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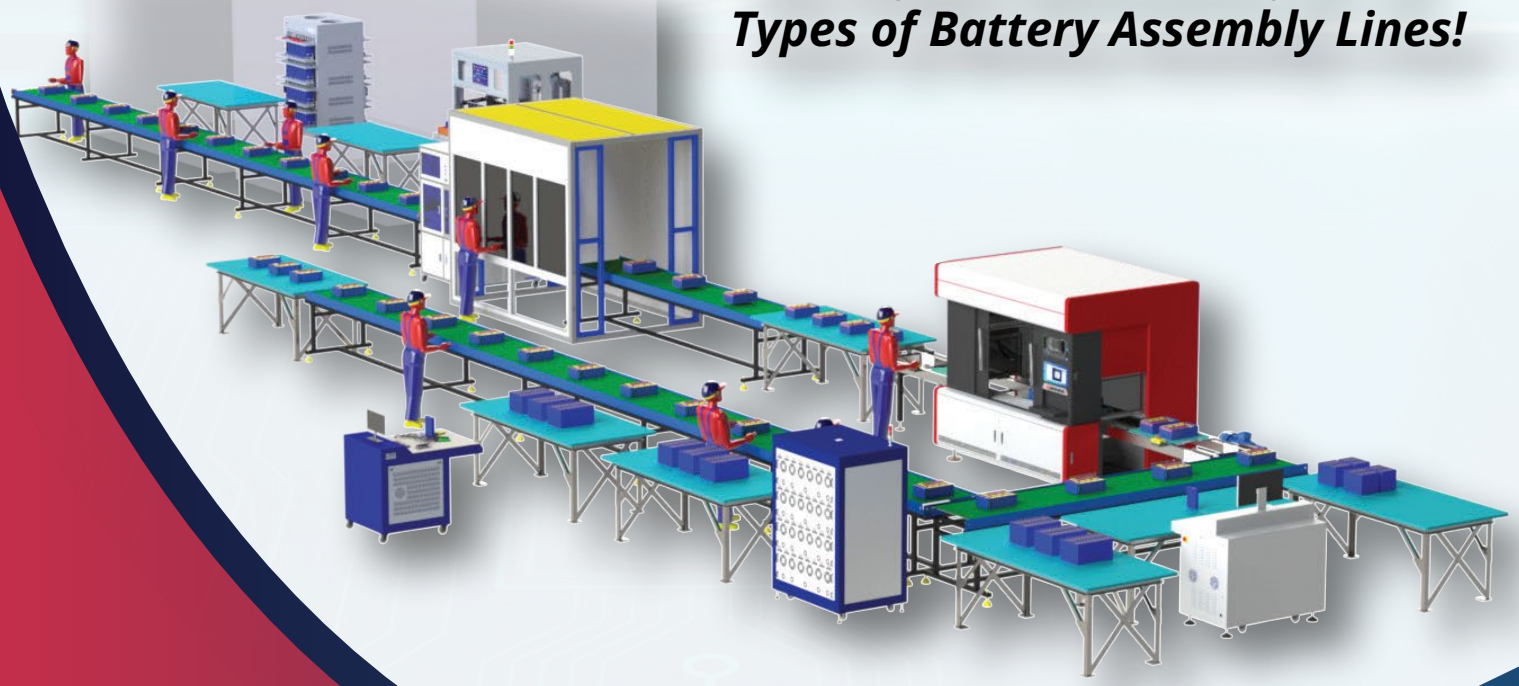

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Auto Monitor

Your Gateway to the Automotive Universe

JANUARY 2025

In Association with

IFEVA™ International Federation of Electric Vehicle Association

Special Issue

Bharat Mobility GLOBAL EXPO 2025

Revolutionizing EV Charging: Phoenix Contact's **CHARX Solution** Transforms India's Infrastructure

Q. Amit, thank you for joining us today. Phoenix Contact has been at the forefront of e-mobility solutions. Can you tell us about the CHARX product line and its significance in the EV charging ecosystem?

Thank you for having me. The CHARX product line is designed to cover the entire charging process for electric vehicles, from the charging station to the vehicle itself. Our products include AC and DC charging cables, controllers, and power electronics, all developed to ensure maximum safety, reliability, and user comfort. The modular design simplifies installation, commissioning, and maintenance, making it easier for operators to manage their charging infrastructure.

Q. Innovation is key in the rapidly evolving e-mobility sector. How does Phoenix Contact approach innovation, particularly with the CHARX products?

Innovation at Phoenix Contact is driven by our commitment to sustainability and efficiency. Phoenix Contact's CHARX DC Charging Cables offer several unique selling points that set them apart in the market:

1. **High Power Handling:** CHARX DC charging cables are designed to handle high power levels, supporting up to 500 A in Boost mode and 375 A permanently at 1,000 V DC. This makes them suitable for fast and ultra-fast charging applications.
2. **Temperature Management:** These cables are equipped with analog temperature sensors that provide real-time temperature monitoring. This feature ensures safe operation by preventing overheating and potential damage to both the cable and the vehicle.
3. **Modular Design:** The modular design of CHARX DC charging cables simplifies installation, maintenance, and replacement. Components such as the mating face frame and DC power contacts are replaceable, which reduces downtime and maintenance costs. .
4. **Compliance with Standards:** CHARX DC charging cables comply with international standards such as IEC 62196-3 and GB/T 20234.3-2015. This ensures compatibility with a wide range of electric vehicles and charging stations globally
5. **Durability and Robustness:** These cables are built to withstand harsh

Amit Tyagi is the Vice President of E-Mobility at Phoenix Contact. He is instrumental in advancing the company's e-mobility initiatives, particularly in high-performance charging technology for electric vehicles and charging infrastructure. Additionally, Mr. Tyagi has significantly contributed to drafting standards for the Bureau of Indian Standards (BIS). His involvement in developing and reviewing standards ensures the safety, reliability, and performance of EV components and systems, which is crucial for establishing a robust regulatory framework to support the growth and adoption of EVs in India.

AMIT TYAGI
Vice President - eMobility
Phoenix Contact India Pvt. Ltd.

environmental conditions, with robust construction that ensures long-term reliability and performance. They are designed to operate efficiently even at temperatures up to +40°C without the need for liquid cooling.

6. **Enhanced Safety Features:** In addition to temperature sensors, CHARX DC charging cables incorporate surge protection and secure communication protocols to ensure safe and reliable charging. These features help protect both the charging infrastructure and the electric vehicle.
7. **Future-Proof Technology:** Phoenix Contact continuously innovates to incorporate the latest technologies into their products. CHARX DC charging cables are designed to be future-proof, supporting the evolving needs of the e-mobility sector. These unique selling points make CHARX DC charging cables a reliable and efficient choice for various e-mobility applications, ensuring fast, safe, and standard-compliant charging.

The modular design of Phoenix Contact's CHARX products offers several significant benefits, particularly for the installation, maintenance, and scalability of EV charging infrastructure. Here are the key advantages:

1. Simplified Installation and Commissioning

- **Ease of Assembly:** The modular components can be easily assembled and configured, reducing the complexity and time required for installation. This is particularly beneficial for large-scale deployments where multiple charging stations need to be set up quickly.
- **Plug-and-Play:** Many CHARX modules are designed with plug-and-play functionality, allowing for straightforward integration into existing systems without extensive reconfiguration.

2. Reduced Maintenance Costs

- **Replaceable Components:** The modular design allows for individual components to be replaced without needing to dismantle the entire system. For example, if a charging cable or controller fails, it can be swapped out independently.
- **Minimized Downtime:** Quick replacement of faulty modules ensures that the charging stations remain operational, minimizing downtime and improving overall reliability.

3. Scalability and Flexibility

- **Expandable Systems:** Modular systems can be easily expanded to accommodate growing demand. Additional modules can be added to increase capacity or functionality as needed.
- **Future-Proofing:** As technology evolves, new modules with advanced features can be integrated into the existing infrastructure, ensuring that the system remains up-to-date without requiring a complete overhaul.

4. Enhanced Customization

- **Tailored Solutions:** The modular approach allows for customization to meet specific requirements. Different modules can be combined to create a tailored solution that fits the unique needs of various applications, from residential to commercial and industrial settings.
- **Versatile Applications:** CHARX products can be configured for different power levels, communication protocols, and safety features, making them suitable for a wide range of e-mobility applications.

5. Improved Safety and Reliability

- **Isolated Faults:** In a modular system, faults can be isolated to specific modules, preventing them from affecting the entire system. This enhances the overall safety and reliability of the charging infrastructure.
- **Standard Compliance:** Modular components are designed to comply with international safety and performance standards, ensuring that each part of the system meets stringent regulatory requirements.

6. Cost Efficiency

- **Lower Initial Investment:** Modular systems allow for phased investments. Operators can start with a basic setup and expand as demand increases, spreading out the costs over time.
- **Operational Savings:** Reduced maintenance and downtime translate into lower operational costs, making modular systems more cost-effective in the long run.

These benefits make the modular design of Phoenix Contact's CHARX products a highly attractive option for building and maintaining efficient, reliable, and scalable EV charging infrastructure.

Q. Megawatt charging is a hot topic in the industry. How is Phoenix Contact contributing to this area?

Megawatt charging is indeed a game-changer, especially for heavy-duty vehicles. Our involvement with the Megawatt Charging System (MCS) aims to provide a standardized solution for high-power charging. The MCS connector is designed to handle up to 3.75 MW of power, with a maximum current of 3,000 A at 1,250 V DC. This requires advanced power electronics and robust cooling systems to manage the high currents involved. For example, our CHARX DC power electronics are designed to efficiently convert and manage high power levels, ensuring safe and fast charging.

Q. Cybersecurity is crucial for the sustainability of EV infrastructure. What measures does Phoenix Contact take to ensure the security of its charging solutions?

Cybersecurity is a top priority for us. We implement robust security protocols to protect our charging infrastructure from potential cyber threats. This includes secure communication channels, regular software updates, and compliance with international cybersecurity standards. For example, our systems use advanced encryption protocols and authentication methods to prevent unauthorized access. Additionally, we employ AI-aided monitoring and digital twin technology to anticipate and mitigate potential vulnerabilities. Our CHARX control modular AC charging controllers are equipped with secure firmware updates and real-time monitoring to ensure the integrity and security of the charging process.

Q. Finally, how does Phoenix Contact envision the future of e-mobility and its role in it?

We see a future where e-mobility is the norm, supported by a robust and secure charging infrastructure. Phoenix Contact aims to lead this transition by continuously innovating and providing sustainable solutions that meet the evolving needs of the industry. Our focus will remain on enhancing the efficiency, safety, and user experience of our products.

Q. Thank you, Amit, for sharing these insights. We look forward to seeing Phoenix Contact's continued contributions to the e-mobility sector.

Thank you. It's been a pleasure discussing our work and vision. ■

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INTERFACE

Dear Readers,

Dr.Rajeev Mishra
Editor

As we usher in the new year with the January 2025 edition of THE AUTO MONITOR, we are proud to present our special issue dedicated to BHARAT MOBILITY. This edition delves into the transformative journey of India's mobility sector, highlighting innovations, sustainable solutions, and emerging technologies that are redefining transportation across the nation.

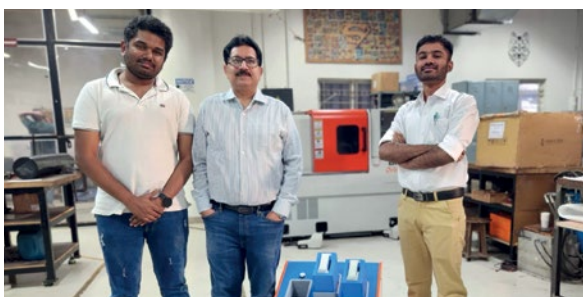
India stands at the cusp of a mobility revolution. From electric vehicles and alternative fuels to cutting-edge smart infrastructure and policy frameworks, the sector is experiencing dynamic growth. This special issue features insights from industry leaders, policymakers, and innovators who are steering India towards a greener, smarter, and more inclusive mobility future.

We extend our gratitude to our contributors and partners whose expertise has enriched this issue. We hope this edition inspires dialogue, collaboration, and action as we collectively navigate the evolving mobility landscape.

Here's to an innovative and sustainable year ahead!

CONTENT

TECHNOLOGICAL INNOVATIONS



INDUSTRY VOICE

SPOTLIGHT FEATURES

Shaping the Future of Battery Technology & Testing Solutions

In Conversation with SEMCO Infratech's
Mr. Neeraj Kumar Singal, Founder - SEMCO GROUP

About SEMCO Infratech

Q. Can you provide a brief overview of SEMCO Infratech and its key contributions to the industry?

Founded in 2006, Semco Infratech Pvt. Ltd. has grown to become the leading provider of Lithium-ion Battery Grading, Sorting, Welding, and Testing Solutions. Headquartered in New Delhi, with offices in multiple cities across India, it is strategically positioned as a key player within the renowned Semco Group.

Q. What sets SEMCO apart from its competitors in the field of battery technology and testing solutions?

SEMCO stands out with its comprehensive solutions, cutting-edge technology, and customer-focused approach. Offering battery grading, sorting, welding, and testing systems, it delivers tailored, high-quality solutions for diverse needs. With unmatched expertise, adherence to global standards, a strong local presence, and a commitment to sustainability, SEMCO is a trusted leader in battery technology and testing.

Lithium-Ion Battery Industry

Q. How would you describe the current landscape of the lithium-ion battery market in India and globally?

The lithium-ion battery market is experiencing significant growth both in India and globally, driven by increasing demand for electric vehicles (EVs), renewable energy storage, and consumer electronics.

In India:

- Rising EV Adoption: Policies promoting EVs and a push for localized manufacturing have accelerated market growth.
- Focus on Domestic Production: Government initiatives like PLI (Production-Linked Incentives) are encouraging the development of indigenous battery manufacturing ecosystems.
- Energy Storage Needs: With an expanding renewable energy sector, lithium-ion batteries are essential for grid storage solutions.

Globally:

- Boom in EV Market: Countries are targeting net-zero emissions, boosting EV production and battery demand.
- Technological Advancements: Innovations in chemistries like LFP and solid-state batteries are improving performance and reducing costs.
- Supply Chain Challenges: Dependency on critical raw materials like lithium and cobalt poses sustainability and geopolitical concerns.
- Recycling and Sustainability: Efforts to establish efficient recycling infrastructure are gaining momentum to address environmental concerns.

Overall, the market is on a trajectory of rapid expansion, with an emphasis on innovation, sustainability, and supply chain resilience. India's active participation in this global shift positions it as a key player in the coming years.

Q. What role does SEMCO play in advancing battery manufacturing and testing technologies?

SEMCO drives innovation in battery manufacturing and testing with advanced solutions for grading, sorting, welding, and assembly. By offering customized, efficient, and sustainable technologies, it supports R&D, large-scale production, and eco-friendly practices. As a trusted industry leader and partner, SEMCO helps businesses meet the growing demand for high-performance batteries.

Innovations and Technology

Q. What are some of the latest innovations SEMCO has introduced in the test and measurement equipment segment?

SEMCO has introduced several cutting-edge innovations in the test and measurement equipment segment, including:

1. **All-in-One Battery Assembly Machines:** Integrated systems combining grading, testing, welding, and assembly functions for streamlined operations.
2. **High-Speed Cell Grading and Sorting Machines:** Ensuring precise and efficient classification of cells based on IR, voltage, and capacity.
3. **Advanced BCDS Systems:** Battery charge-discharge systems with customizable parameters for enhanced testing accuracy and performance evaluation.
4. **Prismatic and Pouch Cell Testers:** Multi-channel testers offering precision in voltage and internal resistance measurements.
5. **Portable Laser Welding Machines:** Compact and efficient solutions tailored for R&D labs and small-scale production.
6. **Integrated Testing Stations:** Combining multiple testing capabilities into a single unit for diverse cell types and chemistries.

These innovations ensure higher accuracy, efficiency, & reliability, supporting the evolving needs of battery manufacturing and R&D.

Q. How is your company adapting to the increasing demand for automation and precision in battery manufacturing?

We adapt to the growing demand for automation and precision by offering integrated, AI-driven machines for grading, sorting, testing, and welding. Our customizable, high-precision systems ensure efficiency, scalability, and sustainability, meeting the evolving needs of modern battery manufacturing.

Challenges and Opportunities

Q. What are the biggest challenges faced by the industry in the testing and measurement space? and How is SEMCO addressing these challenges to create opportunities for growth?

Biggest Challenges in the Industry:

- Accuracy and Reliability: Ensuring precise measurement and consistent testing results across diverse battery types.
- Scalability: Adapting testing systems to both small-scale R&D needs and large-scale production.
- Automation: Balancing high-speed automation with accuracy and efficiency.
- Integration: Combining multiple testing functions into a single system for streamlined operations.
- Cost Efficiency: Developing advanced systems that remain affordable for manufacturers.
- Sustainability: Addressing environmental concerns with energy-efficient and eco-friendly solutions.

SEMCO's Approach:

- Innovative Solutions: Developing all-in-one testing machines to combine grading, sorting, and testing for efficiency.
- Customization: Offering tailored systems to meet specific customer needs in R&D and production.
- High Precision: Leveraging advanced technology for accurate and reliable testing.
- Automation Integration: Implementing AI and IoT for smarter, faster, and scalable testing systems.
- Cost-Effective Models: Providing solutions for both large-scale production and budget-conscious setups.
- Sustainability Focus: Designing energy-efficient equipment that supports eco-friendly practices.

Through these strategies, SEMCO transforms challenges into opportunities, driving innovation and growth in the testing and measurement sector.

Market Trends and Strategy

Q. What trends do you see shaping the future of battery testing and manufacturing?

Future Trends in Battery Testing and Manufacturing:

1. **Automation:** Increased use of AI, IoT, and robotics for precision and efficiency.
2. **Advanced Testing:** Real-time, multi-parameter testing for improved accuracy.
3. **Sustainability:** Eco-friendly processes and recycling technologies.
4. **Customization:** Modular systems for diverse cell types and production scales.
5. **Integrated Solutions:** All-in-one machines for grading, sorting, and testing.
6. **Next-Gen Batteries:** Testing tailored for solid-state and advanced chemistries.
7. **Quality Focus:** Stricter compliance driving reliable systems.
8. **Localized Manufacturing:** Boosting regional production to meet demand.

Q. How is SEMCO positioning itself to stay ahead in this competitive market?

SEMCO stays ahead by delivering innovative, all-in-one battery solutions, integrating advanced automation, and offering customizable systems. With a focus on precision, sustainability, and strong R&D, SEMCO ensures high-quality, cost-effective solutions while adapting to emerging technologies and market demands.

Collaboration and Ecosystem

Q. Can you share insights into any significant partnerships or projects SEMCO is currently involved in?

SEMCO is engaged in significant partnerships and projects that drive innovation and growth:

1. **Strategic Collaborations:** Partnering with global leaders like NEWARE to distribute cutting-edge battery testing and manufacturing equipment in India.
2. **Large-Scale Projects:** Supporting leading battery manufacturers with integrated solutions for grading, sorting, welding, and testing to enhance production efficiency.
3. **PLI Scheme Participation:** Contributing to India's Production-Linked Incentive (PLI) initiative by providing advanced equipment for localized battery production.
4. **R&D Collaboration:** Collaborating with research centers and universities to develop next-gen technologies for battery testing and assembly.

These initiatives highlight SEMCO's commitment to fostering innovation, supporting industry growth, and staying at the forefront of the battery technology landscape. ■

Driving the Future of Automotive Skills: ASDC at Bharat Mobility Expo 2025

The Bharat Mobility Expo 2025 was not just an exhibition of innovation but a testament to India's transformative journey in mobility. Among the standout participants was the Automotive Skills Development Council (ASDC), an organization dedicated to preparing India's workforce for the future of the automotive industry. At the state-of-the-art India International Convention & Expo Centre (IICC), ASDC's presence was a compelling statement of its vision to empower individuals through advanced skills development in an era of rapid technological evolution.

Empowering a Future-Ready Workforce

As industries transition to electric mobility, autonomous technologies, and sustainable practices, the demand for a skilled workforce has surged. ASDC's participation at the Expo showcased its strategic focus on equipping individuals with the expertise required to thrive in this dynamic environment.

Visitors to the ASDC exhibit engaged with a range of interactive programs aimed at addressing critical skill gaps. From training modules in electric vehicle maintenance and repair to the intricacies of autonomous driving systems, ASDC's offerings reflect the needs of a changing mobility landscape. This approach not only prepares trainees for immediate employment but also fosters a deeper understanding of emerging trends, ensuring that they remain relevant as the industry evolves.

Sustainability at the Core

One of the central themes of the Expo was sustainability, and ASDC demonstrated how skilling initiatives can align with broader environmental goals. By integrating sustainable practices into its training modules, the organization highlighted the role of the workforce in reducing the automotive sector's carbon footprint. Programs focusing on efficient manufacturing techniques, recycling processes, and green energy applications positioned ASDC as a key enabler of environmentally responsible innovation.

Road Safety: A Shared Responsibility

"This year, the Expo placed a strong emphasis on road safety, a crucial aspect of India's mobility vision. ASDC leveraged this platform to raise awareness about safer driving practices and their importance in shaping a sustainable future. Through collaborations with campaigns like SAFE INDIA, SMART INDIA, ASDC underscored the role of education in preventing road accidents and fostering a culture of safety", said Mr. F R Singhvi, President, ASDC. By incorporating road safety modules into its skilling programs, the organization is not only creating better drivers but also empowering individuals to act as ambassadors of responsible mobility. This proactive approach ensures that safety becomes a shared priority across the workforce and the community.

A Holistic Approach to Skilling

Mr. Vinkesh Gulati, Vice President, ASDC, mentioned, "Beyond technical expertise, ASDC is redefining how skills are delivered through a blend of digital tools and hands-on training. By adopting advanced learning platforms and simulation technologies, the council has created immersive educational experiences that mirror real-world challenges. This methodology not only enhances learning outcomes but also builds confidence among trainees to tackle complex industry demands."

At the Expo, these forward-thinking approaches were evident in the enthusiasm of visitors who explored ASDC's programs. The council's commitment to skilling is not just about creating job opportunities but fostering careers that drive innovation and growth in the automotive industry.

Shaping a Sustainable and Inclusive Mobility Future

ASDC's participation at Bharat Mobility Expo 2025 reaffirmed its position as a leader in workforce development for the automotive sector. By addressing emerging challenges through innovative skilling solutions, ASDC is laying the foundation for a future where technology and sustainability converge.

As the automotive industry continues to embrace change, ASDC's role becomes even more vital. With a clear vision and robust strategies, the organization is not only preparing individuals for new opportunities but also contributing to India's ambition to be a global leader in mobility innovation. ■

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New Vehicle Efficiency Standard will reduce CO2 from new passenger vehicles by 60% between 2025 and 2029 : Dr. Saroj

In recent interview with Dr. Shailendra Saroj- Chairman International Federation of electric vehicle association, Dr. Saroj explain about international EV policy.

As of early 2025, several governments worldwide have implemented new and evolving policies to support the adoption of electric vehicles (EVs) as part of their efforts to reduce emissions, improve air quality, and accelerate the transition to renewable energy. These policies vary widely depending on the country, but here are some of the latest developments in key regions:

1. United States

Inflation Reduction Act (IRA) of 2022: This significant piece of legislation offers a variety of incentives to promote EV adoption. Key provisions include:

- EV Tax Credits: Consumers can receive up to $7,500 in tax credits for purchasing a new electric vehicle, with conditions on sourcing materials and assembly (e.g., the vehicle must be assembled in North America and meet specific requirements for critical mineral sourcing).
- Used EV Tax Credits: A tax credit of up to $4,000 is available for used EV purchases, aimed at making electric vehicles more affordable for a broader range of consumers.
- Consumer Incentives for Charging Infrastructure: There are provisions for rebates and tax credits to help individuals and businesses install home and workplace charging stations.
- Support for EV Manufacturing: The IRA provides incentives for companies that manufacture batteries, EVs, and related infrastructure within the United States.
- EV Charging Network Expansion: The federal government is investing in the expansion of a national network of fast-charging stations to alleviate "range anxiety."

Biden Administration's EV Goals: President Joe Biden has set a goal of having electric vehicles make up 50% of all new car sales in the U.S. by 2030, with additional funding allocated for research, development, and infrastructure.

2. European Union

Fit for 55: The European Union's climate package, known as "Fit for 55," aims to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. Key provisions relevant to the EV industry include:

- Ban on Internal Combustion Engine Vehicles (ICEVs) by 2035: The EU has proposed a ban on the sale of new cars and vans powered by internal combustion engines by 2035. This policy is designed to accelerate the transition to electric mobility.
- EV Charging Infrastructure: The EU is investing heavily in expanding EV charging infrastructure, with a focus on building fast-charging stations along major highways and in urban areas.
- Battery Regulation: The EU is also working on new regulations aimed at improving the sustainability of batteries, including requirements for greater recyclability and the use of ethically sourced materials.

National Incentives: Individual EU countries offer additional incentives to consumers, including subsidies, tax rebates, and grants for purchasing electric vehicles and installing charging infrastructure.

3. China

- Subsidies for EVs: China has been a global leader in promoting electric vehicles, offering substantial subsidies to consumers and automakers. However, the government is gradually reducing direct subsidies, with the focus shifting to other incentives.
- Carbon Credit System: China operates a carbon credit system where automakers can earn credits for producing electric vehicles, which they can trade or use to offset their production of gasoline-powered cars.
- EV Charging Infrastructure: The Chinese government is aggressively expanding EV charging infrastructure, aiming to have over 4.8 million charging points by 2025.
- Zero-Emission Vehicle Mandate: China

has set a goal for new energy vehicles (NEVs), which include electric, plug-in hybrid, and fuel cell vehicles, to account for 40% of total vehicle sales by 2030.
- Local Incentives: Many Chinese cities offer local incentives for EVs, such as reduced registration fees, free parking, and access to bus lanes.

4. India
- Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) Scheme: The Indian government has extended its FAME II scheme, which provides subsidies for the purchase of electric vehicles, with a focus on electric two-wheelers, buses, and four-wheelers. The scheme also offers incentives for setting up EV charging infrastructure.
- Tax Benefits: Under the Goods and Services Tax (GST) regime, EVs in India are taxed at a lower rate (5%) compared to conventional vehicles (28%).
- State-Level Policies: Several Indian states offer additional incentives such as road tax exemptions, subsidies for EV purchase, and support for local manufacturing of EVs and batteries.
- Battery Manufacturing: India is looking to become a major hub for battery production through initiatives like National Mission on Transformative Mobility and Battery Storage, which aims to foster domestic manufacturing and reduce reliance on imported batteries.

The scheme you're referring to appears to be part of India's push towards greener and more sustainable transportation options. Based on the details provided, it aligns with various initiatives aimed at promoting electric vehicle (EV) adoption and supporting EV manufacturing within the country.

This specific scheme started in April 2024 and will end in July 2024, with a total budget of US$ 60.18 million (Rs. 500 crore). The main objectives of the scheme are:

1. **Enhancing Green Mobility:** This initiative aims to promote the transition to electric mobility, reducing dependence on fossil fuels, lowering emissions, and improving air quality.
2. **Encouraging EV Manufacturing:** It focuses on boosting domestic manufacturing of electric vehicles, including incentives for companies to invest in EV production and technology. This is likely to be part of India's broader goal of becoming self-reliant in EVs and related components, such as batteries.
3. **Support for EV Ecosystem:** While the scheme's exact details aren't fully provided, schemes of this nature typically include:
   - » Subsidies and incentives for purchasing electric vehicles.
   - » Support for charging infrastructure to ensure easy access to charging points.
   - » Technology and innovation funding for the development of electric vehicle technology, including improvements in battery efficiency, range, and affordability.
   - » Green manufacturing policies to encourage the establishment of EV production plants and related industries within India.

Similar Previous Schemes:
In India, there have been other key schemes to promote electric mobility, such as the FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) scheme, which has provided financial incentives for purchasing EVs and building infrastructure. This current scheme might either build upon or complement the existing FAME scheme to further push the agenda of electric vehicle adoption in the country.

Expected Outcomes:
- Increased EV Adoption: The scheme is expected to drive more consumers and businesses towards adopting electric vehicles.
- Domestic EV Manufacturing: It could also help develop a robust local EV manufacturing ecosystem, reducing reliance on imports and encouraging innovation in EV technology.
- Environmental Benefits: A significant reduction in carbon emissions and improved urban air quality.

This scheme is an important step toward India's long-term goal of having a large portion of its vehicle fleet be electric, aligning with its broader climate change goals and push for green energy solutions.

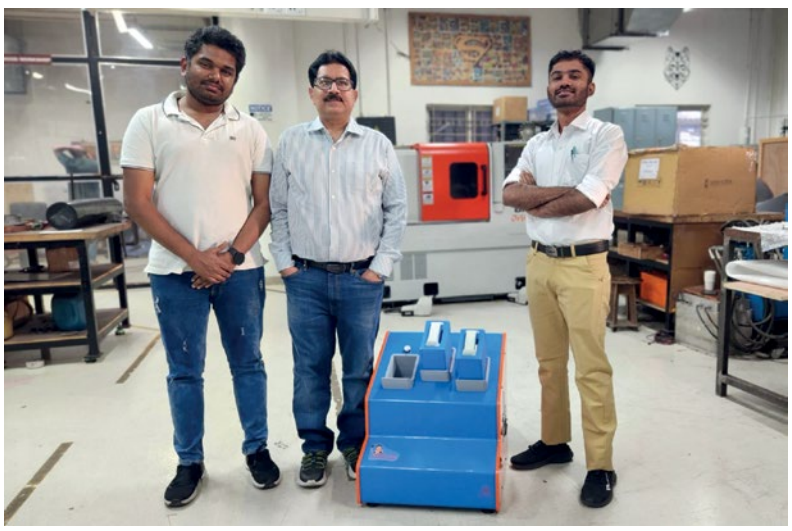
5. United Kingdom
- Ban on Sale of New Petrol and Diesel Cars: The UK government has set a firm target to ban the sale of new petrol and diesel cars by 2030, with hybrid vehicles allowed until 2035. The policy aims to encourage the switch to fully electric vehicles.
- EV Charging Network: The UK has committed significant investments to build a comprehensive EV charging network, including funding for fast-charging stations along motorways and in urban areas.
- Grants for EV Purchases: The UK has provided grants for consumers purchasing electric vehicles, although these are being phased out for higher-priced models, with more focus now on helping lower-income households.
- Battery Recycling and Sustainability: The UK is exploring initiatives to improve the sustainability and recycling of EV batteries, aligning with its broader environmental goals.

6. Japan
- EV Incentives and Subsidies: Japan provides incentives for both individuals and businesses to purchase electric vehicles, including subsidies, tax reductions, and low-interest loans.
- 2035 Target for All New Cars to Be EVs: Japan has announced plans to make all new cars sold in the country zero-emission vehicles by 2035. This includes both electric vehicles and hydrogen-powered vehicles.
- EV Charging Infrastructure: The government has supported the growth of the EV charging infrastructure, aiming for a network that will support millions of EVs in the coming years.

7. Canada
- Incentives for EVs: The Canadian government offers federal rebates of up to $5,000 CAD for the purchase of new electric vehicles and $2,500 CAD for used EVs.
- Zero-Emission Vehicle Standard: Canada has announced plans to make 100% of new vehicle sales zero-emission vehicles by 2035.
- Investment in Charging Infrastructure: The government is investing in EV charging stations across the country, particularly in rural and remote regions, to ensure comprehensive coverage.

Conclusion
Governments around the world are actively promoting the adoption of electric vehicles through a combination of tax incentives, subsidies, regulatory frameworks, and investments in infrastructure. The overarching goal for most of these policies is to reduce greenhouse gas emissions, improve air quality, and transition toward a more sustainable future. While specific policies vary, many countries share a commitment to accelerating the adoption of EVs as part of their climate goals. ■

Accelerating EV Adoption:
Mechlae Energy's Zero Downtime Technology



Rajiv Bajaj
Cofounder and Director
Mechlae Energy

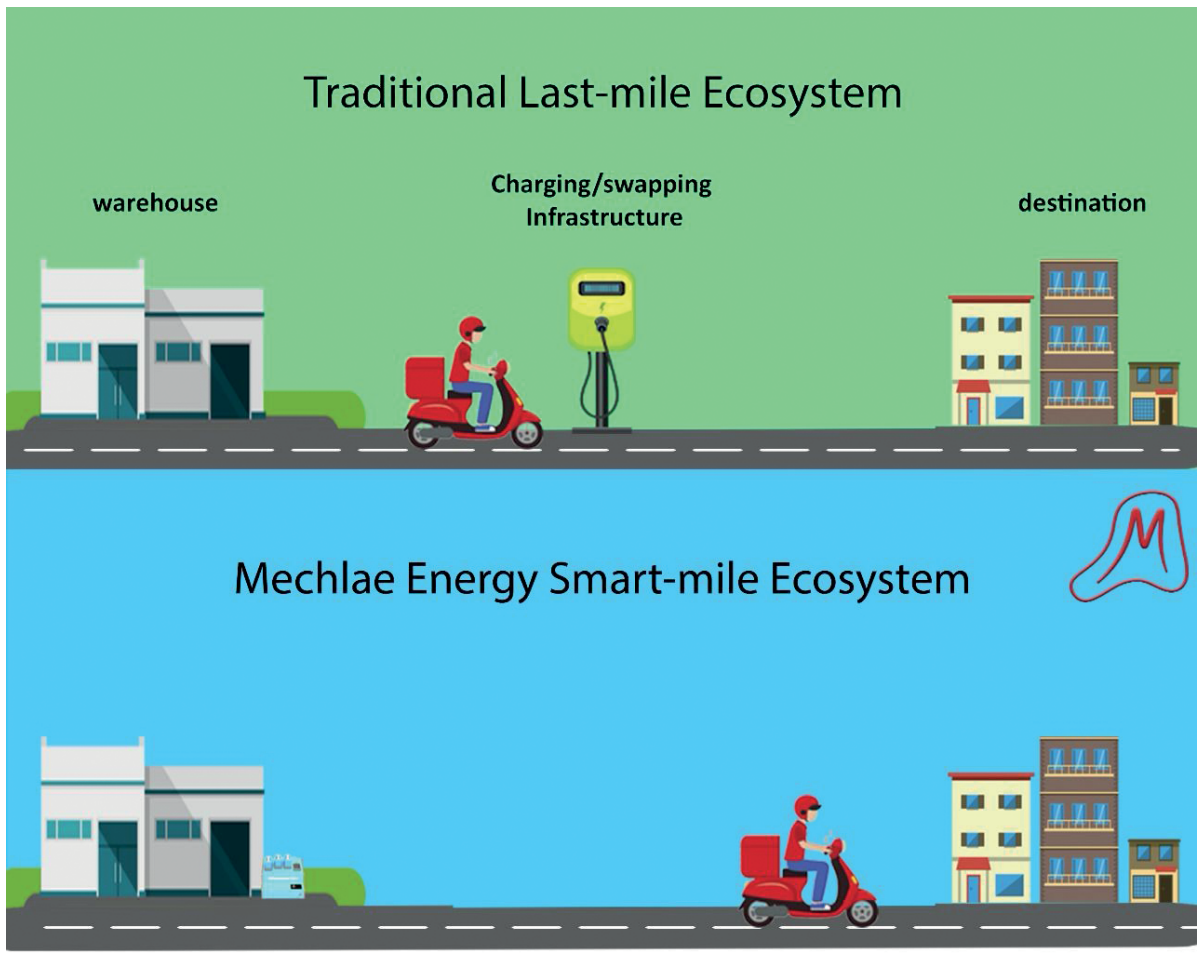
The slow pace of electric vehicle (EV) adoption in last-mile logistics is primarily due to two critical challenges: the high cost of charging infrastructure and prolonged downtimes during recharging. As of 2024, only 15% of light EV fleets have transitioned to electric systems, with infrastructure gaps contributing to over 50% of the delay. Mechlae Energy's innovative zero downtime battery swapping technology offers a groundbreaking solution, enabling rapid EV adoption and reducing the dependency on traditional charging networks.

Traditional EV ecosystems require charging stations that cost an average of $10,000–20,000 per unit to install, with 3x additional operational costs for maintenance and electricity. These stations often take 30–60 minutes to recharge a single vehicle, resulting in significant downtime, it's not about just swapping, it's about dedicated time to reach the destination. Mechlae's portable and user-friendly battery swapping solution eliminates these barriers by allowing fleets to replace batteries in during routine operations, such as delivery pickups enabling Zero-downtime. This process reduces vehicle downtime by over 100% and eliminates the need for fixed infrastructure investments.

From a technical perspective, Mechlae's system is designed for scalability and compatibility with multiple EV platforms. The lightweight swappable battery packs feature advanced safety mechanisms, including twin-case shielding and immersive air-cooled technology, ensuring reliability across diverse environments. The integration of renewable energy sources, such as solar panels, further reduces operational costs by up to 25%.

With the ability to scale EV adoption rates to 80% in areas lacking infrastructure, Mechlae Energy's technology empowers businesses to electrify their fleets quickly. By addressing infrastructure bottlenecks, this solution saves an estimated $50,000 per fleet annually in infrastructure and downtime costs, paving the way for sustainable and cost-effective last-mile logistics.■

Checkout: https://mechlae.com



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India's AUTOMOBILE SECTOR: Inside India's Thriving Automobile Ecosystem

Rajjat Kharbanda
Research Director, 6W RESEARCH

India's Automobile Industry Outlook: Trends, Opportunities, and Challenges

The Indian automobile industry has long been a cornerstone of the nation's economic development, contributing significantly to GDP, employment, and industrial growth. As the country rapidly evolves, the automobile sector is expected to play an even more vital role in shaping India's future. In fiscal year 2023-24 (FY24), the Indian automobile industry demonstrated robust growth across various segments, reflecting its resilience despite challenges such as global supply chain disruptions and evolving consumer preferences. In this article, we provide an overview of the current state, key drivers of growth, and potential challenges faced by the industry, alongside future outlooks and opportunities.

Industry Performance in FY24

India's automobile industry showed positive momentum in FY24, with most segments demonstrating growth despite challenges like semiconductor shortages and rising input costs. The Society of Indian Automobile Manufacturers (SIAM) reported a 12.5% increase in total domestic vehicle sales, amounting to 23.85 million units. This increase was driven primarily by the passenger vehicle (PV) segment, two-wheelers, and three-wheelers.

Passenger Vehicles (PVs)

The passenger vehicle segment, which has become increasingly important in the Indian market, saw domestic sales grow by 8.4%, totaling 4.2 million units. This growth was largely attributed to utility vehicles (UVs), which registered a significant 26% increase in sales, with 2.52 million units sold. The rising popularity of SUVs is reflective of the changing consumer preferences towards more spacious and feature-rich vehicles. As a result, the demand for SUVs has surged, with manufacturers launching new models catering to both premium and mid-range segments.

Two-Wheelers

The two-wheeler segment, which has traditionally been the backbone of the Indian automobile industry, grew by 13%, with total domestic sales reaching nearly 18 million units. However, this growth remained below the pre-pandemic peak of 21 million units seen in FY19. A key factor limiting the recovery in sales was the slower rebound of rural demand, coupled with the rising input costs for manufacturers. Nonetheless, two-wheelers continue to dominate the market, especially in rural and semi-urban areas where they serve as an essential mode of transport.

Three-Wheelers

The three-wheeler segment witnessed a sharp recovery, with domestic sales rising by 48.6%, reaching 11,67,000 units. This strong growth was largely driven by a rebound in shared mobility services and last-mile delivery logistics, areas where three-wheelers play an essential role. The government's push for cleaner fuels through initiatives like CNG and electric vehicles (EVs) also played a role in stimulating demand for eco-friendly three-wheelers.

Commercial Vehicles (CVs)

The commercial vehicle segment, although growing at a slower pace, saw an increase in sales, reaching 967,878 units. However, the growth was not uniform across all sub-segments. While medium and heavy commercial vehicles (MHCVs) showed some growth, light commercial vehicles (LCVs) and small commercial vehicles (SCVs) witnessed a slight decline, primarily due to subdued demand in the compressed natural gas (CNG) segment and fluctuations in freight demand.

Financial Valuation and Market Dynamics

The financial valuation of the Indian automobile sector rose significantly in FY24, reaching ₹10.22 lakh crore, marking a 19% growth compared to the previous year. A major driver of this growth has been the increasing preference for utility vehicles, SUVs, and premium vehicles. These vehicles are characterized by higher price points and advanced features, thus contributing to a larger share of the industry's total value. The demand for premium vehicles has surged, driven by factors such as higher disposable incomes, urbanization, and changing consumer preferences towards advanced technologies like electric powertrains, connectivity features, and enhanced safety systems.

The shift in consumer behavior towards more feature-rich and environmentally friendly vehicles is also visible in the rising sales of electric vehicles (EVs). The Indian government has introduced various policies to stimulate the growth of the EV market, including subsidies and tax exemptions under the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme.

Government Initiatives and Policies

The Indian government has played a crucial role in promoting the growth of the automobile industry. Several key initiatives have been introduced to support both the traditional vehicle segments and emerging technologies like electric vehicles.

Production Linked Incentive (PLI) Scheme

The government's Production Linked Incentive (PLI) Scheme for automobiles and auto components has been a major policy driver, with a budget of ₹25,938 crore allocated from FY23 to FY27. This scheme aims to enhance domestic manufacturing and attract global investment into the sector. By March 2024, the scheme had already attracted proposed investments worth ₹67,690 crore, generating employment for 28,884 people. These investments are expected to create up to 1.48 lakh new jobs in the sector, which will support the wider manufacturing ecosystem in the coming years.

Vehicle Scrappage Policy

Another important policy is the Vehicle Scrappage Policy, which encourages the scrapping of older, polluting vehicles. The government aims to establish scrapping centers across the country, which will help reduce emissions and improve air quality. This initiative is expected to lead to an 18-20% increase in vehicle sales, as consumers will be incentivized to replace their old vehicles with more efficient models.

CNG Infrastructure Expansion

The Indian government is also focusing on expanding the country's CNG infrastructure. With plans to establish 17,500 CNG stations by 2030, the government is promoting the use of CNG as a cleaner alternative to traditional fuels. This move is expected to not only reduce carbon emissions but also provide a viable alternative to rising fuel costs for both consumers and commercial vehicle operators.

Challenges Faced by the Industry

Despite its growth, India's automobile industry faces several significant challenges. One of the most pressing issues is the global supply chain disruptions, particularly the semiconductor shortage. The automotive sector, which relies heavily on semiconductors for vehicle electronics, has faced production delays and increased costs. Manufacturers have had to adapt to these disruptions by diversifying their supply chains and looking for alternative sources for critical components.

Additionally, the transition to electric vehicles presents a complex set of challenges. Manufacturers need to invest heavily in new technologies, production lines, and infrastructure to meet the increasing demand for EVs. This includes building more charging stations, offering affordable battery solutions, and improving the efficiency and sustainability of EVs.

Stricter environmental regulations and rising input costs are also putting pressure on manufacturers. Meeting the requirements of Bharat Stage VI (BS-VI) emission standards, for instance, requires significant investments in engine technologies and exhaust systems.

Future Outlook: Opportunities and Growth

India's automobile industry is set to become the third-largest in the world by 2030, with growth driven by several key factors. The country's rising middle class, growing urbanization, and expanding digital economy will continue to fuel demand for both traditional and electric vehicles. Government policies, such as the FAME scheme, are expected to accelerate the adoption of electric vehicles, contributing to India's commitment to reducing its carbon footprint.

By 2024, the industry's size is expected to double to ₹15 lakh crore, driven by both domestic demand and exports. The export of vehicles and auto components is set to increase as India positions itself as a global manufacturing hub. The demand for connected, autonomous, and electric vehicles will drive technological innovation and R&D investments, ensuring the sector's competitiveness on the global stage.

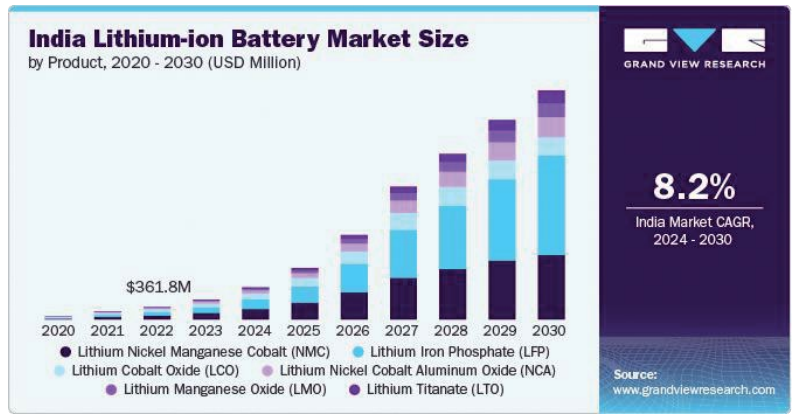
Conclusion

India's automobile industry is on a strong growth trajectory, with significant contributions to the nation's economic development and job creation. While the sector faces challenges such as supply chain disruptions, regulatory pressures, and the transition to electric mobility, the outlook remains positive. With supportive government policies, evolving consumer preferences, and a growing focus on sustainable technologies, India's automobile sector is poised to emerge as a global leader in the coming years. The shift towards electric vehicles, along with the continued demand for SUVs and premium vehicles, will play a central role in shaping the industry's future. ■

Source : 6W RESEARCH

The Future of LITHIUM BATTERIES in India: 2025-2030

Indrajit Ghosh
Global Chairman MSME Chamber of Commerce and Industry of India
& CMD World GREXPO Foundation New Delhi, India



India, a rapidly growing economy with a population of over 1.4 billion, is undergoing a transformation towards cleaner, greener energy solutions. Among the many technologies shaping the future of energy storage, lithium-ion (Li-ion) batteries stand out as a key enabler in this shift. Lithium-ion batteries, the heart of electric vehicles (EVs), renewable energy storage, and portable devices, are poised to revolutionize India's energy landscape from 2025 to 2030.

The role of lithium-ion batteries in India's future is critical, not only for addressing the challenges of energy storage and electric mobility but also for meeting ambitious environmental goals. In this article, we explore the growing demand for lithium batteries in India, technological advancements, challenges, and the future outlook from 2025 to 2030.

1. Rising Demand for Lithium Batteries in India: Key Drivers

(a) Electric Vehicles (EVs) and Transportation Electrification

The most significant demand driver for lithium-ion batteries in India is the electrification of the transportation sector. With increasing concerns over air pollution, carbon emissions, and dependence on fossil fuels, India has set ambitious goals for the adoption of electric vehicles (EVs). The Indian government has introduced numerous initiatives to support EV adoption, including the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, which provides subsidies for electric vehicles and charging infrastructure. By 2030, India aims to have 30% of its total vehicle sales be electric. This shift will create a massive demand for lithium-ion batteries, as these batteries are currently the preferred technology for EVs due to their efficiency, energy density, and cost-effectiveness.

(b) Renewable Energy Integration and Storage

India is investing heavily in renewable energy, particularly solar and wind power, to meet its climate goals. By 2030, the country aims to have 500 GW of renewable energy capacity, a massive leap from the current 150 GW. However, renewable energy is intermittent and dependent on weather conditions, which creates a significant challenge for grid stability. Lithium-ion batteries are an ideal solution to store excess energy generated from renewable sources, enabling a reliable and continuous supply of electricity. As renewable energy generation expands, the need for energy storage solutions, such as large-scale lithium-ion battery storage systems, will grow.

(c) Consumer Electronics and Portable Devices

The growth of the consumer electronics market in India also contributes to the increasing demand for lithium-ion batteries. With the rising middle class and increasing disposable incomes, the demand for smartphones, laptops, tablets, and wearables is expanding rapidly. Lithium-ion batteries, being lightweight, rechargeable, and energy-dense, are the go-to power source for these devices.

(d) Industrial Applications and Grid Energy Storage

Apart from EVs and consumer electronics, lithium-ion batteries are also being used in a range of industrial applications, including grid energy storage, telecommunication infrastructure, and backup power systems. In particular, the use of lithium-ion batteries in grid-scale energy storage systems is gaining traction as utilities seek to improve grid reliability and integrate renewable energy sources.

2. Technological Advancements & Innovations

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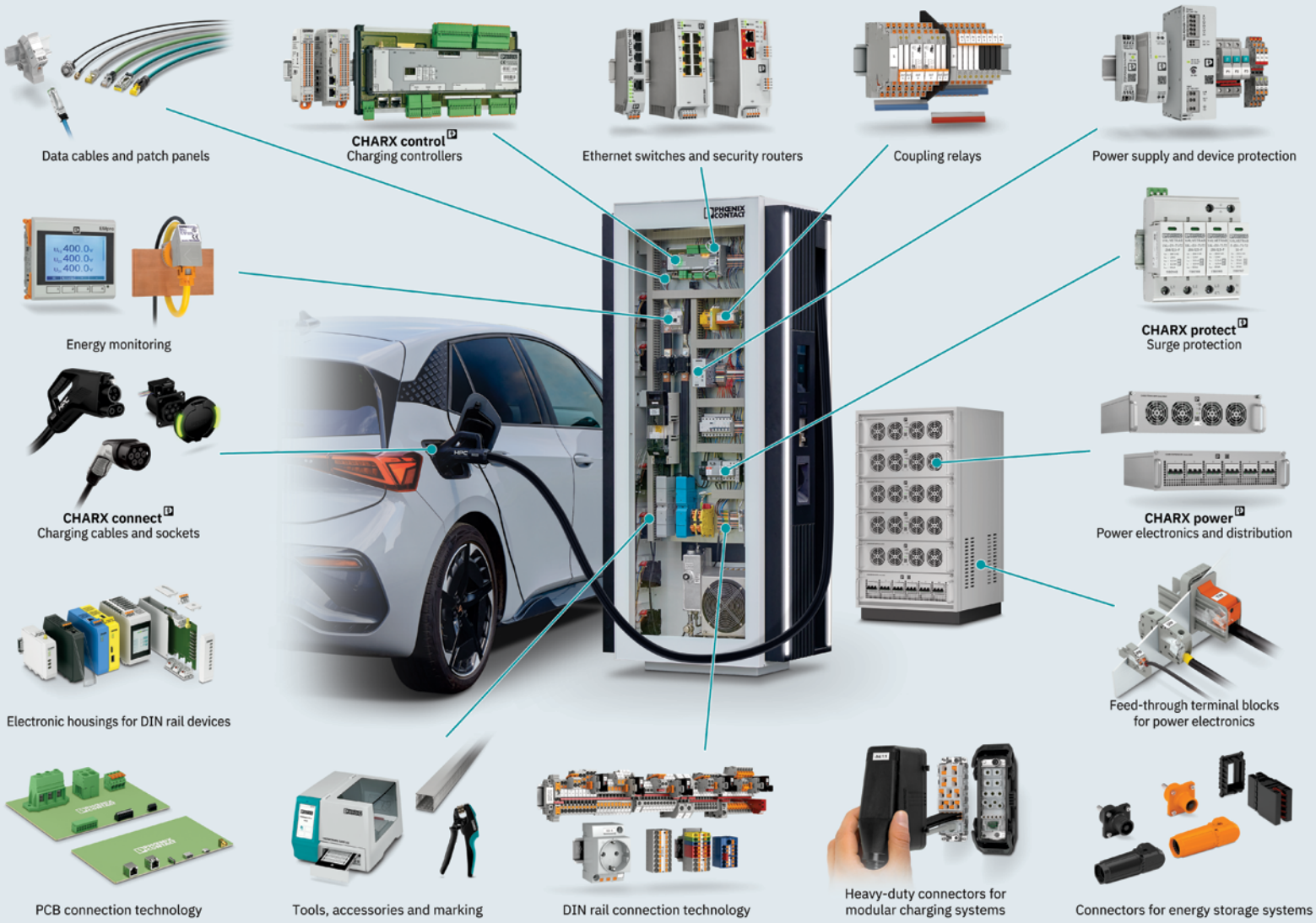

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battery technology will be key to addressing the challenges related to cost, energy density, and lifespan. A few key technological trends that will shape the future of lithium batteries in India include:

(a) Solid-State Batteries

Solid-state batteries represent the next generation of lithium-ion technology. Unlike traditional lithium-ion batteries, which use liquid electrolytes, solid-state batteries use solid electrolytes, offering a safer and more energy-dense solution. Solid-state batteries are expected to have higher energy density, faster charging times, and longer lifespans, making them ideal for EVs and grid storage.

As research and development in solid-state battery technology continues to advance, it is expected that India will begin to see commercial adoption of solid-state batteries by the end of the decade. This could significantly improve the performance of electric vehicles and renewable energystorage systems, further driving the transition to a clean energy economy.

(b) Battery Recycling and Second-Life Batteries

As the adoption of lithium-ion batteries increases, the need for sustainable solutions for battery recycling and repurposing will become even more important. India, which currently faces challenges in the recycling of electronic waste (e-waste), will need to develop efficient systems for recycling lithium-ion batteries to recover valuable materials such as lithium, cobalt, and nickel. Additionally, second-life batteries—used EV batteries that still have usable charge capacity—can be repurposed for energy storage applications. These second-life batteries can help alleviate the cost of new energy storage systems and promote circular economy principles.

(c) Localized Production and Cost Reduction

Currently, India is largely dependent on imports for lithium-ion batteries, primarily from China. However, this is set to change as the government takes steps to promote local manufacturing of lithium batteries. India has already announced initiatives such as the Production-Linked Incentive (PLI) scheme to incentivize domestic manufacturing of batteries & EVs.

The localized production of lithium batteries will not only reduce import dependency but also lower battery costs, making electric vehicles and renewable energy storage systems more affordable. By 2030, it is expected that India will have a robust local lithium-ion battery manufacturing ecosystem.

3. Challenges Facing the Lithium Battery Industry in India

While the prospects for lithium batteries in India are promising, there are several challenges that need to be addressed to unlock their full potential:

(a) Raw Material Sourcing

Lithium-ion batteries require critical raw materials such as lithium, cobalt, and nickel. India does not have significant reserves of these materials, making it dependent on imports. The global competition for these materials, coupled with geopolitical tensions, could lead to supply chain disruptions and price volatility.

To address this, India needs to explore new avenues for securing these raw materials, including developing domestic mining capabilities, securing international supply agreements, and investing in recycling technologies to recover materials from used batteries.

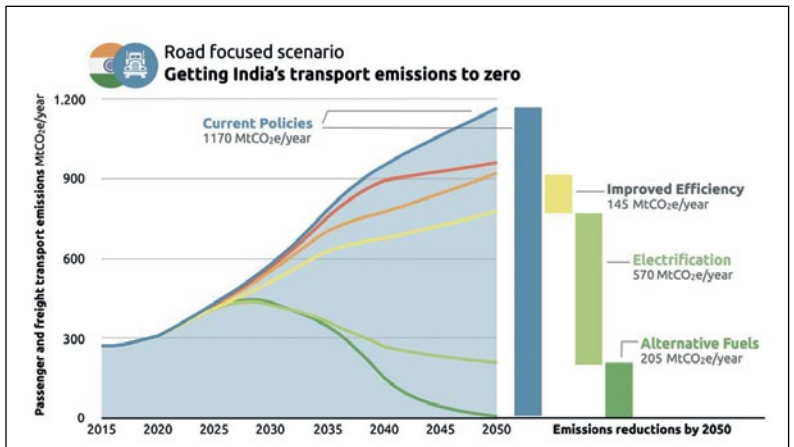


Figure 23. Emissions from passenger and freight transport in the Road focused scenario, showing emission reductions obtained from improved efficiency, electrification of vehicle fleets, and alternative fuels.

(b) Infrastructure and Charging Networks

The widespread adoption of electric vehicles will require a robust network of charging stations, especially in urban and rural areas. While the government has made efforts to promote EV charging infrastructure, India still lacks a comprehensive network of fast-charging stations. Building this infrastructure will be crucial for driving the adoption of EVs and ensuring that lithium-ion batteries are fully utilized.

(c) Energy Security and Grid Challenges

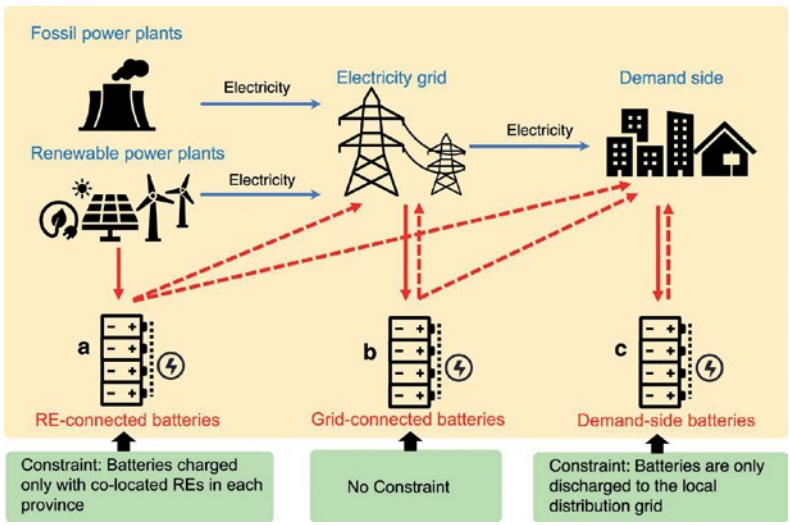
As the demand for lithium-ion batteries increases, so does the need for a stable and reliable grid to support energy storage systems. India's power grid infrastructure is still under development, with grid reliability and the integration of renewable energy sources being significant challenges. A modernized and upgraded grid system will be necessary to handle the increased demand for energy storage and the deployment of lithium-ion batteries.

4. The Road Ahead: 2025-2030

From 2025 to 2030, the future of lithium-ion batteries in India is bright, but their widespread adoption will depend on overcoming several challenges. The government's focus on electrifying transportation, promoting renewable energy, and localizing battery manufacturing will create significant opportunities for growth in the lithium battery sector.

Technological advancements in battery efficiency, coupled with improvements in recycling, will drive down costs and enhance the performance of lithium-ion batteries. However, addressing the challenges related to raw material sourcing, infrastructure development, and grid reliability will be crucial to ensuring a sustainable and scalable lithium-ion battery ecosystem in India.

By 2030, India is expected to become a global leader in lithium-ion battery production, recycling, and energy storage, playing a key role in the global transition to a clean energy future. The adoption of lithium-ion batteries will not only transform India's transportation and energy systems but will also create new economic opportunities, generate jobs, and contribute to the country's environmental goals. The next decade holds great promise for India as it embraces the potential of lithium-ion batteries in driving a sustainable, low-carbon future. ■



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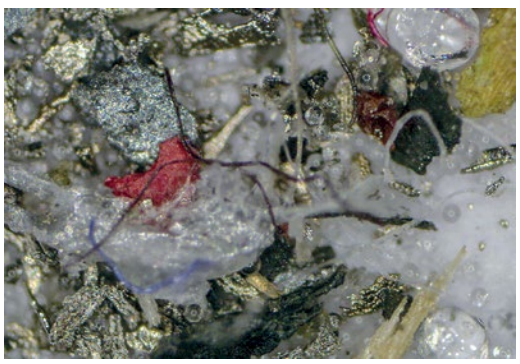
Identifying the root cause of particle contamination in **electronic automotive components**

ZEISS Technical Cleanliness Solutions

Particle contamination in battery production is the enemy of product efficiency, functionality, and longevity.

Production processes, the production environment, and the final packaging all have an influence on component cleanliness. As a result, compliance agreements with limiting values often need to be implemented between the customer and supplier or between product development and production. This means that the cleanliness requirements are not fixed and can be specifically chosen by the customer in accordance with the product geometry function, manufacturability, and verifiability of the component.

Technical cleanliness is attracting increased attention in industry because it promotes the efficiency and effectiveness of individual industrial products. Not only does it begin with the suppliers at the very start of the production chain, it is applicable to all industries – covering implants in the field of medical technology, engine components and assemblies in automotive settings, and even fuels and lubricants in aerospace. Particulate contamination may impair performance in the automotive industry by migrating from previously non-critical areas to sensitive locations such as semiconductors, with metallic and non-metallic particles that gather on these parts causing the car to malfunction or even stopping the engine.



This paper specifically addresses particle contamination on a lithium-ion battery. Though this issue is primarily associated with the automotive industry at present, it is also of wider relevance for many other industries.

The quality solution: technical cleanliness. But what is technical cleanliness?

Technical cleanliness is a two-stage procedure that uses a light microscope to examine the number and size of particles present, then deploys an electron microscope to confirm the chemical composition and origin of the particles. It therefore seeks to eliminate system failures that could potentially be caused by these particles.

The necessary level of technical cleanliness is determined on the basis of the particle-sensitive points on the system in question. The relevant particles may also differ in character – while combustion engines typically encounter hard and abrasive metallic particles, electronic engines can be susceptible to low- and high-conductivity particles. Most particles are generated during the processing of components and assemblies (approx. 80%) and only a fraction (approx. 20%) are due to environmental influences. Since manufacturers cannot address every possible malfunction and manufacturing process, the aim here is to focus on metallic particles.

VDA 19/ISO 16232 was established as a standard for enabling customers and suppliers to address the risk of potential damage to products across the production chain. In the electronics industry, VDA 19 does not specify any limiting values for component cleanliness. These must be

defined according to component function, producibility, and verifiability. When residual contamination is sufficiently low, the system is considered adequately clean.

VDA 19.2: a brief overview

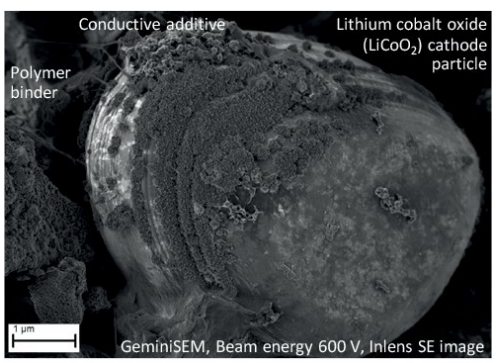
The aim of VDA 19.2 is to prevent critical particulate contamination at sensitive sites, to remove unavoidable particles, and to protect components and assembled systems against the entry of particles from the surroundings. As well as targeting these technical goals, the guideline also helps standardize procedures for planning and optimizing cleanliness-sensitive assembly areas. It is essential for the product development process.

The Illig method, as described in the VDA 19.2 standard, is used to test the cleanliness of a given location based on its environmental conditions – such as air or workbenches. Particle traps make it possible to analyze the number of sedimented particles per time unit (Illig value). The detected particle number per size class is multiplied by a weighting factor, added up, and normalized to calculate the Illig value. This Illig value is generated by normalizing the sum value to an area of 1000 cm2 and a measuring time of 1 h. The calculated Illig value provides the basis for comparing the collected particle contamination at different locations over a certain time period. With the Illig formula, larger particles are more heavily weighted than smaller ones as the former are more likely to have a higher damage potential.

Ion battery structure

All lithium-ion batteries share the same fundamental structure, comprising an anode and a cathode that need to be kept a fixed distance apart. They also feature an electrolyte that lets the charge transfer from one electrode to the other.

Foils act as the separator in such batteries. Not only must this be sufficiently flexible to prevent short circuits by maintaining the necessary gap between the electrodes, it needs to be structured in a way that allows the ions generated in the electrolyte to pass through.



BATTERY CATHODE PARTICLES

Contamination errors in the manufacturing process of an ion battery

Lithium-ion batteries are very sensitive to contamination in the manufacturing process. Contamination in the form of particulate, ionic contamination, and even water can all cause significant levels of defects in the finished product.

A moisture environment can react with active materials and render them non-functional, which is why the manufacturing process needs to be undertaken in an extremely dry environment. This results in very high static charges during the process and causes the attraction of particles. These particles present a high risk of penetrating the separator foil and thereby causing short circuits. The consequences of lithium-ion battery contamination are only seen when the end customer puts the battery into operation.

Cleanliness – preventing particle contamination

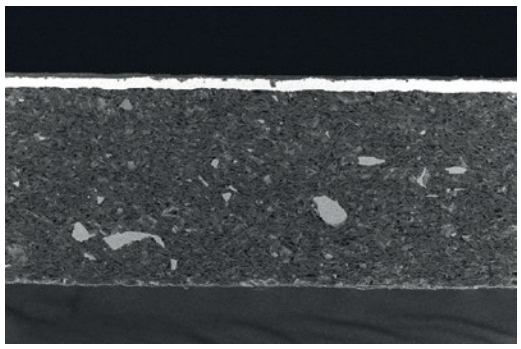
Metallic particles present a higher risk of damaging the battery cell, which can cause lithium dendrite growth, an electrical short, or thermal runaway – a significant safety issue for the lithium-ion battery. These metallic particles can easily be accumulated when transporting the battery or during the manufacturing process, with every metallic particle over the size of 5 µm considered critical for the battery. Since the blade cutter is the main root cause of metal burrs on copper and aluminum, users must make a trade-off between quality and cost in deciding when to change the blade.

Working in combination with the ZEISS Technical Cleanliness Analysis (TCA) software, ZEISS light microscopes provide quantitative particle analysis that distinguishes between the metal, fiber, and non-metal particle types down to a size of 1 µm. Electron microscopes from ZEISS instantly state the chemical composition of each particle. ZEISS technical cleanliness solutions therefore offer ideal imaging for diverse customer groups from R&D through to mass production.

And the intuitive correlative workflow implemented by ZEISS, which ensures perfect interplay between the hardware and software, makes it easy to move from light to electron microscopes.

Electric vehicle battery contamination

Battery cells handle highly complex and electrochemical processes that form the most important part of an electric car. A vehicle battery must withstand many challenges relating to aspects such as its size, the different components from which it is made, and the high voltages transferred by these components. Any particle contamination in the processed part can affect the lifetime and quality of the battery. Iron particles located at the anode, cathode, or separator can cause the battery cell to self-discharge. And since contamination may also cause overheating that leads to the destruction of the battery cell, technical cleanliness within the manufacturing process is more important than ever. ■

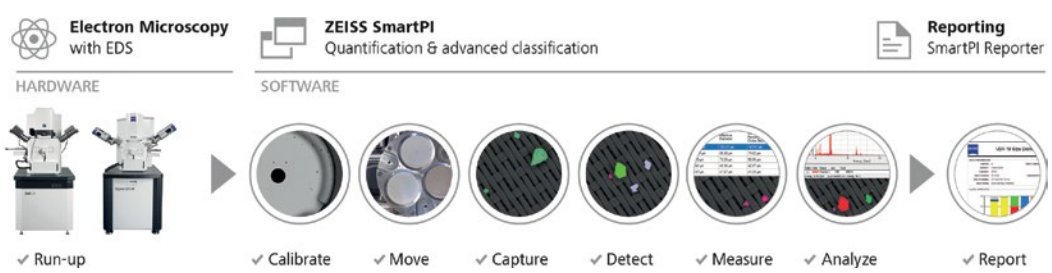


BATTERY ANODE CROSS-SECTION

Quality gates during battery development and production

Battery manufacturers cannot take shortcuts on quality if they wish to become serious players in the growing market for new energy vehicles (NEVs).

Quality assurance begins with research and development, continues through every step of production, and even affects how the raw materials are processed for assembly of the battery modules.



AI: Revolutionizing the Electric Vehicle Landscape

Mukesh Kr. Bansal
CTO, TelioEV Private Limited

The automotive industry is undergoing a profound transformation, propelled by the convergence of electrification and artificial intelligence (AI). Beyond sleek designs and silent operation, AI is the critical enabler of advancements in electric vehicles (EVs), impacting everything from the driver experience to the complexities of charging infrastructure and fleet management. This article explores how AI is reshaping the EV landscape, incorporating relevant data and insights to underscore its transformative impact.

Elevating the EV Driving Experience with AI:

AI is revolutionizing the daily interaction with EVs through several key applications:

- **AI-Powered Personalization:** AI algorithms analyze driver preferences, habits, and even emotional state to create a highly personalized driving experience. Imagine a vehicle that adjusts cabin temperature, music, and even suspension settings based on your mood or the current traffic conditions. Studies suggest that personalized in-car experiences can increase driver satisfaction by up to 30%.
- **AI-Enhanced Safety (ADAS):** AI is the backbone of advanced driver-assistance systems (ADAS), which are crucial for enhancing road safety. These systems, powered by deep learning and computer vision, can detect and respond to potential hazards with greater accuracy and speed than human drivers. According to the National Highway Traffic Safety Administration (NHTSA), ADAS features like automatic emergency braking (AEB) can reduce rear-end collisions by up to 50%.
- **AI-Optimized Performance:** AI algorithms can optimize EV powertrain performance in real-time, improving acceleration, handling, and energy efficiency. This can translate to a 10-15% improvement in range or a noticeable boost in acceleration, depending on the implementation.

Building a Robust and Intelligent Charging Ecosystem:

A robust and intelligent charging infrastructure is crucial for widespread EV adoption. AI addresses this challenge through:

- **Smart Grid Integration:** AI algorithms can optimize electricity distribution across the grid, ensuring sufficient power for EV charging while minimizing strain on the grid. This is crucial as EV adoption increases; some projections estimate a 30-40% increase in electricity demand by 2030 due to EV charging.
- **Wireless Charging and Dynamic Power Transfer:** AI is instrumental in developing efficient wireless charging solutions and dynamic power transfer systems (charging while driving). These technologies, estimated to reach wider adoption by 2025-2027, could significantly reduce range anxiety and enhance charging convenience.
- **AI-Driven Charging Station Management:** AI can optimize charging station operations by predicting demand, managing load balancing, and implementing dynamic pricing. This can improve utilization rates by up to 20% and reduce charging costs for consumers.

Optimizing Electric Fleet Operations with AI:

AI provides significant advantages for businesses operating electric fleets:

- **Predictive Maintenance:** AI algorithms can predict EV battery health and maintenance needs with high accuracy (up to 90% in some cases), minimizing downtime and extending battery lifespan by up to 20%.
- **Autonomous Fleet Management and Route Optimization:** AI can optimize fleet routing, scheduling, and charging, reducing operational costs by 10-15% and improving delivery efficiency

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by up to 20%.
- **AI-Powered Driver Training and Efficiency Monitoring:** Personalized driver training programs powered by AI can help EV fleet drivers improve their driving skills and reduce energy consumption by 5-10%, resulting in significant cost savings and a smaller carbon footprint.

Future Trends and CTO Focus Areas:

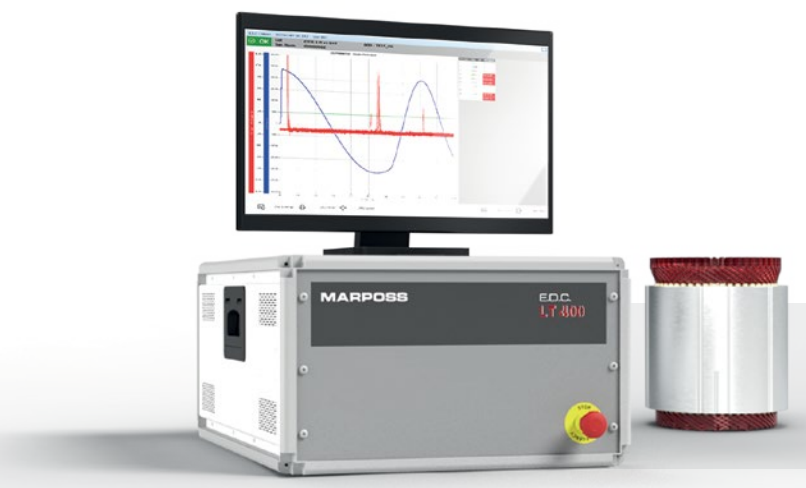
Looking ahead, several key trends will shape the future of AI in the EV sector:
- **AI-First Vehicle Design and Software-Defined Vehicles (SDVs):** Automakers are increasingly adopting an AI-first approach to vehicle design, creating platforms optimized for AI performance, safety, and over-the-air updates. The SDV market is expected to grow significantly, with some forecasts predicting a market value exceeding $800 billion by 2030.
- **AI-Powered Over-the-Air (OTA) Updates and Feature Enhancements:** OTA updates, facilitated by AI, will become increasingly common, allowing for continuous improvement of vehicle software, adding new features, and enhancing performance over time.
- **AI-Driven Cybersecurity and Data Privacy:** As EVs become more connected, cybersecurity becomes paramount. AI plays a crucial role in detecting and preventing cyberattacks, ensuring data privacy and vehicle safety.

New Innovations and Future Ideas:

- **AI-Powered Traffic Management and Smart Cities Integration:** AI can optimize traffic flow and reduce congestion, improving EV efficiency and contributing to the development of smart cities.
- **AI-Enhanced Battery Technology and Recycling:** AI can accelerate the development of next-generation battery technologies, such as solid-state batteries, and optimize battery recycling processes, contributing to a more sustainable EV ecosystem.
- **AI-Driven Personal Mobility Assistants and Integrated Mobility Services:** AI can power personal mobility assistants that seamlessly integrate various transportation modes, making it easier for people to plan and manage their travel.

The Road Ahead:

The integration of AI into the EV ecosystem is accelerating the transition to sustainable mobility. For automotive CTOs, investing in AI technologies is not just an option but a strategic imperative. By leveraging the power of AI, we can unlock the full potential of EVs and create a cleaner, more efficient, and more enjoyable transportation future. ■



LT400:
Winding and Insulation Analyzer

The LT400 is a system designed to perform partial discharge measurements on components, windings, processes and finished products. The LT400 is a very useful tool in all phases of new product development and production, from design to production quality checks.

The rapid deployment of electric vehicles on a large scale is placing higher expectations on component reliability on manufacturers. These demands have implications for quality and process control requirements in the production line.

The insulation system of electrical machines is a critical reliability feature, as a failure of the insulation can lead to system failure. Standard electrical tests, required by regulations, are not sufficient to identify all types of failures because many faults produce only partial discharges, and these can only be identified by the partial discharge test method.

The LT400, a partial discharge winding analyzer for the R&D and quality control department, is a Marposs solution to identify all latent defects in the insulation system that could lead to failures.

A single unit capable of performing standard high voltage tests (AC/DC and Pulse) plus partial discharge measurements that allows to: select wires, plastic insulating materials, impregnation process; identify insulation weak points inside stators; identify the beginning of permanent insulation degradation during life tests.

The LT400 partial discharge measurement system is based on capacitor coupling technology. Compared to the antenna type solutions normally applied in this market, the capacitor coupling technique is more sophisticated and less sensitive to external noise and therefore more suitable for applications in the production area. Since it does not use an external sensor, the capacitor coupling approach requires equipment that can detect partial discharge simply by connecting the terminals of the product under test with the same cables used to perform standard tests. The result is a solution that is very easy to use (without any external sensors) and optimized for the production environment.

The LT400 uses the same flexible test software (developed in-house) as the production machines. This means that the calibration of the test parameters, optimized during the development of the device in the laboratory, can be fully transferred to the production test machines.

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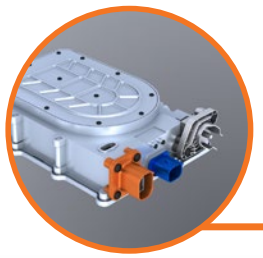

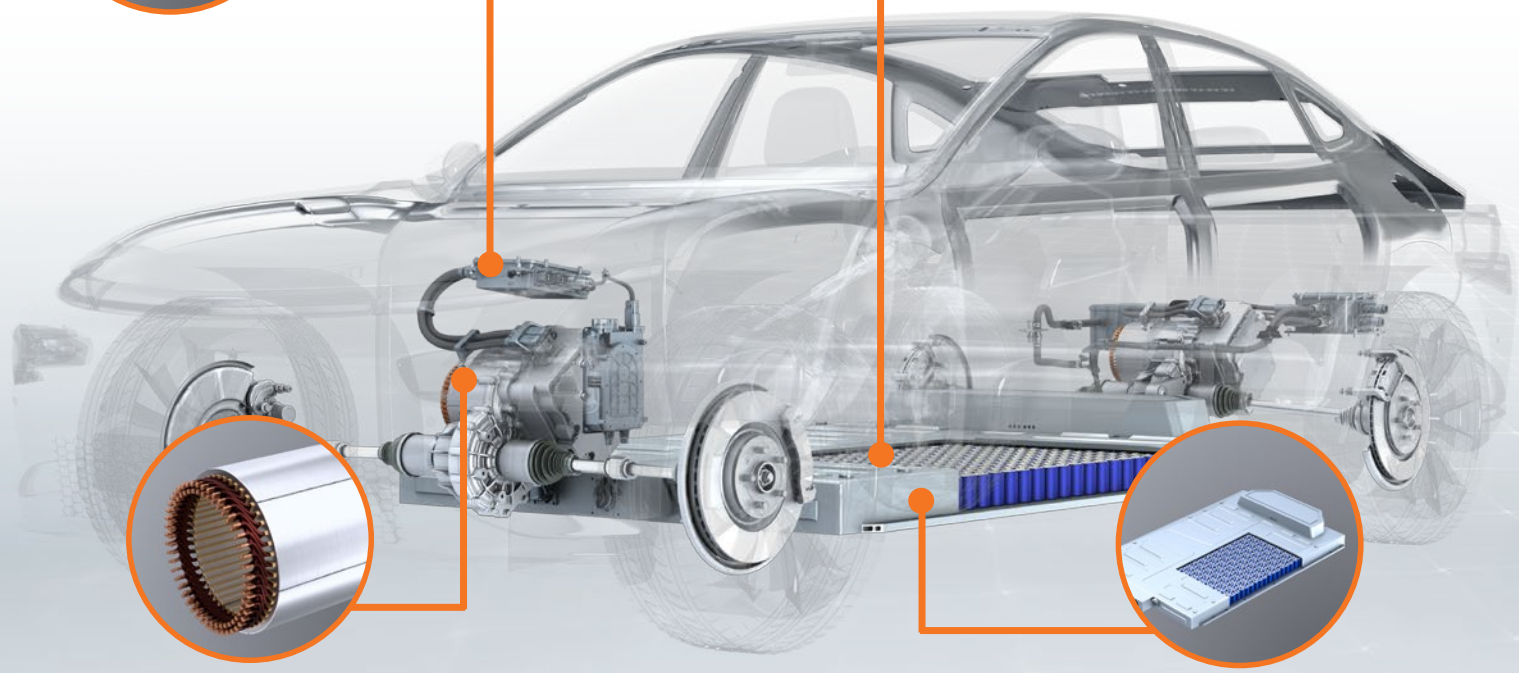

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IPG E-MOBILITY MANUFACTURING SOLUTIONS

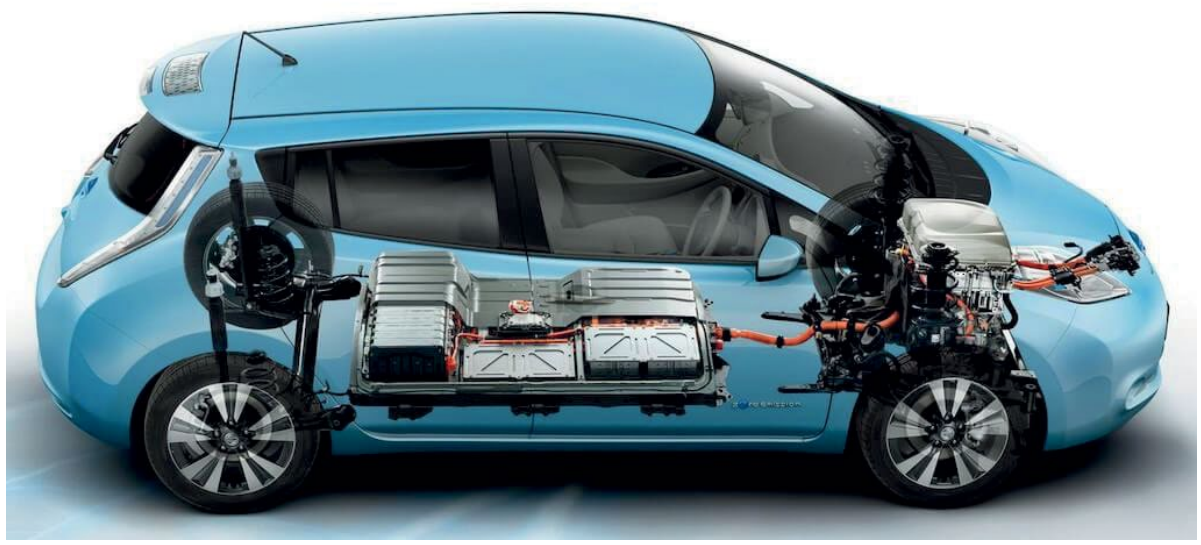
Power batteries stand at the forefront of the electric vehicle (EV) revolution, serving as the lifeblood of these eco-friendly vehicles and a pivotal factor influencing their development. As the world accelerates toward a sustainable transportation future, the key challenge lies in crafting power batteries that offer higher energy density, increased power output, extended service life, and cost-effectiveness.

In this overview, we delve into the common performance indicators of electric vehicle power batteries, encompassing crucial metrics like State of Charge (SOC), State of Health (SOH), and Battery Management System (BMS). These indicators play a vital role in ensuring the efficiency, reliability, and safety of EV operations. Furthermore, we explore the essential performance requirements for power batteries in electric vehicles, emphasizing the need for optimal energy storage, maximum power output, cost efficiency, and user-friendly maintenance.

Additionally, we categorize power batteries into three types—chemical, physical, and biological—each contributing uniquely to the diverse landscape of EV technology. Join us on this exploration into the heart of new energy vehicle power batteries, where innovation sparks a sustainable and electrifying future.

Terms and metrics frequently used to describe electric vehicle power batteries

- **State Of Charge (SOC):** The remaining capacity of the battery and the percentage of total capacity.
- **State Of Health (SOH):** Provide battery health status information.
- **Battery Management System (BMS):** Real-time monitoring of power battery operation parameters, fault diagnosis, SOC estimation, driving mileage estimation, short-circuit protection, leakage monitoring, display alarm, charging and discharging mode selection, etc., so as to ensure electric steam The car is efficient, reliable, and safe to operate.
- **Ratio energy (Wh/kg):** The size of the electrical energy emitted by the electrode material per unit mass, which marks the endurance of electric vehicles in pure electric mode.
- **Ratio power (W/kg):** The power provided by the



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battery per unit mass is used to judge the acceleration performance and maximum speed of electric vehicles, which directly affects the power performance of electric vehicles.

- **Cycle life:** The number of batteries charging and one-week discharge cycle is an important indicator to measure the power battery life. The more cycles, the longer the power battery will be used. The rate of discharge of the pool is a quantity of speed and slow discharge.
- **Battery discharge C (double) rate:** indicates the rate of battery discharge, that is, a measure of the speed of discharge. The total capacity of the battery is 1h discharge, which is called 1C discharge.
- **Discharge depth (DOD):** refers to the ratio of the capacity released by the battery to the rated capacity of the battery.

Power battery performance requirements for electric vehicles

As an energy storage device of a vehicle, electric vehicle batteries not only require sufficient energy to meet a certain driving cycle and mileage, but also provide the maximum power required to achieve the specified acceleration performance of the vehicle. That is to say, the power battery is required to have good charging and discharging performance, high specific power and specific energy, low price, and convenient use and maintenance.

Power battery types of electric vehicles

There are three types of power batteries commonly used in electric vehicles:

- **Chemical batteries:** devices that use chemical energy to convert electrical energy are mainly divided into two categories: storage batteries and fuel cells.
- **Physical batteries:** devices that rely on physical changes to provide and store electrical energy, such as supercapacitors, flywheel batteries and solar cells.
- **Biological batteries:** devices that use biochemical reactions to generate electricity, such as microbial batteries use the anodes of batteries to replace natural electron receptors such as oxygen or nitrates to generate electrical energy through the continuous transfer of electrons.

In conclusion, the realm of new energy vehicle power batteries is marked by an exciting intersection of innovation and sustainability. As we strive for electric vehicles to rival their fuel counterparts, the pursuit of higher energy, greater power, extended life, and affordability remains paramount.

The performance indicators, from SOC and SOH to BMS, serve as the compass guiding the evolution of power batteries, ensuring efficiency and safety. The diverse types of power batteries—chemical, physical, and biological—contribute to a dynamic landscape, offering unique solutions for energy storage. This overview underscores the pivotal role of power batteries in reshaping the future of transportation, where breakthroughs in technology drive us closer to a greener and more electrifying horizon. ■

NVH G-EAR

Noise Testing Of Individual Gears

The IMTEX 2025 will offer its scene to Marposs presenting one of its most valuable application for the gear measurement and testing: the NVH G-EAR machine.

With the now firmly established hybrid (HEV) and full electric vehicles (EV), the noise of the drivetrain has become one of the major issues that every car manufacturer has to deal with. In BEVs, a silent gearbox not only ensures the mechanical reliability and efficiency of the electric drive unit, but also represents a comfort issue for the driver.

To achieve the target of a silent gearbox, it is paramount to test 100% each individual gear prior to the assembly of the transmission or gear reducer. The identification of potential noisy gears at this stage represents a huge time and cost saving for our customers.

The ideal solution for gear noise testing in a manufacturing environment is Marposs NVH G-EAR, a machine that is capable to test the parts at challenging operating conditions (3000 rpm rotation speed, 40 Nm torque) using a special master gear that engages the part based on the Single Flank rolling action.

Marposs NVH gear tester is able to detect macro-geometry and micro-geometry defects that are responsible for gear whine and noise phenomena.

Visitors can see the application details on a large display at the Marposs booth, counting on the support of our experts introducing the system and answering any specific question. ■

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For more information,
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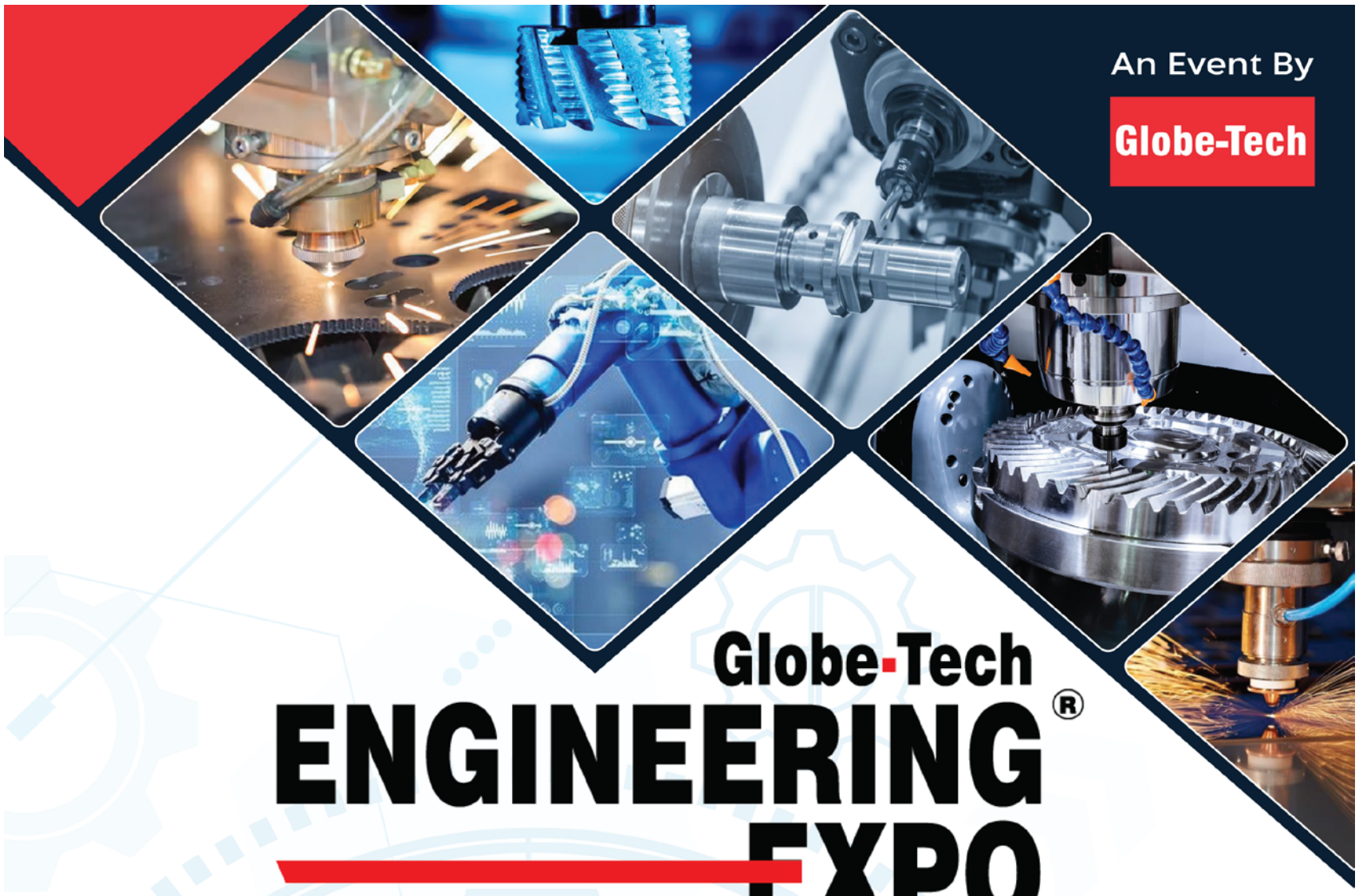

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FADA Releases December'24 Vehicle Retail Data

FADA President, Mr. C S Vigneshwar, shared his perspective on the auto retail performance for December 2024:

"In our previous release, 60% of dealers expected December to either experience de-growth or remain flat. Reflecting this sentiment, December's total retails dropped by -12% YoY. All categories except Tractors witnessed de-growth, with 2W, 3W, PV and CV falling by -17.6%, -4.5%, -2%, and -5.2% YoY respectively. Tractors, on the other hand, registered a notably contrasting 25.7% YoY growth.

The 2W segment suffered a substantial drop of -17.6% YoY and -54.2% MoM. Dealers cited low cash flow and poor market sentiment—exacerbated by delayed crop payments, halted government disbursements and typical year-end factors—as the main reasons. Supply challenges for popular models and the growing push toward EVs further weighed on volumes. Many dealers also mentioned that heightened discounts and limited financing options failed to offset weak demand.

PV retails declined by -1.9% YoY and -8.8% MoM, primarily due to high inventory levels following the festive season and aggressive discounting aimed at clearing stock. Poor market sentiment, limited new model launches and intense price competition among co-dealers further impacted sales. While some dealers benefited from year-end schemes and expanded product ranges, overall demand remained subdued, with many customers deferring purchases to January for anticipated benefits. Inventory levels ranged between 55 and 60 days.

CV retails declined by -5.2% YoY and -12.1% MoM due to low market sentiment, delayed government fund releases and slow financing approvals. Many customers postponed purchases, preferring 2025 models. While some segments, such as tippers, demonstrated resilience, ongoing LCV degrowth and unseasonal rains further dampened demand. Although year-end schemes and inquiries offered limited relief, overall sales remained under pressure."

About FADA India

Founded in 1964, Federation of Automobile Dealers Associations (FADA), is the apex national body of Automobile Retail Industry in India engaged in the sale, service and spares of 2 & 3 Wheelers, Passenger Cars, UVs, Commercial Vehicles (including buses and trucks) and Tractors. FADA India represents over 15,000 Automobile Dealerships having over 30,000 dealership outlets including multiple Associations of Automobile Dealers at the Regional, State and City levels representing the entire Auto Retail Industry. Together we employ ~4.5 million people at dealerships & service centres.

FADA India, at the same time also actively networks with the industries and the authorities, both at the Central & State levels to provide its inputs and suggestions on the Auto Policy, Taxation, Vehicle Registration Procedure, Road Safety and Clean Environment, etc. to sustain the growth of the Automobile Retail Trade in India. ■

All India Vehicle Retail Data for CY'24

CATEGORY	CY'24	CY'23	YoY %
2W	1,89,12,959	1,70,72,932	10.78%
3W	12,21,909	11,05,942	10.49%
E-RICKSHAW(P)	*4,81,786*	*4,74,226*	*1.59%*
E-RICKSHAW WITH CART (G)	*58,940*	*35,149*	*67.69%*
THREE-WHEELER (GOODS)	*1,24,972*	*1,14,732*	*8.93%*
THREE-WHEELER (PASSENGER)	*5,55,236*	*4,80,955*	*15.44%*
THREE-WHEELER (PERSONAL)	*975*	*880*	*10.80%*
PV	40,73,843	38,73,381	5.18%
TRAC	8,94,112	8,71,918	2.55%
CV	10,04,856	10,04,120	0.07%
LCV	*5,58,207*	*5,62,239*	*-0.72%*
MCV	*75,560*	*70,734*	*6.82%*
HCV	*3,17,568*	*3,27,202*	*-2.94%*
Others	*53,521*	*43,945*	*21.79%*
Total	**2,61,07,679**	**2,39,28,293**	**9.11%**

Source: FADA Research

All India Vehicle Retail Data for December'24

CATEGORY	Dec'24	Nov'24	Dec'23	MoM%	YoY%
2W	11,97,742	26,15,953	14,54,353	-54.21%	-17.64%
3W	93,892	1,08,337	98,384	-13.33%	-4.57%
E-RICKSHAW(P)	*40,845*	*40,391*	*45,100*	*1.12%*	*-9.43%*
E-RICKSHAW WITH CART (G)	*5,826*	*5,423*	*3,692*	*7.43%*	*57.80%*
THREE-WHEELER (GOODS)	*9,122*	*10,940*	*9,546*	*-16.62%*	*-4.44%*
THREE-WHEELER (PASSENGER)	*38,031*	*51,466*	*39,962*	*-26.10%*	*-4.83%*
THREE-WHEELER (PERSONAL)	*68*	*117*	*84*	*-41.88%*	*-19.05%*
PV	2,93,465	3,21,943	2,99,351	-8.85%	-1.97%
TRAC	99,292	80,519	78,944	23.31%	25.78%
CV	72,028	81,967	76,010	-12.13%	-5.24%
LCV	*39,794*	*47,530*	*42,814*	*-16.28%*	*-7.05%*
MCV	*4,662*	*5,473*	*4,987*	*-14.82%*	*-6.52%*
HCV	*22,781*	*24,441*	*23,904*	*-6.79%*	*-4.70%*
Others	*4,791*	*4,523*	*4,305*	*5.93%*	*11.29%*
Total	**17,56,419**	**32,08,719**	**20,07,042**	**-45.26%**	**-12.49%**

Source: FADA Research

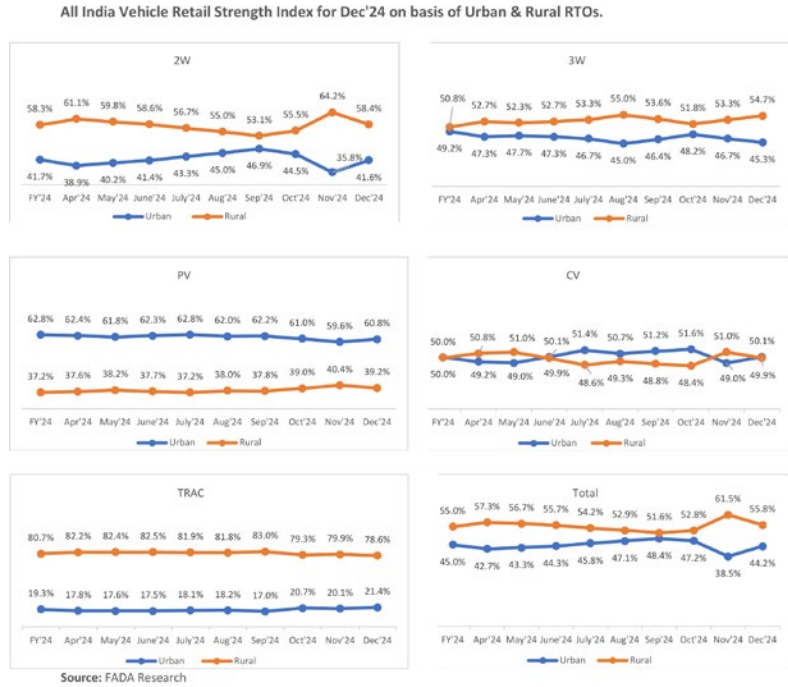
Chart showing Vehicle Retail Data for YTD FY'25 & December'24

All India Vehicle Retail Data for YTD FY'25 (April'24 to Dec'24)

CATEGORY	YTD FY'25	YTD FY'24	Growth %
2W	1,44,67,968	1,30,81,797	10.60%
3W	9,20,408	8,66,441	6.23%
CV	7,30,151	7,35,545	-0.73%
PV	30,02,311	28,88,868	3.93%
TRAC	6,50,136	6,48,538	0.25%
Total	**1,97,70,974**	**1,82,21,189**	**8.51%**

Source: FADA Research

All India Vehicle Retail Strength Index for Dec'24 on basis of Urban & Rural RTOs.



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