



OUTLOOK FOR WIND TURBINE LUBRICANTS DEMAND

In the Current Economic Environment

Webinar

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Today's Speaker



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Lubricants for Wind Turbines: Global Market Analysis and Opportunities

Wind energy has emerged as one of the major alternate energy sources to address global warming and resource conservation concerns. With government support, wind energy installations have grown exponentially in the last decade, creating a strong demand for lubricants used in wind turbines. Although a small fraction of the global lubricant market, wind turbine lubricants is an important market segment due to its severe performance requirements, rapid growth, and high penetration of synthetic lubricants.

This report provides an overview of Kline syndicated study **Lubricants for Wind Turbines: Global Market Analysis and Opportunities**.

- » Introduction
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Introduction

- This report summarizes the findings of Kline & Company's study of lubricants used in the global wind energy industry. It provides an independent assessment of the market in terms of its size, growth, challenges, and opportunities. The wind energy industry continues to exhibit exponential growth, which drives the growth of lubricants. However, despite overall volume growth, this market faces numerous challenges.
- This study is global in coverage. Wind turbines are found in all parts of the world, both onshore and offshore. Lubricant consumption patterns for offshore turbines are significantly different from onshore turbines. Among onshore installations, the top five country markets have been examined in detail. These top five markets represent close to three-fourths of the global wind energy installed base and will remain the growth engine for this market for the next five years. Insights from these five markets – China, the United States, Germany, Spain, and India- and the global off-shore market forms the basis of the global estimates made in this study.
- The study provides lubricant demand estimates for 2019 (the base year) and year-wise projections until 2024. Demand estimates were built up based on lubricant consumption norms for turbines of various power ratings (developed based on original equipment manufacturer [OEM] interviews) and estimates for oil change intervals developed during the survey. Lubricant demand projection is based primarily on three parameters: growth in the installed wind energy capacity, changes in drain interval, and penetration of direct drive machines. All three parameters were considered while developing demand estimates for the next five years. Alternate outlook scenarios have been developed using different assumptions for these parameters.
- Lubricant demand in wind energy includes two components: initial fill (made during the manufacturing of wind turbine) and service fill (made during the maintenance of an operational turbine). It is assumed that the year of turbine build is the year of initial fill. In fact, there can be a lag between the two in rapidly growing markets, like China, where due to grid connectivity and other issues, turbines may remain in inventory for a long time before installation. The distortion in demand due to this aspect of the market has been ignored.
- Field and telephonic interviews were conducted in all the major markets (China, the United States, Germany, Spain, and India) for studying the onshore segment, and in markets like the United Kingdom and Denmark, for studying offshore segment. Primary interviews were conducted among the following industry groups: manufacturer of components - gear box and bearings; wind turbine manufacturers; wind farm operators; independent service providers; wind energy industry associations; and lubricant suppliers to the wind energy sector. Public domain information was used, including company websites and industry publications; supplier product literature; recent trade and technical literature. The source of secondary information, wherever used, has been specified.

Lubricants for Wind Turbines: Global Market Analysis and Opportunities

Base Year: 2019 A comprehensive analysis examining lubricants for the wind energy market and providing details on important market segments in each country. The report focuses on key trends, developments, changes, challenges, and business opportunities.

Published: May 2020

3rd edition

Regional Coverage:

- China
- India
- Spain
- United States
- Germany
- Global Off-Shore

SCOPE

- › Lubricant demand in wind turbines for 2019 and an outlook to 2024
- › Analysis of key markets including China, Germany, India, Spain, the United States, and global off-shore
- › Demand by key products including gear oils, hydraulic fluids, and grease
- › Penetration of synthetic and bio-based lubricants
- › Penetration of different wind energy technologies and impact on lubricant demand
- › Key lubricant suppliers

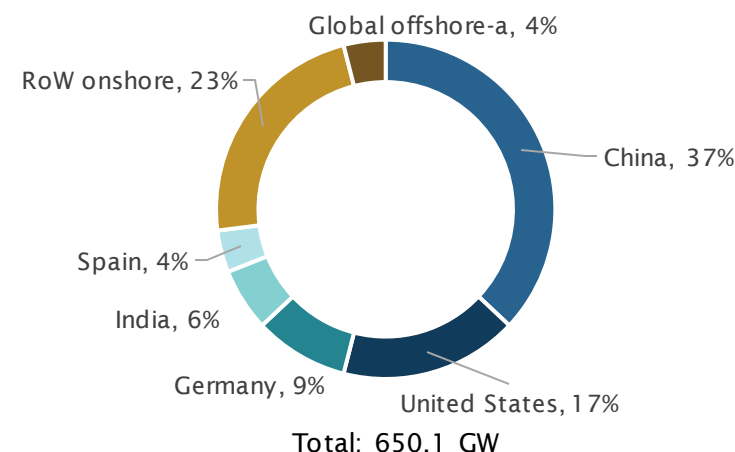
Wind Power Industry Overview

- The year 2015 marked a peak in terms of new installations reaching 63.8 GW. In 2019, new installations reached 60.4 GW, which was the second-highest year. This came as both China and the United States showed a strong performance. China installed as many machines as possible ahead of the expiry of the feed-in tariffs for onshore farms in 2021. Similarly, in the United States, the Production Tax Credit (PTC) has been phased down since 2016 and is set to expire at the end of 2020.

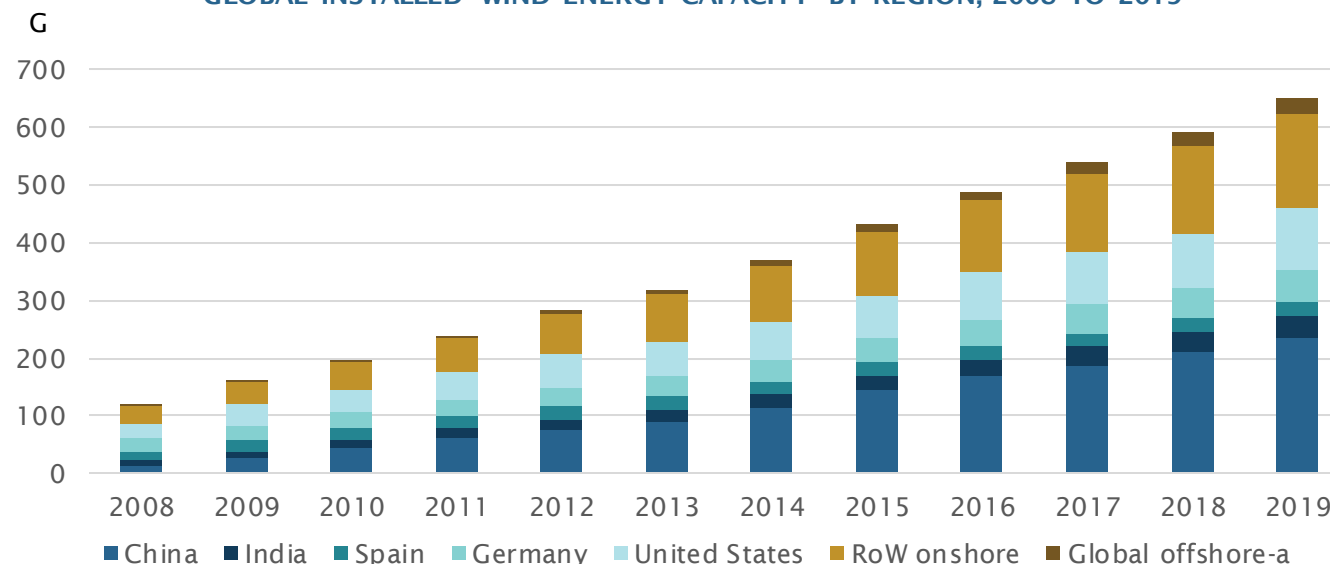
REGIONAL INSTALLATION

- Wind energy installations are largely concentrated in a few key markets. The top five markets—China, the United States, Germany, India, and Spain—together accounted for three-fourths of the global wind energy installations. China increased its share from 33% of the global capacity in 2015 to 37% in 2019.
- In 2019, onshore capacity represented close to 95% of the global installed wind energy capacity. Offshore capacity, though small, is growing at a higher pace. Most of the global offshore capacity is installed in Europe (primarily the United Kingdom, Germany, and Denmark). In 2019, China accounted for the highest offshore wind capacity outside Europe, with 6.7 GW, followed by Japan and South Korea.

TOTAL WIND ENERGY INSTALLED CAPACITY
BY MAJOR MARKETS, 2019



GLOBAL INSTALLED WIND ENERGY CAPACITY BY REGION, 2008 TO 2019



a- Includes off-shore installations for all countries.

Source: GWEC

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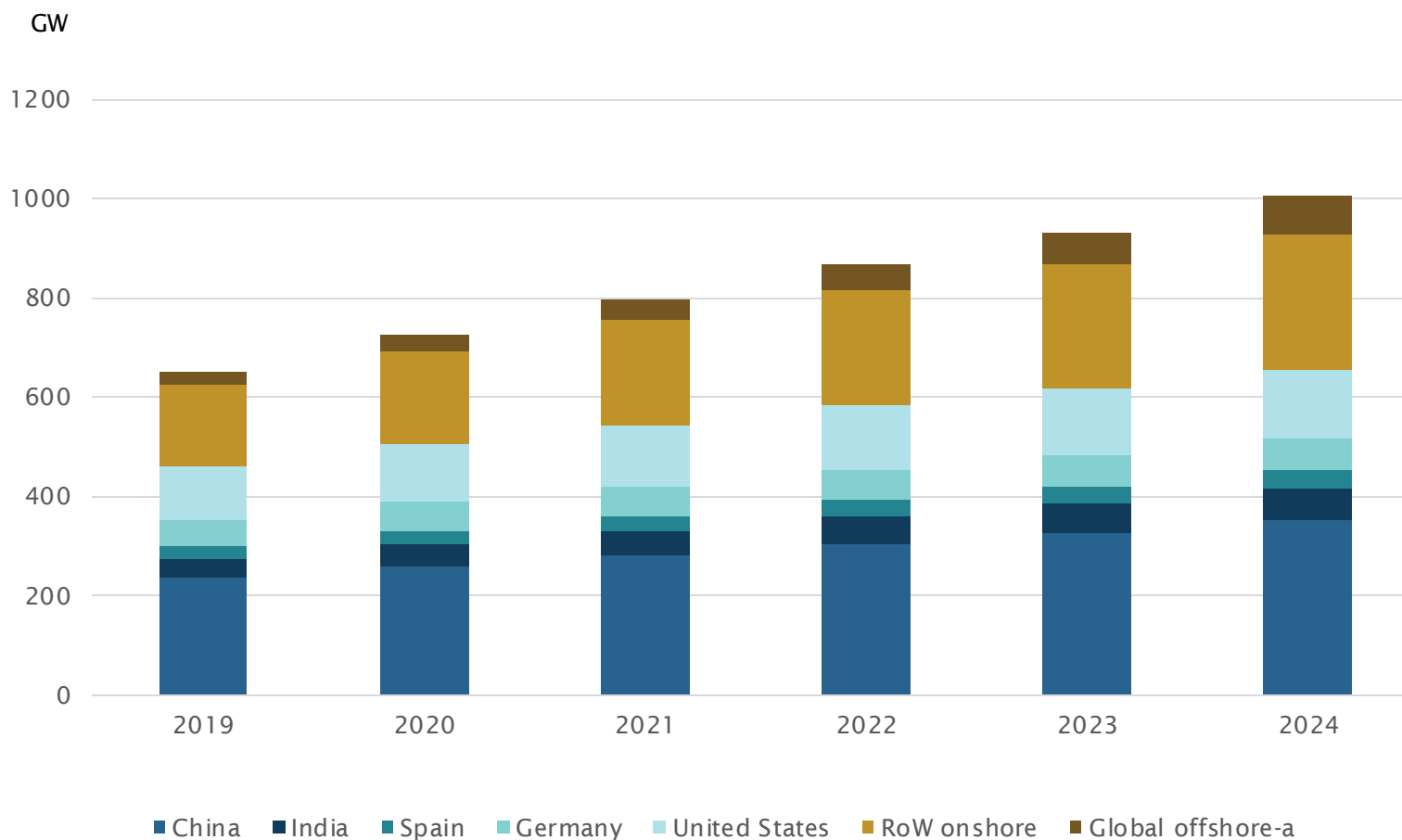
Wind Power Industry Overview

OUTLOOK

Wind power generation

- Total installed wind energy capacity is estimated to grow at a CAGR of 9.1% over the forecast period to reach 1,005.0 GW by 2024. The analysis is based on the new installations published in the GWEC outlook for spring 2020. New installations should grow at a CAGR of 4.1%, from 60.4 GW in 2019 to 73.4 GW in 2024. This is the most optimistic case which is discounting the COVID-19 impact on the global economy. A more pessimistic case would suppose a 2% CAGR for new installations and 5% CAGR for total installed capacity over the forecast period.
- Economic uncertainty coupled with phased out subsidies will contribute to further consolidation among wind turbine OEMs and wind farm operators. Further pressure could come from the COVID-19 pandemic which has stalled manufacturing in China since the beginning of 2020 and spread globally afterwards. The level of economic impact is unclear, as the situation is still unfolding well into the second quarter of 2020.

GLOBAL WIND ENERGY INSTALLED CAPACITY OUTLOOK BY MAJOR MARKETS, 2019 TO 2024



a- Includes off-shore installations for all countries.

Source: GWEC and Kline analysis

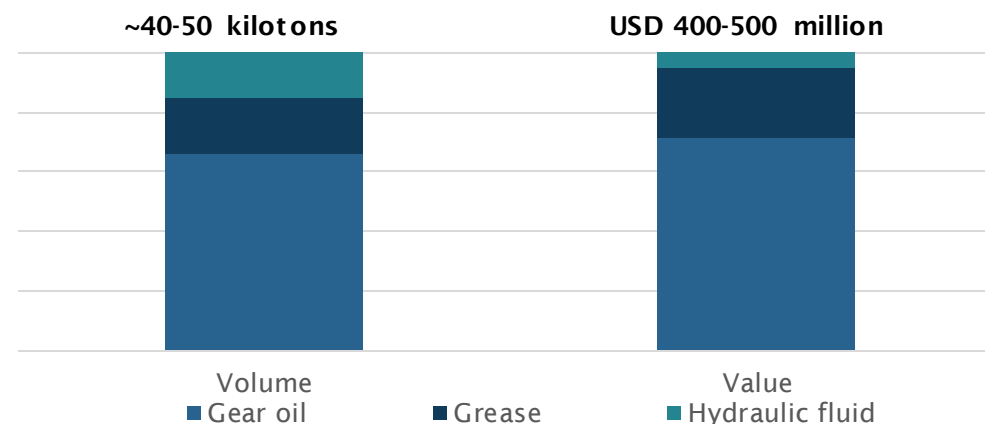
► Lubricant Products In Wind Energy

OVERALL MARKET

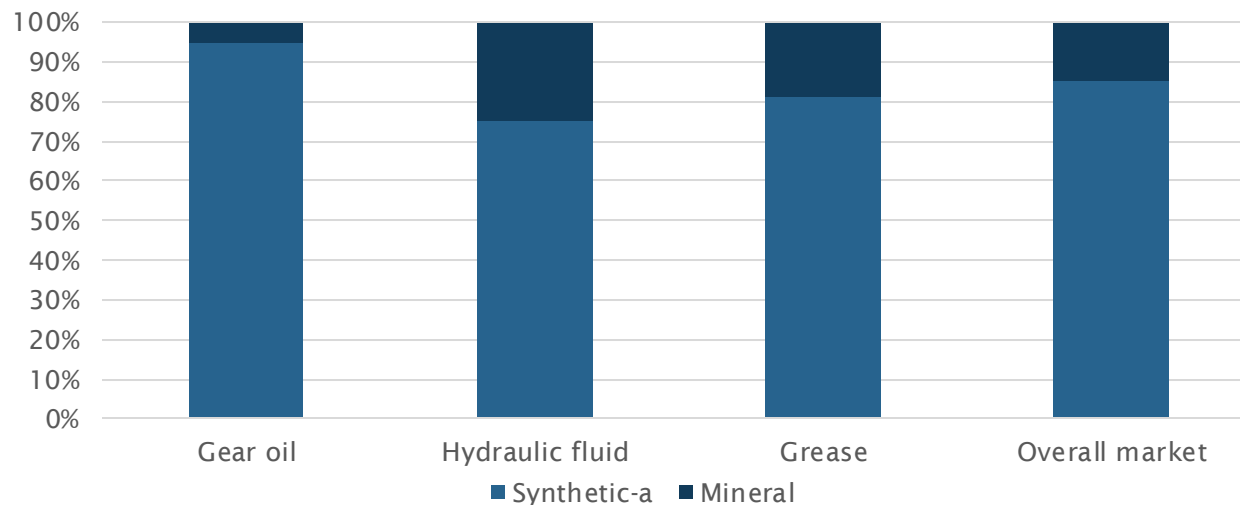
Demand by product type

- Gear oils used in offshore installations are almost entirely synthetic products. Synthetics are required due to the long drain interval, five years on average in 2019. The lubricant service intervals for wind turbines using synthetic gear oils are as low as 3 years or as high as 10 years, depending on the condition of the gear box and wind profile of the geography where the wind turbine is located. Very high drain intervals are possible mainly because of condition monitoring.
- Hydraulic fluids have the lowest penetration of synthetics among all products. Use of synthetics is primarily a means to ensure long life, rather than meeting severe operating conditions. The use of synthetics has picked up in emerging markets. About 80% of hydraulic oils used in China and Germany are synthetics, formulated with Group III or PAO. Drain intervals for hydraulic fluids used in wind turbines is between four and five years.
- Use of semisynthetic and biodegradable lubricants is small, limited to offshore wind farms. Given the risk-averse nature of the wind turbine industry, the usage of biodegradable oils has not increased. Furthermore, gear box leakage is not a significant issue, and even if it were to happen, the leakage would be contained in the nacelle. Hydraulic oil is the only application where biodegradable oils are used.

GLOBAL DEMAND FOR LUBRICANTS IN WIND ENERGY BY PRODUCT, 2019



SHARE OF SYNTHETIC PRODUCTS^A IN GLOBAL LUBRICANT DEMAND IN WIND ENERGY BY PRODUCT, 2019



a- Includes minor quantities of biodegradable and semi-synthetic products.

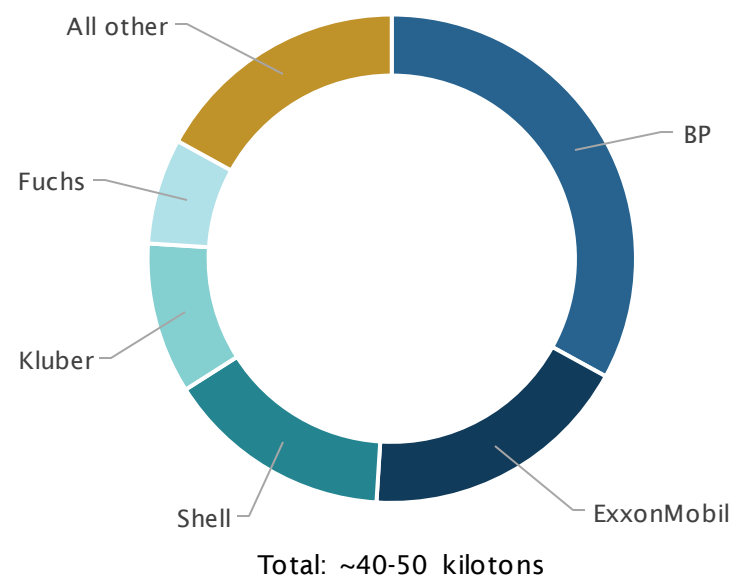
► Lubricant Products In Wind Energy

OVERALL MARKET

Key Suppliers

- The supply base for lubricants used in wind turbines is largely consolidated in the hands of a few key companies. Suppliers like global majors ExxonMobil, BP (Castrol), and Shell are present in almost all markets. Other suppliers to this market include Fuchs, Chevron, Total, Amsoil, and specialist grease suppliers, like Kluber, Dow, SKF, and FAG.
- The leading suppliers, and in particular the global majors, have a strong relationship with wind turbine OEMs, which enables them to cater to their initial fill and warranty business.
- New suppliers face several entry barriers, including a rigorous approval process, a good track record as a supplier, and a performance history of new product development. Besides, the industry is risk-averse, and this results in an extension of warranties and the use of the same products outside the warranty period. Certain OEMs, such as Suzlon, do not have any agreement in place with a lubricant supplier and will purchase lubricants for initial fill and service fill from the open market.

GLOBAL LUBRICANT MARKET IN WIND ENERGY BY KEY SUPPLIERS, 2019



► Lubricant Products In Wind Energy: Gear Oils

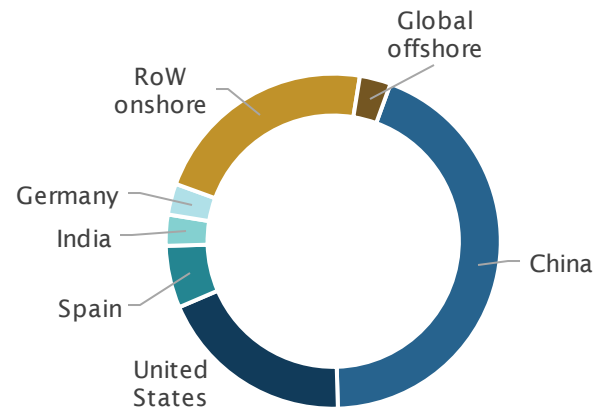
Consumption norm

- Wind turbine gear box manufacturing is largely consolidated with large suppliers, like Winergy, Hansen, and Bosch Rexroth, serving the majority of the market. This has resulted in a few standardized designs. Gear oil consumption increases as the capacity of the wind turbine increases. It has been observed that the consumption of gear oil is around 200 liter to 300 liter of gear oil per MW capacity. But this trend is slowing down in new machines with better condition monitoring. Top-ups play an important part in prolonging the lifespan for oil and machinery. Comprehensive maintenance checks are typically carried out one to two times per year, where the oil is topped-up by 20 to 75 liters per year, depending on the presence of faults that cause lubricant leakages. Lubricant leakage is a common occurrence.

Gear oil demand

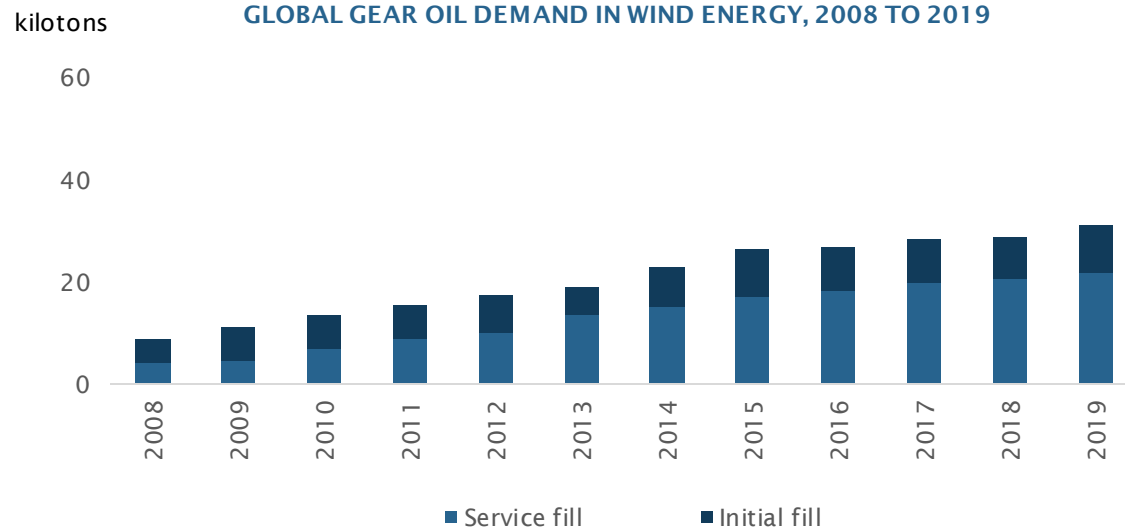
- The overall demand for gear oil was at a CAGR of 12.3% from 2008 to 2019. The year 2015 marked a peak in terms of new installations, reaching 63.8 GW. In 2019, new installations reached 60.4 GW and was the second highest year. Both years mark a significant initial fill volume.
- The growth rate for gear oil has lagged the overall wind capacity growth rate during the same period. This is mainly due to extended drain intervals resulting from the use of synthetic gear oils, as well as loss of demand to direct drive wind turbines. Turbines based on direct drive technology do not use a central gear box, and hence, the demand for gear oil in the main gear box is eliminated. Gear oil demand for the service fill-market has increased as a share of the total from 2015 to 2019. This underlines the significance of the service-fill market

GLOBAL GEAR OIL DEMAND IN WIND ENERGY BY KEY MARKETS, 2019



Total: ~20-40 kilotons

GLOBAL GEAR OIL DEMAND IN WIND ENERGY, 2008 TO 2019



► Lubricant Products In Wind Energy: Hydraulic fluids

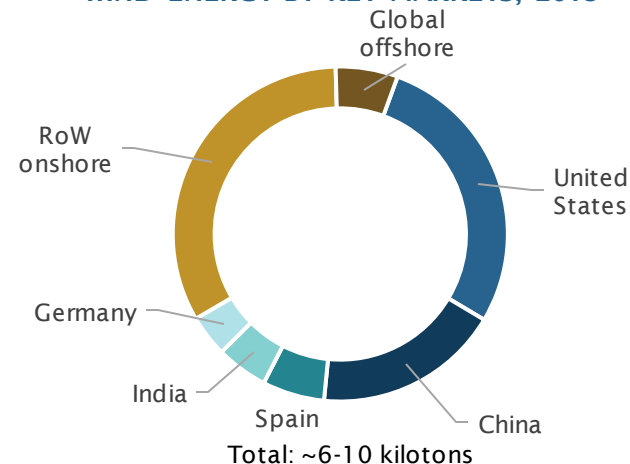
Oil drain interval

- The usual practice is to carry out hydraulic fluid change at the time of gear oil change. There is a tendency to extend the drain interval for hydraulic fluids. Drain intervals for synthetic hydraulic fluids used in wind turbines are similar to gear oils.

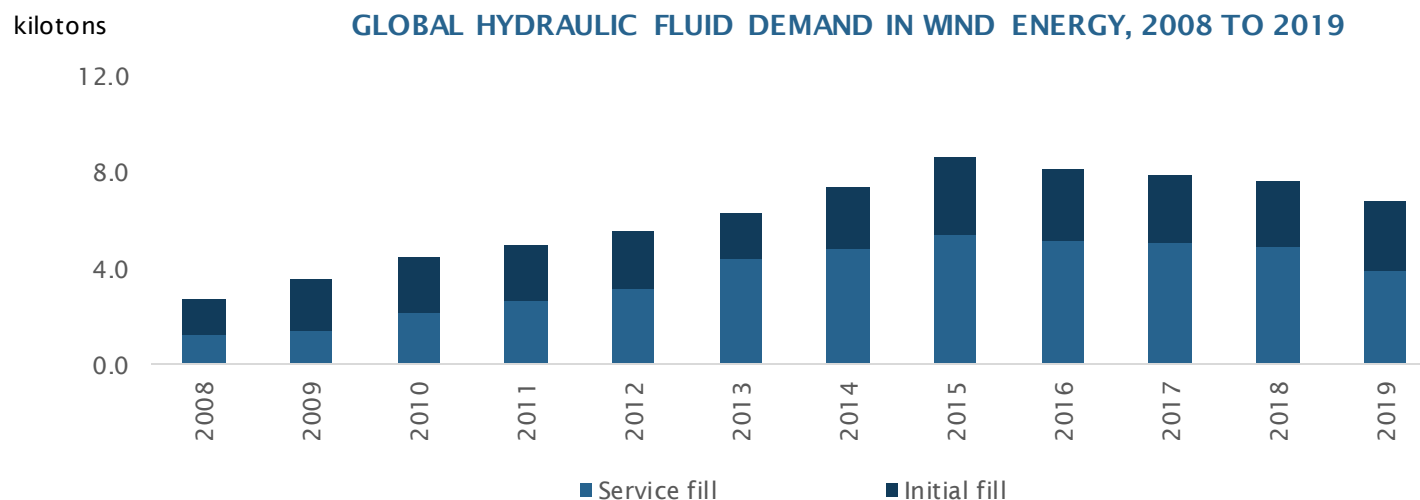
Consumption norm

- The quantity of hydraulic fluid used in wind turbines may vary from design to design. As per the rule of thumb, the quantity of hydraulic fluids used in wind turbines is approximately half of the quantity of gear oil used.
- The growth rate for hydraulic oil has lagged the overall wind capacity growth rate during the same period. In fact, the demand for hydraulic oil has fallen with a 5.7% CAGR since its peak in 2015. This is mainly due to the fact that the quality of hydraulic oil improved significantly and the increased penetration of synthetic oils. The share of the service-fill market has decreased from 2015 to 2019, underlying the growing importance of new installations with increased drain intervals.

GLOBAL HYDRAULIC FLUID DEMAND IN WIND ENERGY BY KEY MARKETS, 2019



GLOBAL HYDRAULIC FLUID DEMAND IN WIND ENERGY, 2008 TO 2019



► Lubricant Products In Wind Energy: Grease

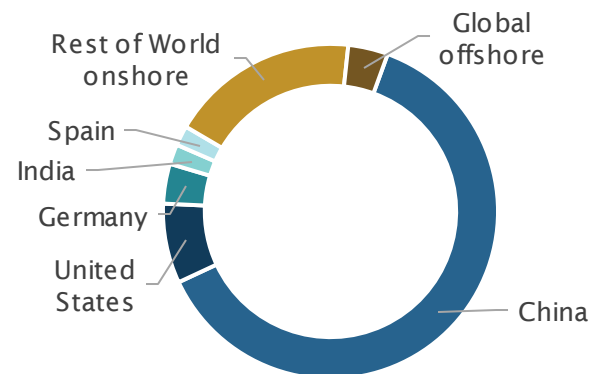
Properties and specifications (contd.)

- Unlike gear oil, grease has to be replenished continuously. Most of the wind turbines come with a central greasing system to which a certain quantity of grease is filled every year. Grease from this system is automatically applied to the relevant parts of the wind turbine. Generator bearings have auto-lubrication (auto-lubers) systems because more frequent lubrication is required due to their higher speed. Auto-lubers tend to use more grease than manual greasing. For turbines having auto-lubers, top-up of greases is done in minor volumes whenever necessary (usually every six months) and an equal amount is flushed out.

Consumption norm

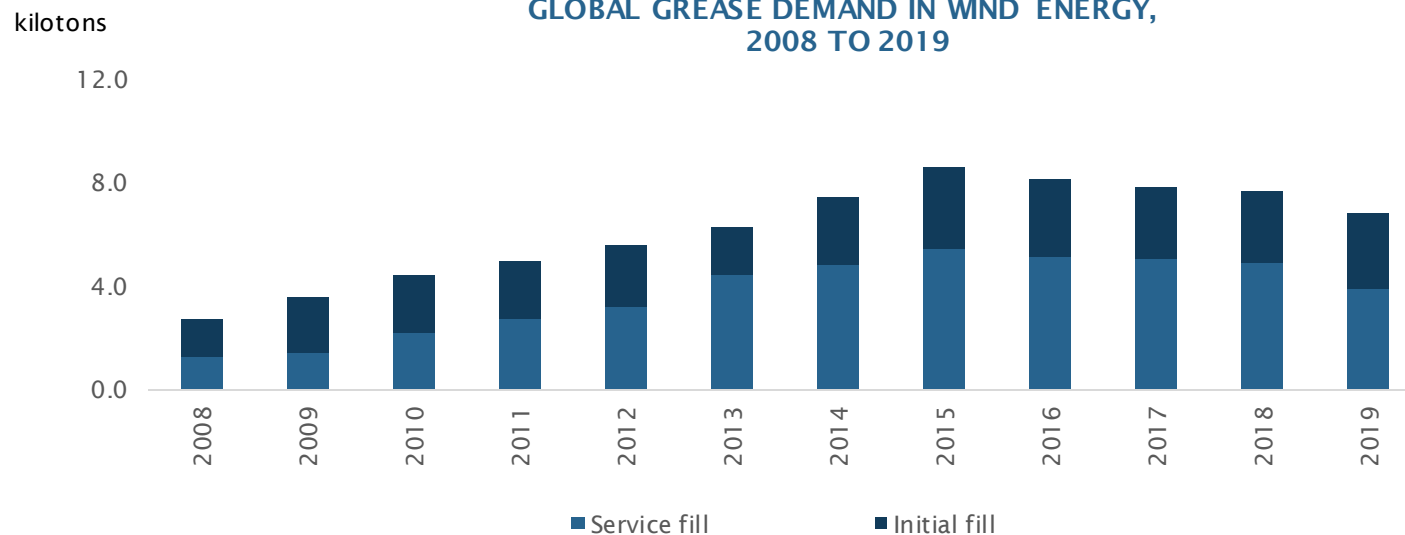
- The requirement for grease increases with machine size as the quantity of grease used is correlated to the diameter of the bearings.
- The major portion of demand for grease comes from rotor shaft bearing and blade bearings. Additionally, some minor demand comes from generator bearings and yaw bearings.
- The share of the initial fill market has increased from 2015 to 2019, underlining the growing importance of the installed base.

GLOBAL GREASE DEMAND IN WIND ENERGY BY KEY MARKETS, 2019



Total: ~6-10 kilotons

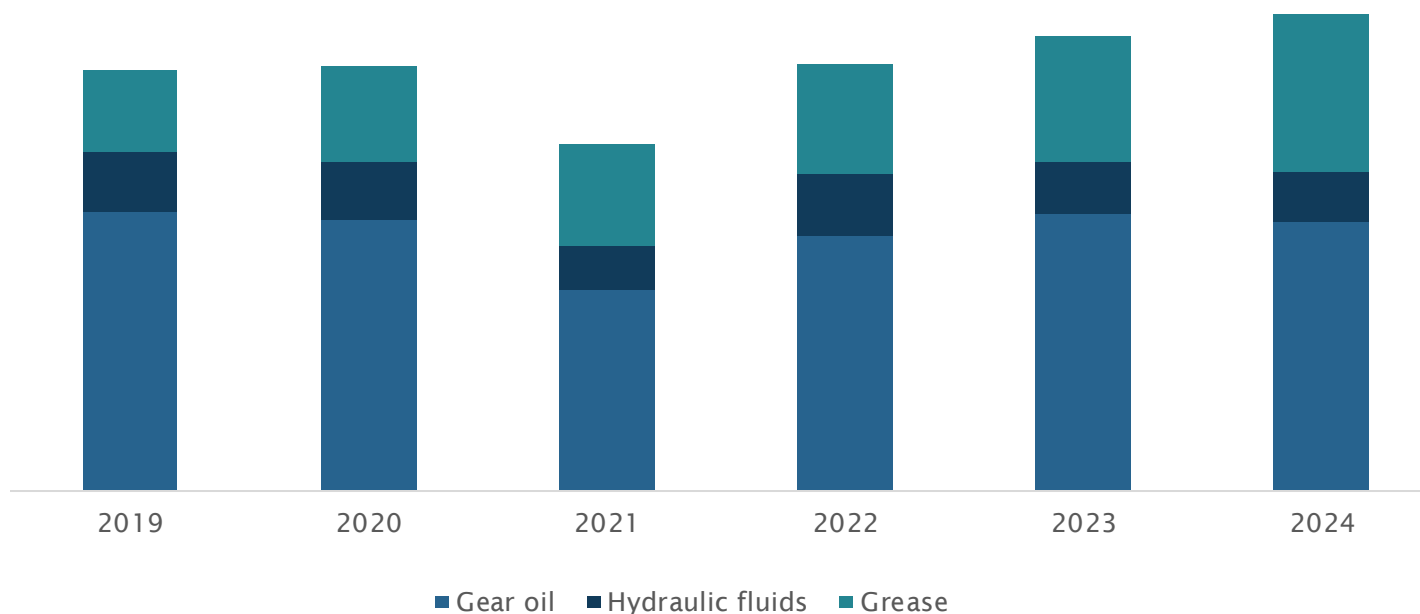
GLOBAL GREASE DEMAND IN WIND ENERGY, 2008 TO 2019



➤ Lubricant Products In Wind Energy: Demand Outlook

- Total installed wind energy capacity is estimated to grow at a CAGR of 9.1% over the forecast period to reach 1,005.0 GW by 2024 from 650.1 GW in 2019. The analysis is based on the new installations published in the **GWEC Outlook Spring 2020**. New installations should grow at a CAGR of 4.1%, from 60.4 GW in 2019 to 73.4 GW in 2024.
- Demand for gear oil is set to become increasingly correlated with new installations, since drain intervals are increasing. Additionally, there is increasing penetration of direct-drive wind turbines in emerging markets.
- Grease is the bright spot in volume terms. Grease is expected to grow at a fast pace until 2024 fueled by new installations and higher consumption. Direct-drive machines use grease but do not use gear oil.
- Hydraulic fluids will continue to decline as synthetic formulations will continue to replace mineral formulations in order to match the extended drain intervals of gear oils. Hydraulic oils will see a negative CAGR in volume terms. In value terms, both hydraulic oils and gear oils are set to increase.

GLOBAL LUBRICANT DEMAND OUTLOOK IN WIND ENERGY BY PRODUCT, 2019 TO 2024



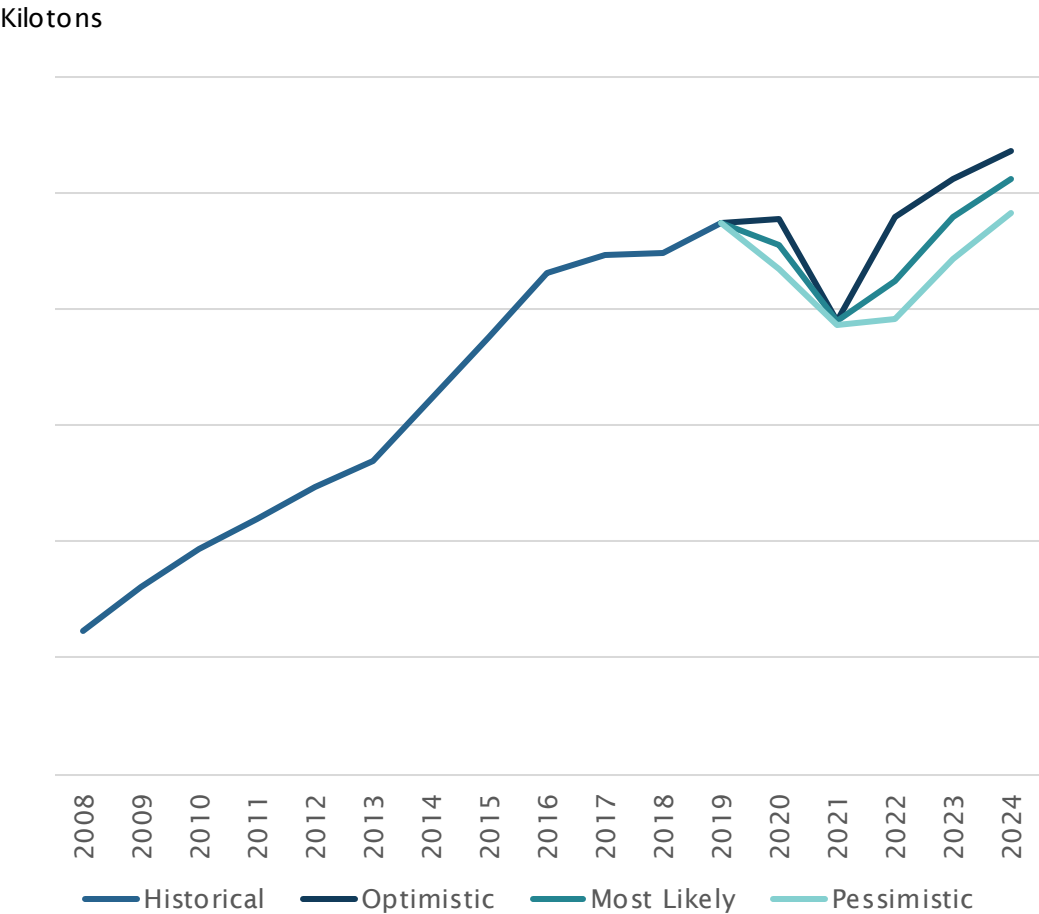


Market Evaluation

The wind energy industry has experienced exponential growth over the last 20 years. The strong growth has not gone unnoticed, and new entrants are emerging especially in the service fill market. Despite the growth, there are several concerns about the industry in the minds of lubricant marketers:

- Industry growth in the current economic climate.
- The effect of direct drive machines and drain interval extension on lubricants consumption.
- Fading subsidies and the transition to a new model.

OUTLOOK FOR GLOBAL LUBRICANT DEMAND IN WIND ENERGY, 2019 TO 2024



Market Evaluation: Summary

- Wind turbines do not use any natural resource and provide carbon free energy. With increased awareness and acceptance of global warming, governments around the world are promoting wind energy in their energy mix.
- **In Asia**, more urgent than global warming is the need to address deteriorating air quality due to pollution from coal fired thermal power plants. Both China and India have seen rapid growth in wind energy in last 15 years. Over the next five years, China will account for nearly 40% of all new wind turbine capacity.
- **Some countries, such as Germany**, plan to phase out nuclear power following the accident in Japan. Wind energy will have a big role to play as the replacement energy source.
- **The year 2015 marked a peak** in terms of new installations reaching 63.8 GW. **In 2019, new installations reached 60.4 GW, which was the second-highest year.** This came as both China and the United States showed a strong performance.



- The wind energy business is a high margin business for lubricant marketers. The share of synthetics in the overall demand exceeds any other end-use industry. The cost of lubricants is not significant in the overall maintenance cost and sales are driven more by product performance guarantees and track record. Thus, there is minimal downward pressure on product prices.
- The COVID-19 epidemic is expected to stall much of the activity and perhaps postpone some of the scheduled projects. In terms of a potential economic stimulus, the wind energy sector might not be on most governments agenda since the sector employs rather few people.

» Thank you for your time. We hope you found this presentation useful and informative.



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