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Whitepaper

The Multi-Lane Highway: Bosch's Vision for Next-Generation Trucks and SUVs

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Why HEVs are the Truck & Large SUV of the Future: The Multi-Lane Highway Approach

The U.S. truck and large SUV market is not short on demand; it's short on clarity. Misinformation around electrified powertrains, combined with uncertainty over fuel costs and the broader market direction, is leaving many consumers confused and reluctant to move beyond the traditional powertrains they know. At the same time, OEMs are resetting after heavy BEV investments without the accompanying sales growth. Adapting to the consumer sentiments and seeking a more captial-efficient solution, OEMs are increasingly turning toward hybrid-electric vehicle (HEV) architectures as a market-ready path forward.

That shift will not be won with a one-size-fits-all solution. Pickup trucks and large SUVs span one of the widest ranges in the industry, from bare-bones work trucks that must deliver uncompromised capability to premium luxury SUVs where refinement and advanced features are non-negotiable. That is why the future is a **multi-lane highway** of hybrid solutions, with different HEV concepts tailored to distinct consumer needs, use cases, and expectations.

While traditional Internal Combustion Engine (ICE) trucks and SUVs maintain strong loyalty, particularly for their familiar qualities and long-distance performance, hybrids offer a logical and appealing transition by retaining these trusted attributes while integrating new electrified benefits. Bosch's quantitative UX data confirms that powertrain choice can be polarizing, with **traditional demographics strongly preferring ICE, and younger, urban, more affluent demographics leaning towards hybrids.** The strong brand presence of V8 engines in the USA underscores the need for a multi-energy strategy that acknowledges these loyalties.

Hybrid vehicles are gaining momentum, especially among U.S. consumers who value capability and reliability. Recent trends show hybrid trucks achieve notable traction, indicating electrification is most successful when it complements established strengths.

Hybrid concepts, including Full Hybrid Electric Vehicles (FHEVs) and Range Extended Electric Vehicles (REEVs), are emerging as viable options thanks to their compatibility with current market preferences. Internal combustion engine (ICE) trucks and SUVs still enjoy significant loyalty from buyers, particularly those prioritizing trusted qualities like familiarity and long-distance performance. Hybrids offer a logical enhancement by retaining these attributes while adding new electrified benefits. Most importantly, electrification of powertrain succeeds best when it enhances, rather than replaces, familiar vehicle features.

- **FHEVs (Full Hybrid Electric Vehicles):** FHEVs are likely to be the highest-volume path into broader hybrid adoption because they offer a frictionless step up from conventional ICE vehicles. In trucks and large SUVs, seamless usability features for **ICE loyalists** and **value-driven practicalists** include no lifestyle disruption, such as no charging requirement, no trip-planning burden, and no compromise in capability. Positioned correctly, FHEVs deliver a familiar ownership experience with tangible gains in fuel economy, smoother drive quality, stronger low-end response, and useful feature enhancements, all with only a modest price premium. From a technical standpoint, these architectures are well suited to ICE-based platforms and can be implemented through established configurations giving OEMs flexibility to tune cost, packaging, and performance for different truck and SUV applications.

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- **REEVs (Range Extended Electric Vehicles):** REEVs are better aligned with **early adopters** and highly feature-conscious customers who want the best of both worlds: the smooth, quiet, high-torque electric driving experience of a BEV together with the long-distance usability, towing confidence, and functional reassurance associated with traditional trucks and SUVs. In this sense, REEVs appeal to buyers who want cutting-edge vehicle capability without accepting the full trade-offs of a pure BEV. In REEVs the engine functions as an onboard generator rather than the primary source of wheel torque, REEVs can preserve an electric-first character while reducing anxiety around charging access, long family road trips, or demanding work and recreation use cases. They also create a strong platform for complementary technologies such as vehicle-to-load and vehicle-to-home capability, advanced driver assistance, software-enabled features, and future AI-driven experiences that benefit from a more electrified vehicle architecture.

Across all consumer segments, **towing capacity remains a core requirement, with a minimum expectation of 8,000 lbs.** Bosch's UX studies reveal that truck and SUV buyers purchase the "capability" to tow, whether they use it frequently or not, making towing performance a non-negotiable "table stakes" feature. Additionally, **two-thirds (2/3rds) of the market expresses a desire for V2L capability,** enabling capabilities like powering heavy-duty tools or partially powering a home during an outage. These findings underscore that successful electrification enhances, rather than replaces, familiar vehicle features.

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Major Challenges for End Consumers, OEMs and Suppliers

Executing this multi-lane hybrid strategy presents a set of interconnected challenges for OEMs and suppliers—not only in engineering and investment planning, but also in defining clear customer value and bringing it to market with confidence.

- **Market Fragmentation and Understanding the Customer "Why":** Demand for hybrid trucks and large SUVs is highly fragmented, making it difficult for OEMs to define the right product portfolio, feature set, and value proposition with confidence. The challenge is not simply identifying broad segments, but understanding the distinct motivations of **early adopters, ICE loyalists,** and **value-driven practicalists**—including the use cases, functional expectations, and decision triggers that shape purchase behavior. For OEMs and suppliers, that means grounding hybrid strategies in a sharper understanding of why customers choose a given powertrain, where hybridization creates meaningful value versus ICE or BEV alternatives, and how those insights translate into differentiated products. Affordability is another major customer pain point that needs to be addressed.
- **Vehicle affordability:** Vehicle costs continue to increase and risk putting many buyers out of reach for new technology. The value for the added cost must be clearly explainable. While new technology often starts in higher trim levels, the path to all trim levels must be clear and attainable in a short period of time.
- **Consumer Misunderstanding and the Learning Curve of Hybrid Benefits:** Hybrid systems do not struggle because their value is absent, but because that value is not always easy for consumers to interpret. The learning curve around hybrid architectures, benefits, and trade-offs creates confusion—especially when buyers are trying to differentiate among HEV, PHEV, REEV, and BEV options while sorting through inconsistent information. For OEMs, the challenge is strategic as much as technical: successful hybrid launches require clear communication of benefits, aligned with the brand promise and customer expectations of each nameplate.
- **Navigating an Uncertain Investment Landscape:** OEMs are making decisions in a capital environment already shaped by substantial prior investments in both BEV programs and traditional powertrain portfolios, SdV (software driven vehicle), ADAS etc... At the same time, new ICE and hybrid investments are increasingly difficult to size and prioritize because the long-term outlook remains uncertain: consumer reactions to new powertrains are still evolving, regulatory frameworks may shift over investment-relevant time horizons, and further technology disruption remains possible. The challenge is not simply deciding where to invest next, but how to allocate limited capital across overlapping and uncertain pathways while preserving future strategic flexibility.

Major Challenges for End Consumers, OEMs and Suppliers

- **Integration Complexity and Cost:** Expanding hybrid offerings can quickly multiply development complexity through additional powertrain variants, new interfaces across propulsion including today's transmissions, vehicle systems, and supplier components that may initially be developed for relatively limited-volume subsegments. For OEMs and suppliers, the burden is to manage integration, packaging, validation, and manufacturing complexity while maintaining a cost structure that can support broader market adoption.
- **Regulatory framework and Addressing Geopolitical & Localization Challenges:** OEMs and suppliers must adhere to all applicable emission standards and regulations, including those in North America. Furthermore, shifting geopolitical tensions and increasing calls for localization require manufacturers to secure supply chains, source critical components domestically, and adapt to regulatory frameworks that demand local content and manufacturing. Balancing these requirements adds complexity to strategic planning and product development, making it essential to integrate emissions compliance and localization strategies into every phase of hybrid vehicle production.

Bosch's System-Level Solutions for the Hybrid Future

Bosch, with decades of internal-combustion experience and systems-engineering expertise, is well positioned to serve as a development partner for next-generation HEV pickups and SUVs. Its technology stack supports end-to-end system solutions across the entire value chain, helping OEMs manage complexity from architecture definition through integration and feature delivery. This system-level approach addresses several of the most critical needs facing OEMs:

- **Flexible and Scalable Architectures:** Bosch's system solutions along the entire tech stack enables flexible, scalable architectures across a multi-platform portfolio, helping maximize supplier part commonization across powertrain solutions to improve economies of scale and reduce supply-chain complexity for both OEMs and suppliers. This is increasingly important as manufacturers must support a broader range of hybrid concepts, while also integrating customer-driven technologies such as advanced driver assistance, connected vehicle features, software-enabled experiences, and next-generation infotainment. By designing compatible system solutions that work coherently across these different architectures, mitigating integration burdens, Bosch helps OEMs deliver performance, refinement, utility, and feature content without multiplying unnecessary complexity.
- **48-Volt Electrical Systems:** Expanded 48-volt capability supports higher electrical loads, improves subsystem efficiency, and hybrid architectures enable a smoother transition to 48V powernets when compared to traditional ICE vehicles.
- **Power Net Guardian:** Supports electrical stability in hybrids with high-availability electrical loads, voltage networks and distributed functions. Power net management becomes critical to maintain system robustness and functional availability while balancing electrical architecture TCO.
- **High-Performance Compute and Domain Fusion:** Creates a foundation for a scalable architecture while reducing complexity, integrating multiple domains on a common compute backbone. OEMs can simplify integration and unlock advanced vehicle controls and software enabled customer experiences in a more efficient and scalable platform.
- **Advanced Thermal Management:** Intelligent thermal systems that add, recover, and reject heat across key vehicle subsystems improve efficiency, support electric performance, protect durability, and enhance occupant comfort—critical advantages in larger vehicles with demanding towing, payload, and climate-control requirements. This is enabled through integrated systems that can be scaled to multi-energy platforms and enabled by controls and connectivity features that optimize energy flow withing the systems that are predictive and personalized.
- **Vehicle Motion Management:** Intermittent engine use in hybrids drives the need for electrified braking solutions that can provide reliable performance regardless of the engine state. Increases in GVW, towing and payload demands as pickups, and large SUVs are hybridized may require scalable higher force new braking solutions and higher steering torque to maintain performance and safety. The higher voltage hybrid battery can also enable additional features and personalization that were not possible in a traditional 12V ICE application e.g.; active suspension and active rollbars.

Core Technologies for HEV Powertrain Differentiation

Bosch brings a portfolio of core technologies that can be configured across different platforms, allowing OEMs to build solutions that are both technically coherent and commercially differentiated. Bosch helps integrate the supporting technology stack required for modern trucks and SUVs—including propulsion, thermal systems, motion systems, electrical architecture, vehicle controls, ADAS and software-enabled features.

- **Integrated eAxles:** Highly integrated and highly efficient (>90%) electric-drive solutions combine traction functions, power electronics, thermal interfaces, and related subsystems in a compact package. Bosch 3-in-1 and 2-in-1 eAxles are unique due to the high power density enabled with 3rd generation SiC (Silicon Carbide) MOSFETs that have vertical trench etching technology combined with direct cooling of stator winding and rotor slots in an efficient way. This enables high continuous power needed for pick-ups in North America.
- **Dedicated eAxles for hybrids:** A dedicated hybrid gearbox with integrated electrical machine and power electronics that couples directly to the combustion engine; providing an elegant and highly efficient hybrid solution significantly simpler and more cost effective than solutions common on the market today.
- **V2X, transforming the vehicle into a mobile power hub:** Bosch's industry-leading power electronics bring robust, high-output V2L and V2H functionality to the North American hybrid segment, transforming the vehicle into a resilient power source capable of effortlessly charging recreational gear off-grid, and acting as a critical home backup during emergency outages - combining premium utility with proven automotive-grade reliability.
- **Dedicated Hybrid Engine (DHE):** Hybrid solutions through holistic optimization of the engine, aftertreatment and powertrain based on the chosen hybrid concept, enabled by solutions like **Pre-Chamber Sparkplug (PCSP)** and **Rapid Catalyst Heating (RCH)**: Bosch's combustion innovations help increase engine thermal efficiency and operate more often in their most efficient ranges, improving fuel consumption, emissions performance, and overall hybrid-system effectiveness while preserving the capability expectations of truck and SUV customers. Rapid Catalyst Heating helps hybridized combustion engines meet emissions requirements under demanding operating conditions such as cold starts or intermittent engine use, making it especially relevant for architectures in which the ICE is not continuously active. By providing 25+ kilowatts of heat directly to catalyst it accelerates the light-off as well as eliminating the need for the inefficient operation of engine for catalyst heating.

Strategic Enablers for Scalable, Localized Deployment

- **Accelerated Development with AI and Machine Learning:** Bosch uses multiphysics development tools, AI, and machine learning to iterate, simulate, and optimize system designs across architectures, helping OEMs shorten development timelines, reduce validation burden, and converge more quickly on solutions that balance cost, performance, efficiency, and feature integration nd feature integration while ensuring that accelerated development never compromises quality.
- **Deep Consumer Insight Integration:** Bosch helps translate consumer insight into system decisions by connecting powertrain choices and feature stacks to the motivations of **early adopters, ICE loyalists,** and **value-driven practicalists**. That means not only identifying which concept best fits a target customer, but also understanding which complementary features—such as connectivity, driver assistance, vehicle-to-load capability, software-enabled experiences, or AI-driven functions—should be paired with that powertrain to create a more compelling overall vehicle proposition.
- **Supply chain resiliency and regulations:** Bosch places highest importance to not only adhering to regulatory frameworks but consistently outperforming them thus providing OEMs the confidence to focus on differentiating technologies and delivering customer experience and value. Bosch is a global company with production locations for the entire tech stack in all the major auto production hubs. For example in North America, with a dedicated fabrication facility for SiC (Silicon Carbide semiconductors) in Roseville, CA, acquired in 2023 with a planned **$1.9 billion investment**, Bosch supports domestic sourcing for critical components.

By applying a holistic, system-level approach, Bosch enables OEMs to navigate topology complexity, reuse technology more effectively across programs, reduce integration burden, and align vehicle concepts more closely with end-customer needs. The result is a clearer pathway to trucks and SUVs that are competitive in cost, credible in performance, differentiated in features, and better positioned for success in the evolving landscape.

Endnotes

1 *For a technical overview of RCH development, implementation and performance, see: Disch, C., O'Donnell, R., Singh, R., Chutipassakul, S., et al., "A Rapid Catalyst Heating System for Gasoline-Fueled Engines," SAE Int. J. Adv. & Curr. Prac. in Mobility 7(2):773-797, 2025,* https://doi.org/10.4271/2024-01-2378