

Climate policies are reshaping the Base Oil landscape

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Europe's Green Deal may be the most ambitious climate policy in the world. It sets targets for carbon emissions and enhanced forests, farming, green transport, recycling and renewable energy. Significantly, it is backed by a proposed climate law that converts policy rhetoric into a legal obligation.

According to the 2019 Eurobarometer survey published by the European Commission, 93% of Europeans see climate change as a serious problem.

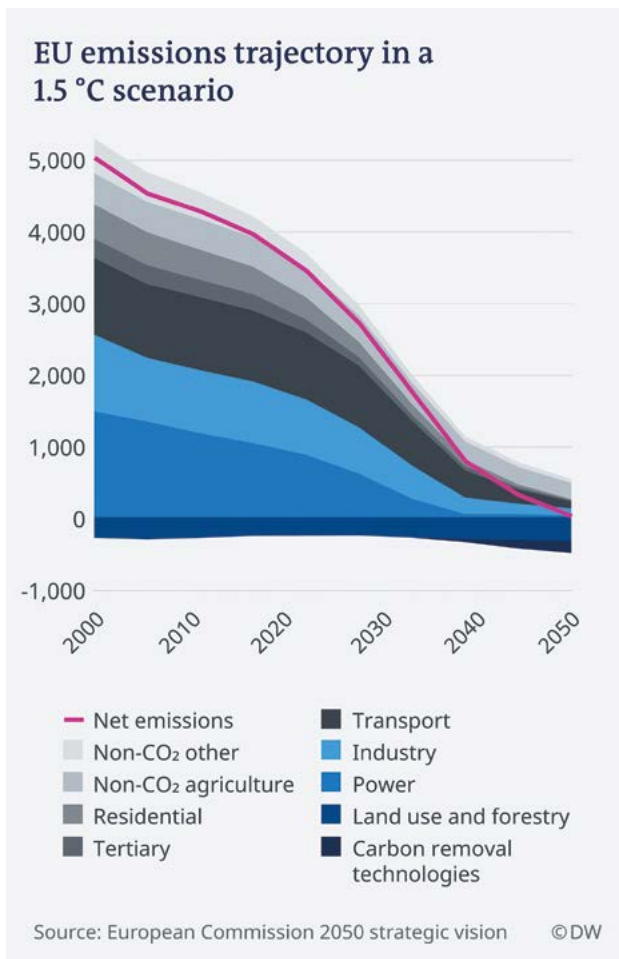
Climate assessment tools, such as Marginal Abatement Cost (MAC) curves and Life Cycle Assessment (LCA) provide insights on decarbonisation opportunities. MAC curves evaluate Green House Gas (GHG) emission volume impact vs cost to implement

reduction showing users how to get the greatest decarbonisation per Euro spent.

LCA quantifies the overall GHG impacts of a product or service through its lifetime. Referred to as a cradle to grave assessment, it evaluates the environmental impacts from raw material extraction and processing (cradle), through manufacture, distribution, use, recycling and final disposal (grave) for a product.

As decarbonisation mandates tighten, and producers want to improve their LCA, demand will grow for lubricants that are from sustainable feeds, and out-perform fossil fuel derived alternatives. Decarbonisation is creating both challenges and opportunities for Base Oil producers and their customers.

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In Europe the three most carbon intense segments, Transport, Industry and Power - all have a critical base oil component.

The transition to bio/sustainable Base Oils will be gradual

Historically, and into the future, the adoption rate of new Base Oil technology is driven by OEM fuel economy and exhaust emission requirements, in conjunction with supply availability and formulating costs.

The introduction of ISODEWAXING® technology in the mid-90s enabled production of large volumes of affordable Group II and Group III Base Oils, which had high purity and lower cold crank and volatility characteristics. It dramatically changed the market, but it took 15 years for the full effect to be felt. Supply availability, engine design, specifications and performance testing all had to be developed.

Initially, Group II/III Base Oils were used as a correction fluid. As fuel economy and low SAPS specs tightened, demand for lower viscosity motor oils grew. Group III Base Oils became the predominant Base Oil in 5W-30 formulations.

Today, the market is ratcheting down to 0W-20 formulations. Globally, the handful of formulation profiles range from Group III with 15% correction fluid to 100% Group III+/PAO. But, the move to low viscosity lubricants is pushing the performance limits of existing Base Oil technology.

PAO, the gold standard in correction fluid, has always challenged blenders due to its high cost and inconsistent supply availability. Now, PAO may have reached its performance limits. With AEO specs moving to 0W-16/12/8 performance, – its volatility isn't low enough for fuel economy retention.

Additionally, it is not from sustainable feeds and it is not biodegradable.

AEO specs moving to 0W-16/12/8 in conjunction with decarbonisation is opening the door for new Base Oil technologies.

Next generation of Base Oils will not likely come from crudes, coal or natural gas

Sufficiently low cold crank and volatility for future 0W-16 lubricants can't be achieved with current Base Oil technology. While, theoretically, regular crudes could be severely cracked to achieve VI targets, the yields plummet to uneconomical levels. Additionally, supply availability of waxy crude, the required feedstock, has historically been limited, hard to transport and is now drying up.

GTL Base Oils, designed to fill the performance gap, are energy intensive and have a carbon footprint that is worse than mineral oils. CTL Base Oils have similar drawbacks, and are unlikely to be an option without substantial government subsidies.

Market needs solutions that are both evolutionary and revolutionary

Meeting dual market demands for low viscosity and low carbon impact will require revolutionary Base Oils. Ideally, they will be produced from sustainable resources. Critically, they will have to have exceptionally low viscosity and volatility and deliver true hydrocarbon functionality that surpasses PAO or mineral oils. The next generation of Base Oils must enable better fuel economy goals for OEMs.

The greatest potential will come from bespoke molecules that produce perfect product consistency.

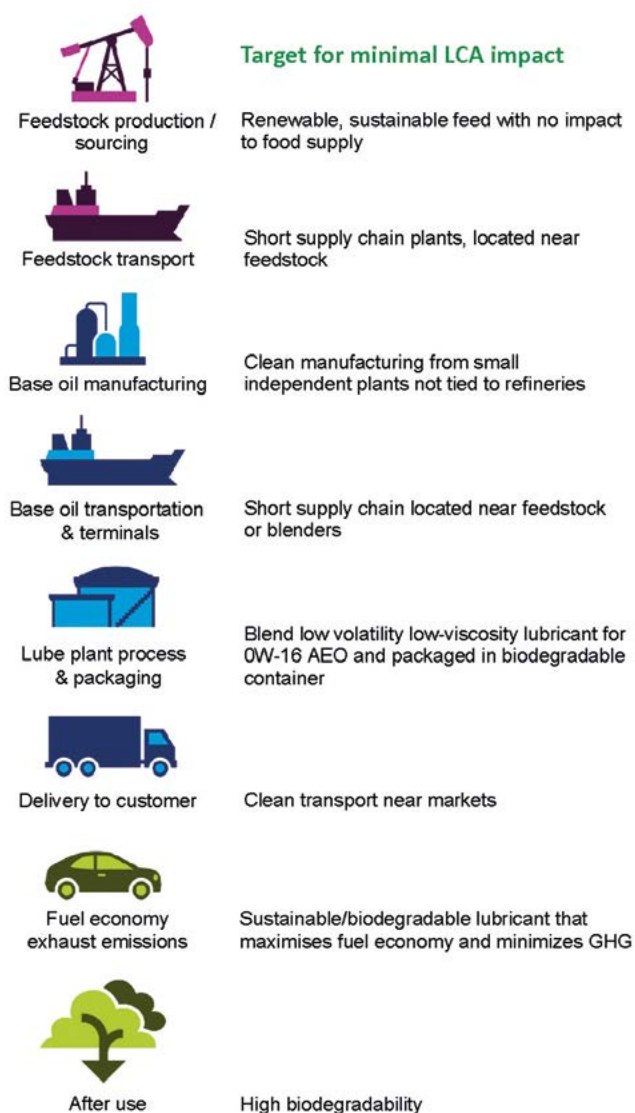
GHG reduction can be maximised if production is scalable so plants can be located near feedstocks or customers. And, of course the Base Oils would be biodegradable.

Large and small companies are investing in solutions that meet some or all these criteria.

The solutions will be evolutionary

As new sustainable Base Oil technologies emerge, market penetration will be evolutionary, similar to the introduction of Group II/III Base Oils. Importantly, new Base Oils need to be compatible with mineral oil formulations and blend plants. If they equal or surpass PAO, they will be used as a super high-performance correction fluid in the near and medium term. As supply expands, specifications will tighten to OW-16, OW-12 and even OW-8 levels. Demand will grow.

Potential Base Oil LCA



Summary – A dynamic new Base Oil world is coming

The Base Oil industry is responding to the need for renewable, sustainable, biodegradable Base Oils. In response to LCA, they will need to have minimal climate impacts while delivering equal or superior performance to existing mineral oil options. Adoption will be gradual as supply comes on line and performance testing is completed. The bottom line is the market needs sustainability, biodegradability and superior performance.

Initially lubricant blenders will be challenged in meeting diverse market needs while minimising the number of Base Oils they carry, but transitioning to sustainable Base Oils will likely be required as they become more readily available. Early movers will benefit, just as the early movers to Group III did.

LINKS
novvi.com
Chevronbaseoils.com

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Jeff is a pioneer in renewable solutions. Before founding Novvi he was instrumental in bringing new technologies to market at five different companies committed to lowering the carbon footprint in industries as diverse as solar, materials science and petroleum. Novvi's mission is bringing sustainability and industry-leading performance to the Base Oil and specialty chemicals industries.



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Luyen's more than 20 years of experience in the oil and gas industry includes roles in refining, process engineering, supply chain, strategic investment analysis, procurement and commercial sales for Base Oils. Her current role casts an eye to the future, seeking solutions to the evolving technical and performance challenges of the Base Oil industry.

