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# Global New Energy Vehicle Industry Transformation: Market Landscape, Technological Breakthroughs, and High-Quality Development Pathways

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**Abstract**: After over a decade of rapid growth, the global new energy vehicle (NEV) industry has entered a critical phase transitioning from scale expansion to quality improvement. In 2025, global electric vehicle sales exceeded 20 million units for the first time, with a 25% market penetration rate, and China remained the world's largest NEV market. Meanwhile, battery technology has seen multiple breakthroughs: accelerated industrialization of solid-state batteries, commercial deployment of sodium-ion batteries, and continuous iteration of lithium iron phosphate (LFP) technology. However, the industry also faces challenges including slowing growth, profit pressures, escalating trade barriers and key technological bottlenecks. Based on the latest data from the International Energy Agency's *Global EV Outlook 2026* and the China Association of Automobile Manufacturers, this paper systematically analyzes the development status and trends of the global NEV industry in 2025–2026, focusing on diversified progress in battery technologies, industrial structural challenges and high-quality development pathways. It puts forward policy recommendations including accelerating solid-state battery industrialization, improving charging infrastructure, and deepening international cooperation, to provide a reference for the sustainable development of the NEV industry.

**Keywords**: New energy vehicles; Power batteries; Solid-state batteries; Industrial transformation; High-quality development

## 1.Introduction

The new energy vehicle industry is at a historic turning point. According to the *Global EV Outlook 2026* released by the International Energy Agency (IEA) in May 2026, 2025 global electric vehicle sales grew 20% year-on-year, surpassed 20 million units for the first time, accounting for 25% of global new car sales. In China, NEV production and sales reached 16.626 million and 16.49 million units respectively, ranking first globally for 11 consecutive years. The industry has exited the earlier phase of "synchronized explosive growth across all global markets" and entered a new stage of slowing growth, intensifying competition and diversified technological pathways.

As the core NEV component, batteries directly determine the industry's competitiveness and sustainable development. 2025 is a critical year for solid-state batteries to transition from "proof-of-concept" to "industrialization". Sodium-ion batteries made their commercial debut; LFP batteries achieved a step-change in energy density while retaining cost and safety advantages. These diversified battery technology breakthroughs are reshaping the NEV industry's technological landscape and competitive ecosystem.

However, deep-seated challenges beneath prosperity cannot be ignored. In 2025, China's automotive industry revenue grew 4% to 10.6 trillion yuan, but profits fell 8% year-on-year, with a profit margin of only 4.3%. Trade protectionism escalated, and the European Union imposed additional tariffs of up to 35.3% on Chinese-made pure electric vehicles. Although all-solid-state batteries are widely anticipated, the three obstacles of safety, engineering feasibility and cost remain unresolved. Against this background, systematically reviewing industrial development trends, technological breakthroughs and practical challenges is of important theoretical and practical significance for promoting high-quality development of the NEV industry.

## 2. Global NEV Market Landscape and Regional Divergence

### 2.1Global Market: Crossing the 20-Million-Unit Threshold

In 2025, the global electric vehicle industry achieved notable results. IEA data indicates EV sales set records in nearly 100 countries and regions, rising about 20% year-on-year to exceed 20 million units for the first time. EV-Volumes data puts 2025 annual sales at around 21.6 million units, with a global new car market penetration rate of 25.4%, meaning one in four new cars sold globally was electric.

On the production side, 2025 global EV production neared 22 million units, up over 25% year-on-year, with around one quarter entering international trade. Widespread EV adoption has brought substantial energy security benefits: 2025 global EV stock cut oil consumption by about 1.7 million barrels per day, and this figure is projected to reach 5 million barrels per day by 2030.

The IEA forecasts global EV sales will hit 23 million units in 2026, accounting for nearly 30% of total new car sales. By 2035, the global EV fleet is expected to reach 510 million units, over six times the 2025 level, with EVs making up around 50% of global car sales by that time.

### 2.2 Regional Divergence: China Leads, Europe Catches Up, the U.S. Lags

In 2025, the global EV market showed clear "two hot, one cold" regional divergence.

China remained leading: its 2025 NEV production and sales hit 16.626 million and 16.49 million units, up 29% and 28.2% year-on-year respectively, taking 47.9% of China's total new car sales, 7 percentage points higher than 2024, with a 52.3% penetration rate in December. Chinese automakers supplied around 60% of global EV sales. BYD sold 4.6024 million NEVs in 2025, its pure electric sales surpassed Tesla for the

first time, ranking as the world's top EV seller. Nearly 70% of China's pure electric models are cheaper than comparable fuel vehicles without subsidies, with strong supply chain scale advantages.

The European market rebounded strongly after a 2024 slowdown from subsidy phase-outs. In 2025, European EV sales grew over 30% year-on-year, with a 28% market share, making it the fastest-growing major market. The EU's stricter 2025 $CO_2$ emission standards were the core policy driver. European EV sales continued to grow nearly 30% year-on-year in Q1 2026.

The U.S. market was notably weak. In 2025, EVs accounted for nearly 10% of new car sales, but sales declined in the second half, partly due to the federal government terminating tax credits for new EV purchases. From January to May 2026, U.S. EV sales dropped 33.7% year-on-year, with a penetration rate below 9%.

Emerging markets saw explosive growth. In 2025, EV sales doubled in Southeast Asia, with penetration approaching 20%; EV sales in Latin America grew 75%. In Q1 2026, EV sales in the Asia-Pacific region excluding China grew 80% year-on-year. Growth in emerging markets is reshaping the geographical layout of the global NEV industry.

## 3.Diversified Breakthroughs in Power Battery Technologies

### 3.1Solid-State Batteries: From Concept to Engineering Validation

2025 was a watershed for the solid-state battery industry, which transitioned from "proof-of-concept" to the critical phase of "industrialisation and engineering validation".

For semi-solid batteries, technological maturity has improved notably. No longer limited to high-end models, they have begun penetrating the mainstream market. Multiple automakers have launched mass-produced models equipped with semi-solid batteries covering mid-to-high-end and premium segments. Semi-solid cell energy densities generally reach 300–350 Wh/kg. CATL's condensed semi-solid battery achieved mass production in Q1 2025, and SAIC Motor's MG4 semi-solid "Anxin" version has launched.

For all-solid-state batteries, global leading battery manufacturers and automakers have generally reached a consensus, with mass production timetables set for 2027–2028. The sulfide electrolyte route, with extremely high ionic conductivity, has become the mainstream common technological choice. In May 2025, CATL's world-first sulfide-based all-solid-state battery pilot line started operation in Hefei, planning small-scale mass production by 2027. In November 2025, China's first large-capacity all-solid-state battery production line was completed and is now in small-batch trial production. Changan Automobile's "Golden Bell Jar" all-solid-state battery technology has moved from laboratory to vehicle validation, with on-vehicle testing expected in 2026. Geely plans to complete vehicle validation for all-solid-state batteries in 2026 and achieve mass production in 2027.

Entering 2026, the all-solid-state battery industry entered a critical period of engineering validation. TrendForce notes that in 2026, the technological readiness of all-solid-state batteries made significant progress: some leading manufacturers advanced from laboratory prototype validation to engineering manufacturing, product consistency, and automotive-grade validation. Japanese manufacturers including Toyota, Honda, Nissan, and Samsung SDI lead in small-scale trial production, and Japanese automotive products have completed validation for certain performance indicators. Chinese manufacturers including CATL, BYD, and FAW are also advancing small-scale all-solid-state battery trial production lines smoothly.

On the materials side, core materials such as lithium sulfide face market opportunities. As of H1 2026, global lithium sulfide production capacity exceeded 600 metric tons, and is expected to reach the kiloton level by 2027. Driven by supply chain cost-reduction pressures, lithium sulfide prices have dropped by more than 50% in the past six months.

### 3.2 Sodium-Ion Batteries: Commercialisation Debut

In 2025, the sodium-ion battery industry completed the critical transition from technology validation to large-scale delivery. Mass-produced products from leading companies achieved energy densities exceeding 170 Wh/kg, with outstanding low-temperature performance, maintaining high usable capacity at -30°C to -40°C.

In 2025, CATL launched its next-generation sodium-ion battery "Naxt Energy", with improved energy density, low-temperature performance, charge rate, and cycle life. It obtained certification under the new national safety standard (GB 38031-2025), as the world’s first sodium-ion power battery to pass this standard. Multiple Changan Automobile brands including Avatr will equip Naxt Energy. BAIC, Chery and other automakers have plans to launch sodium-ion battery models in 2026.

On the cost front, after core materials reached tens-of-thousands-ton scale, the cell cost of some companies fell below 0.45 yuan/Wh. According to EVTank data, global sodium-ion battery shipments doubled year-on-year in 2025. Sodium-ion batteries are rapidly penetrating low-speed EVs, electric two-wheelers, home energy storage and other applications.

### 3.3Lithium Iron Phosphate Batteries: Further Consolidation of Dominance

In 2025, LFP batteries further consolidated absolute dominance in China’s power battery market.

Data from the China Automotive Power Battery Industry Innovation Alliance shows that 2025 domestic power battery installations reached 769.7 GWh, among which LFP batteries accounted for 625.3 GWh (81.2% of total), up 52.9% year-on-year; ternary lithium battery installations were 144.1 GWh, accounting for 18.7%.

Technologically, LFP batteries achieved an energy density leap: cell-level energy density increased to 400 Wh/kg, system-level density to 260 Wh/kg. Vehicles equipped with new-generation LFP batteries have an energy consumption of 12–14 kWh/100 km, and range under the same capacity increased by about 15–20%. High compaction density, high rate capability and long cycle life have become core competitive indicators.

Globally, over 90% of LFP supply chain shipments come from Chinese companies. As Chinese manufacturers put LFP cell plants in Europe, Southeast Asia and other regions into operation, overseas supply chain localisation is accelerating.

### 3.4Forward-Looking Technology: New Breakthrough in Anode-Free Lithium Batteries

At the end of 2025, a team of scientists from the Korea Advanced Institute of Science and Technology, Pohang University, and Kyungpook National University developed a novel anode-free lithium metal battery with a volumetric energy density of up to 1270 Wh/L, roughly twice that of current mainstream EV lithium-ion batteries. This achievement could potentially double the driving range of electric vehicles. Through a "dual-insurance strategy" combining a reversible host structure and a tailored electrolyte, the team effectively suppressed dendrite growth, retaining 81.9% of initial capacity after 100 cycles at a high areal capacity of 4.6 mAh/cm². This breakthrough opens a new direction for next-generation high-energy-density battery technologies.

## 4.Structural Challenges During the Industrial Transition

### 4.1Slowing Growth and Profit Pressures

In the first half of 2026, the global automotive market saw slight overall growth with weak momentum and regional divergence. After years of rapid expansion, the NEV industry exited its high-growth era. From January to May 2026, global new-energy passenger vehicle sales hit 7.5 million units, up only 0.9% year-on-year, far lower than the 40% compound annual growth rate from 2017 to 2025, showing a clear fade in growth dividends. In Q1 2026, affected by purchase tax policy adjustments and front-loaded demand, China's NEV production and sales declined year-on-year by 8.3% and 5.0% respectively for new-energy passenger vehicles.

Slowing growth results from multiple overlapping factors: early market penetration dividends are mostly exhausted; early adopters have completed vehicle replacement, and new core demand has shrunk; subsidy phase-outs, surging memory chip prices and rising battery raw material costs drove widespread NEV price increases, leading consumers to delay purchases. More severely, profit pressure is growing: in 2025, global automotive industry revenue rose 4% to 10.6 trillion yuan, but profits fell 8% year-on-year, with an industry profit margin of only 4.3%. Continuous price cuts by OEMs have severely squeezed supplier profits, leaving some suppliers barely able to operate.

### 4.2 Escalating Trade Barriers and Supply-Chain Restructuring

In the first half of 2026, global automotive trade barriers intensified again. The EU officially implemented the Carbon Border Adjustment Mechanism, gradually extending coverage to vehicles and core components, and the Industrial Acceleration Act requires over 70% of non-battery core components for new energy vehicles to be produced within the bloc. The EU has also imposed additional tariffs of up to 35.3% on Chinese-made pure electric vehicles, and plans further restrictions on imported plug-in hybrids.

The U.S. has also erected barriers, with additional "reciprocal tariffs" effectively blocking direct exports of Chinese NEVs to the country. "Near-shoring, regional closed loops, and local factory construction" have become core strategies for an increasing number of automakers to hedge against geopolitical risks and regional trade barriers. The decades-old globally integrated automotive supply chain is facing increasing strain.

### 4.3 Core Technological Bottlenecks and "Chokepoint" Challenges

Despite considerable progress in battery technologies, the commercialisation of all-solid-state batteries still faces significant hurdles. In 2025, test results from a national special project investing 6 billion yuan in solid-state batteries were "far from ideal", with the three major issues of safety, engineering feasibility, and cost not yet fully resolved. J.P. Morgan noted that "safety is the biggest obstacle". The production processes, equipment, and environmental requirements for solid-state batteries are stringent, resulting in substantially higher production costs than conventional batteries. The "halving" of winter driving range and occasional safety incidents remain core concerns for many consumers when considering NEV purchases.

At the industrial-chain level, key raw materials such as lithium, cobalt, and nickel remain heavily dependent on external sources, posing risks to resource security. "Chokepoint" areas such as automotive-grade chips and vehicle-level sensors still need breakthroughs. The core contradiction in the supply chain is a "new supply-demand mismatch": OEMs cannot find reliable new components, while companies with new technologies struggle with "difficult access to vehicle integration".

### 4.4 Structural Contradictions in Charging Infrastructure

Although China has made significant progress in charging infrastructure – by the end of 2025, the number of charging facilities reached 20.092 million, forming the world's largest EV charging network – structural contradictions remain prominent. Public charging facilities are concentrated in certain regions, and although private charging facilities have grown significantly, the convenience gap between urban and rural residents persists. High power-grid upgrade costs, imbalanced utilisation rates, and future grid-coordination pressures have cast doubt on the profitability of ultra-fast charging stations. The battery-swap model, meanwhile, faces constraints such as huge fixed-asset investment, complex operational scheduling, and the difficulty of standardising battery specifications across different manufacturers.

## 5. High-Quality Development Pathways and Policy Recommendations

### 5.1 Accelerating the Industrialisation of Solid-State Batteries

Solid-state batteries are widely regarded as the "ultimate solution" to NEV range and safety core pain points. Currently, major global players target mass production by 2027–2028. It is recommended that the state increase investment in solid-state battery basic research and engineering development, promote national standard formulation, and support enterprises to accelerate the transition from pilot lines to mass-production lines. Meanwhile, view commercialisation realistically: as a transitional solution, semi-solid batteries balance energy density, safety and cost well, encourage their large-scale application first to accumulate engineering

experience and market acceptance for eventual all-solid-state deployment.

## 5.2 Improving Charging Infrastructure and Energy Synergy

With total charging facilities already exceeding 20 million units, policy focus should shift from "quantity expansion" to "quality improvement". Construction of charging facilities in county-level and rural areas should be accelerated to fill the lower-tier market shortfall and optimize public charging station geographical distribution. At the same time, promotion of high-power charging, vehicle-to-grid interaction and other technologies should be advanced, and coordinated dispatch mechanisms between charging facilities and the power grid should be explored. For the battery-swap model, battery standard unification should be promoted to cut operating costs and coordination difficulties.

## 5.3 Deepening International Cooperation and Global Layout

Faced with escalating trade barriers, China's NEV industry should shift from finished vehicle exports to a full-chain collaborative global expansion strategy. Enterprises are advised to build local production capacity in overseas markets proactively to maintain global market share by hedging against geopolitical risks. At the same time, technical cooperation and standard alignment with high-growth emerging markets such as Southeast Asia and Latin America should be strengthened to expand industrial space. At the technical level, active participation in international standard-setting for solid-state batteries, intelligent connectivity and other fields is needed to enhance China's voice in global industrial governance.

## 5.4 Promoting the Transition from Scale Expansion to Quality Improvement

2026 is the start of China's 15th Five-Year Plan, and a critical year for China's automotive industry to shift from scale leadership to quality leadership. The industry should exit "involutionary" competition, and shift from volume-based competition to differentiated competition based on technological routes.

The synergistic iteration of electrification and intelligent technologies is the core direction: high-voltage fast charging, hybrid solid-liquid batteries and advanced driver-assistance systems are rapidly deployed, and AI large models accelerate integration into vehicles to realize "emotion-aware" capabilities. Enterprises should increase R&D investment, and build self-reliant core technological capabilities in automotive-grade chips, solid-state batteries and intelligent driving.

In addition, the power-battery recycling system should be standardized. In 2025, China's comprehensive utilisation of spent power batteries exceeded 400,000 tons. Full life-cycle management meets environmental requirements and guarantees resource security.

Conclusion

The global new energy vehicle industry is at a critical juncture, transitioning from policy-driven to market-driven growth, and from scale expansion to quality improvement. 2025 global sales exceeding 20 million units marks electrification moving from "trend" to "reality". Accelerated industrialisation of solid-state batteries, commercial deployment of sodium-ion batteries and continuous iteration of LFP technology inject new technological momentum. Still, challenges including slowing growth, profit pressure, trade barriers and technological bottlenecks are prominent.

Looking ahead, high-quality NEV industry development requires coordinated advancement of technological and institutional innovation. In battery technology, a diversified development path should be adopted: while addressing all-solid-state challenges, leverage the complementary advantages of semi-solid, sodium-ion and LFP technologies. In market development, deepen the domestic market and expand overseas, using localisation to counter trade barriers. In the industrial ecosystem, shift from single-vehicle manufacturing to an integrated "electrification + intelligence + greenisation" multi-business structure. Only this can the industry seize the initiative in global automotive transformation, and achieve the historic leap from "scale leadership" to "quality leadership".

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