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Beyond Specifications: Unlocking Fuel Efficiency

The Role of Flat Viscosity Engine Oil in Plug-in Hybrid Vehicles

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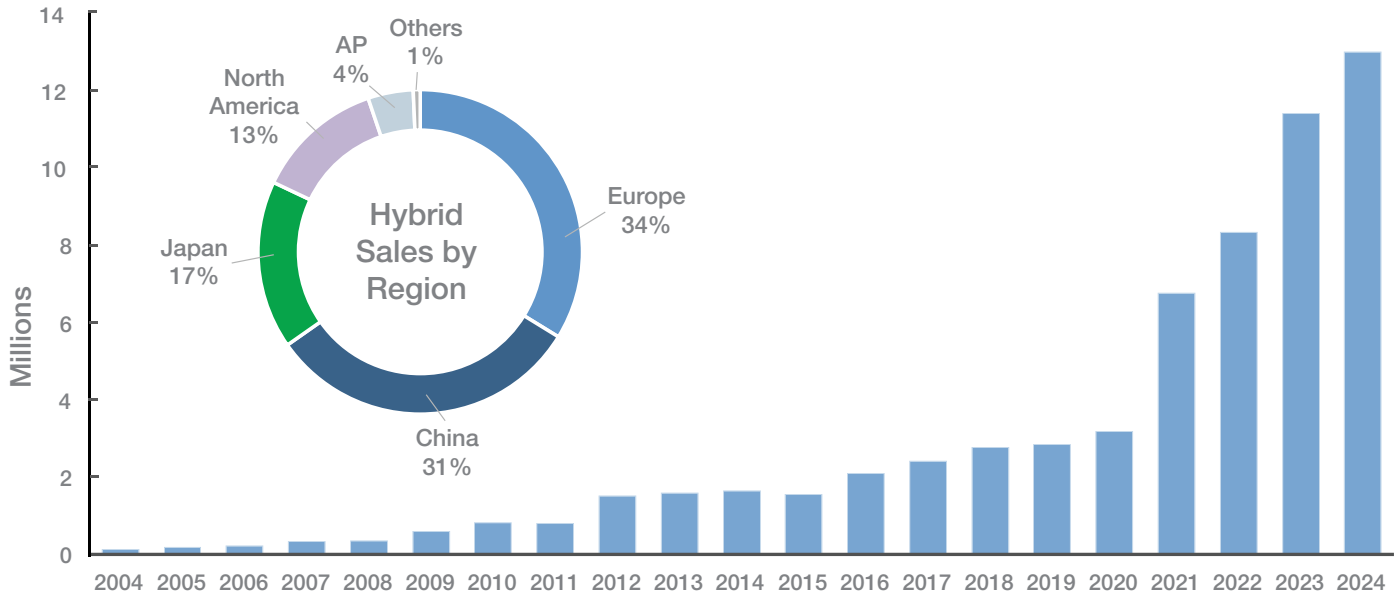
As climate change drives stricter global emissions regulations, the automotive industry is accelerating its shift toward cleaner technologies. Plug-in hybrid electric vehicles (PHEVs) have emerged as a key solution—offering both environmental benefits and practical scalability. But as hybrid powertrains evolve, a new question arises: Can engine oil technology keep pace and further boost fuel economy? This article explores how flat viscosity engine oil could be a game-changer for hybrid efficiency.

Figure 1: Hybrid vehicle sales rapidly penetrating the market

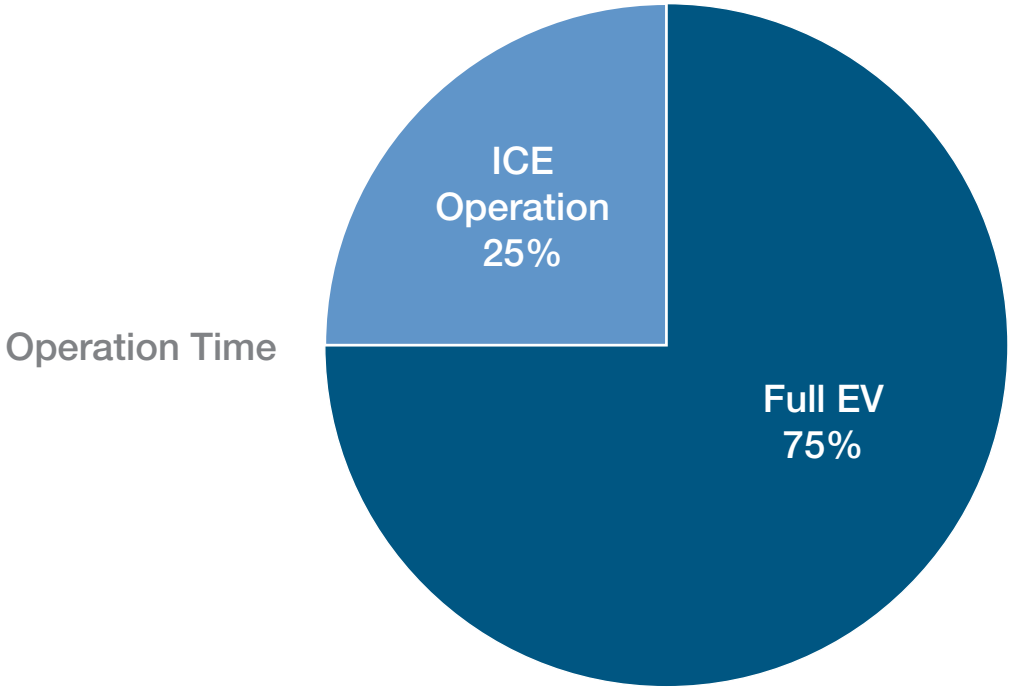


The Japanese Automotive Standards Organization (JASO) has released a new engine oil specification called GLV-2, which supports the flat viscosity concept to help improve fuel economy in hybrid vehicles through advanced engine oil technology.

The Hybrid Challenge: Engine Oil in a New Operating Environment

PHEVs combine internal combustion engines (ICEs) with electric motors to reduce fuel consumption and emissions. Unlike traditional vehicles, ICEs in hybrids operate intermittently, often at lower temperatures and under lighter loads. These conditions challenge conventional engine oils, which are formulated for continuous, high-temperature operation. To meet the unique demands of hybrid engines, oil formulations must adapt—ensuring protection and performance even during extended idle periods and cooler cycles.

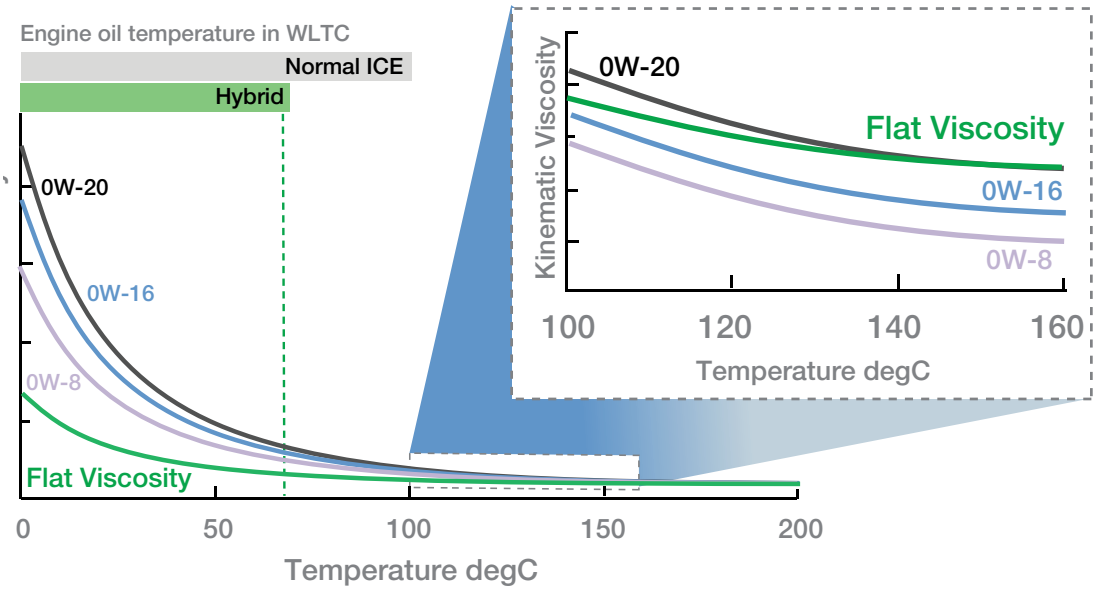
Figure 2: Hybrid operation has low engine load and low coolant temperature



What Is Flat Viscosity Oil—and Why It Matters

Flat viscosity oil is designed to maintain a lower, more stable viscosity across a wide temperature range. In hybrid vehicles, where engine temperatures are typically lower, this stability reduces internal friction, thereby improving fuel economy. The formulation relies on advanced base oils and additives to achieve a balance of thermal stability, oxidation resistance, and engine protection. Compared to traditional oils, flat viscosity oils deliver more consistent performance under hybrid-specific conditions.

Figure 3: Flat viscosity concept delivers more fuel economy especially for Hybrid vehicle



Benefits vs. Trade-offs

Key advantages of flat viscosity oils include:

- Improved fuel economy through reduced friction
- Compatibility with existing engine designs—no hardware changes needed

However, there are trade-offs:

- Lower viscosity can increase volatility, potentially leading to higher oil consumption
- Some formulations may not meet API NOACK volatility limits, complicating certification
- Striking the right balance is essential for commercial viability.

Research Motivation: Putting Theory to the Test

To evaluate real-world performance, a fleet test was conducted using the BYD Qin Plus DM-i, one of China's top-selling PHEVs. The study focused on:

- Fuel economy gains
- Long-term wear protection
- Oxidation resistance
- Comparison with standard reference oils

Test routes included urban and highway driving in Suzhou and Shanghai, reflecting typical usage patterns.

Methodology: How the Test Was Run

The test involved 2021 model BYD Qin Plus DM-i vehicles, compliant with China VI emissions standards. Two oil types were used:

- A flat viscosity formulation (0W-20 JASO GLV-2)
- A standard reference oil (0W-20 API SQ / GF-7)

Each vehicle was driven for 12,000 km, with oil samples analyzed for:

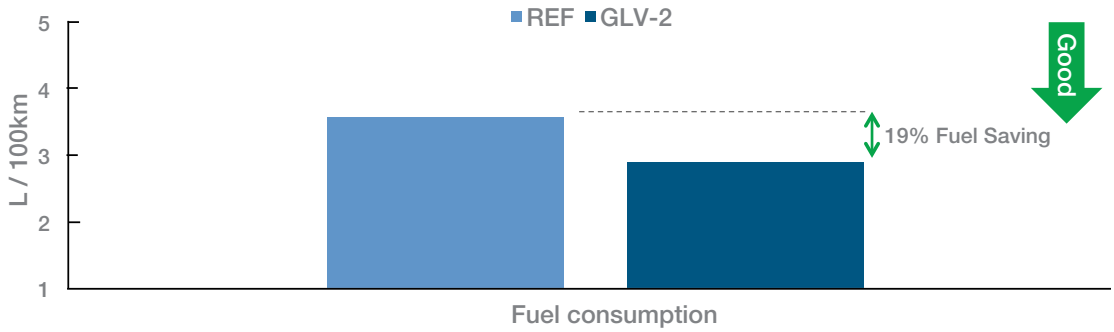
- Viscosity
- Total Acid Number (TAN)
- Total Base Number (TBN)
- Elemental wear metals

Results: Fuel Economy and Engine Protection

Key findings:

- 75% of driving was electric; ICE operated 25% of the time
- Flat viscosity oil maintained SAE-grade viscosity after 12,000 km
- TAN and TBN values showed strong performance reserves
- Lower wear metal concentrations indicated better engine protection
- Most notably, vehicles using flat viscosity oil saw a 19% improvement in fuel economy
- These results confirm that flat viscosity oils can enhance efficiency without compromising protection.

Figure 4: GLV-2 solution delivers fuel economy benefit in hybrid drive



Summary: A Step Forward in Hybrid Lubrication

This study validates the performance potential of Afton's GLV-2 technology within a 0W-20 flat-viscosity engine oil, formulated with HiTEC® 11455 PCMO Additive Package and boosted with HiTEC® 11521 Booster Additive Package, for use in hybrid applications. Even with limited ICE use, the oil delivered measurable fuel economy gains and maintained protective properties. As hybrid technology continues to evolve, flat viscosity oils offer a promising path forward.

Next steps in research may include:

- Testing longer drain intervals
- Evaluating performance across different hybrid platforms
- Further refining volatility characteristics

With proven results and readiness for commercialization, Afton's flat viscosity solution marks a significant advancement in engine oil technology for the hybrid era.

Let's build the future of hybrid lubrication together.

Contact Afton to collaborate on customized solutions that optimize protection, efficiency, and durability for modern hybrid powertrains.

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