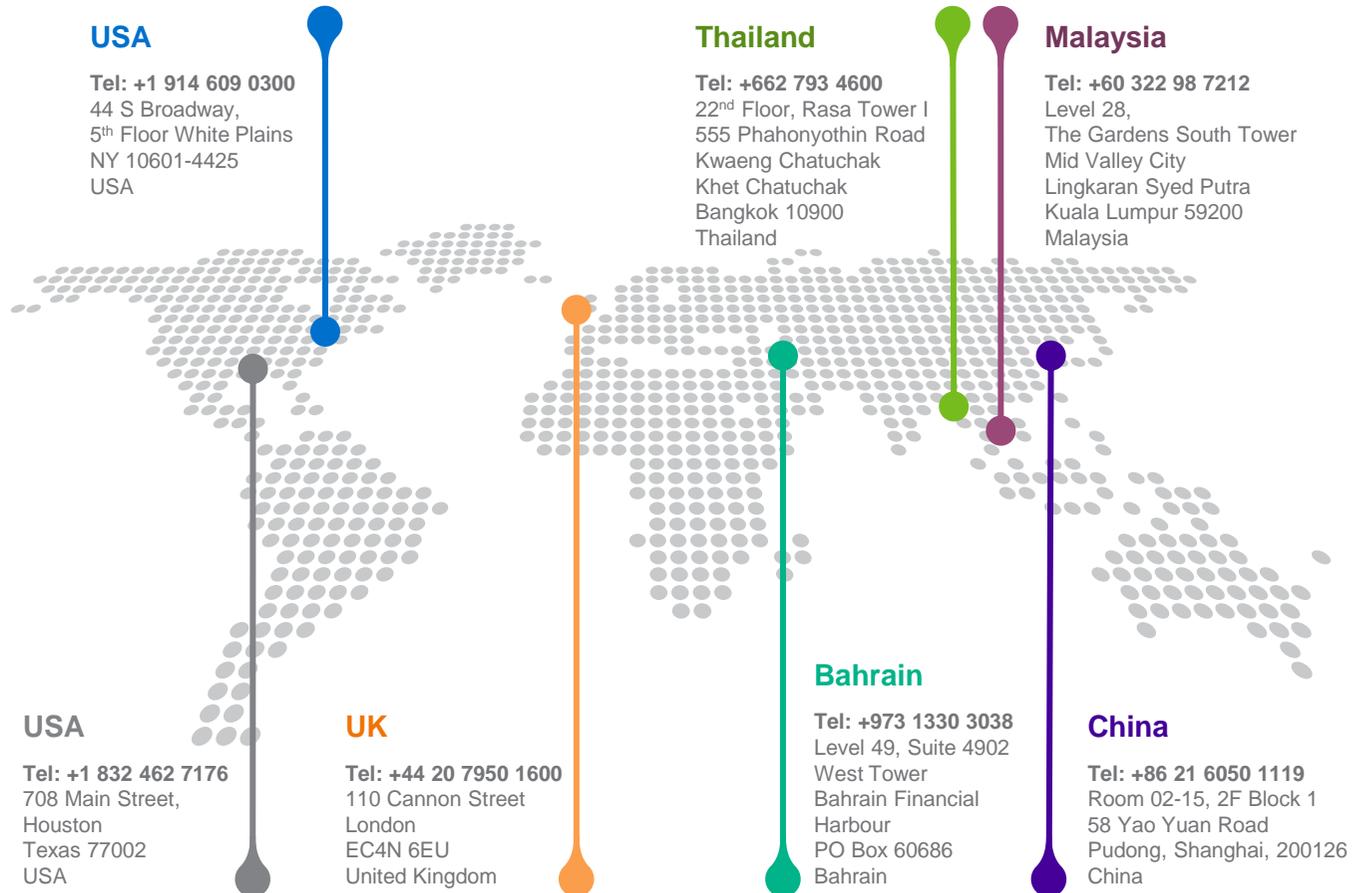
The pricing, profitability, and cost competitiveness analyses will cover NexantECA’s low, medium, and high crude oil price scenarios

Scope Clarifications (Continued)

Report Section		Proposed Scope
Section 5: Pricing and Profitability Analysis	Price Histories and Forecasts	<ul style="list-style-type: none"> ■ Pricing for low- and high-viscosity PAOs in US, Western Europe, and Northeast Asia for 2010-2040 ■ Price forecasts for three crude oil price scenarios
	Margins and Profitability	<ul style="list-style-type: none"> ■ Profit margins and plant profitability for production of major PAO type (low-viscosity PAO based on decene-1) in US, Western Europe, and China ■ Profitability analysis for integrated LAO and PAO production
Section 6: PAO Cost Competitiveness Analysis	Cash Costs	<ul style="list-style-type: none"> ■ Analysis of cash costs for major PAO type (low-viscosity PAO based on decene-1) in US, Western Europe, China, and Middle East for three crude oil price scenarios ■ Cash cost analysis for integrated LAO and PAO production
	Delivered Costs	<ul style="list-style-type: none"> ■ Analysis of delivered costs of plants in US, Western Europe, China, and Middle East serving major regional markets (North America, Western Europe, and Asia) under three crude oil price scenarios ■ Delivered cost analysis for integrated LAO and PAO production



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