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THE FUTURE DEVELOPMENT OF NEW ENERGY VEHICLES AND KEY COMPONENTS

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Abstract: Driven by policies worldwide, new energy vehicles (NEVs) have developed rapidly in recent years, with their market share increasing annually. By analyzing the current status of NEVs at home and abroad, this paper sorts out the technologies and development directions of NEVs and their key components. From the perspective of sustainable development of NEVs, it further analyzes these core technologies, summarizes future technical routes, and promotes the healthy development of NEVs.
Keywords: New energy vehicles; Key components; Future development

1 INTRODUCTION

Against the backdrop of the accelerated transformation of the global energy structure and the in-depth advancement of the "dual-carbon" goals, the new energy vehicle industry has shifted from policy-driven growth to an explosive development phase driven by both market and technology. In 2024, the penetration rate of new energy vehicles in China exceeded 50%, and their global sales accounted for over 60% of the total, marking that new energy vehicles have officially become the dominant force in the automotive market. However, behind this progress, the industry is facing multiple challenges such as technological iteration and vehicle safety. As the core support of new energy vehicles, key components' technological breakthroughs and industrial collaboration capabilities will directly determine whether China can continue to lead in the global new energy race. Therefore, it is necessary to build a globally competitive new energy industry ecosystem and provide Chinese solutions for global energy transformation and sustainable development.

2 CURRENT STATUS OF NEW ENERGY VEHICLES AT HOME AND ABROAD

In recent years, driven by factors such as stricter environmental protection requirements and energy structure transformation, the development of NEVs has accelerated. Although the development status varies across countries, the market share of NEVs has generally increased year by year.

In 2024, China's automobile production and sales reached 31.282 million and 31.436 million units, respectively, with year-on-year growth of 3.7% and 4.5%. Among them, NEV production and sales reached 12.888 million and 12.866 million units, up 34.4% and 35.5% year-on-year, accounting for 40.9% of total new car sales, an increase of 9.3 percentage points compared with 2023[1]. From January to May 2025, China's NEV production and sales reached 5.699 million and 5.608 million units, up 45.2% and 44% year-on-year, accounting for 44% of total new car sales[2].

Globally, in 2024, global electric vehicle sales reached 17 million units, a year-on-year increase of about 25%, accounting for more than 20% of the global automobile market for the first time; in the first quarter of 2025, global electric vehicle sales grew 35% year-on-year[3].

The above data show that NEVs are developing vigorously at home and abroad. Driven by national policies, NEV consumption has grown steadily, promoting the further extension and improvement of the NEV industry chain, which in turn helps expand the NEV consumer market.

3 SORTING OUT TECHNOLOGIES OF NEW ENERGY VEHICLES AND KEY COMPONENTS

NEVs are generally classified into three categories: Battery Electric Vehicles (BEVs), Hybrid Electric Vehicles (HEVs/PHEVs), and Fuel Cell Electric Vehicles (FCEVs). Regardless of the category, they all revolve around the "three electric systems" (battery, motor, and electronic control), supplemented by key technologies such as intelligence and connectivity, and lightweighting.

3.1 Battery Technology

Current NEV batteries mainly use lithium-ion batteries, including ternary lithium and lithium iron phosphate technologies. Core indicators for evaluating batteries include energy density, charging speed, safety, and cost.

3.2 Motor Technology

NEV drive motors convert electrical energy from batteries into kinetic energy for vehicle operation. Common drive motors include DC motors, asynchronous motors, and permanent magnet synchronous motors. Core evaluation indicators are power density, efficiency, noise, and reliability.

3.3 Electronic Control Technology

The NEV electronic control system manages motor operation, directly affecting key performance indicators such as maximum speed and acceleration. It also handles complex tasks like energy recovery to ensure efficient and safe vehicle operation. Core indicators include energy management efficiency, smoothness of driving mode switching, and safety redundancy.

3.4 Intelligence and Connectivity Technology

Intelligent and connected vehicles integrate advanced on-board sensors, controllers, actuators, and modern communication/network technologies to enable intelligent information exchange and sharing between vehicles, humans, roads, and backends. This enhances safety, energy efficiency, and environmental performance, ultimately enabling autonomous driving. The core evaluation indicator is safety, including the safety of traffic participants and data security.

3.5 Lightweight Technology

NEVs are generally heavier due to onboard batteries. To reduce energy consumption and mitigate pedestrian impact risks, various lightweight technologies are widely adopted, such as extensive use of aluminum alloys and integrated die-casting. Core indicators include weight reduction ratio, cost, and process feasibility.

4 DEVELOPMENT DIRECTIONS OF NEV AND KEY COMPONENT TECHNOLOGIES

Based on the above analysis, the following sections outline future technology trends.

4.1 Battery Technology Development

Current battery challenges include slow charging, insufficient range, and heavy weight. Future development will focus on addressing these issues.

4.1.1 Improving charging speed

To solve slow charging, NEV manufacturers are developing high-power charging technologies. For example, BYD launched its "Megawatt Charging" technology in March 2025, achieving a global mass-produced maximum charging power of 1 megawatt (1000kW), marking the entry into the "megawatt era"[4]. This technology enables 2 km of range per second and 400 km of range with 5 minutes of charging, with a single-module motor power of 580kW, demonstrating breakthroughs in solving charging speed pain points.

4.1.2 Enhancing battery range

Battery capacity is primarily influenced by energy density. Efforts are underway to develop high-energy-density lithium-ion batteries, with silicon-carbon anodes and high-nickel cathodes enabling energy densities of 280-300Wh/kg, supporting ranges over 600 km. Solid-state batteries are another promising solution, with theoretical energy densities of 400-500Wh/kg and cycle life exceeding 3,000 times[5].

4.1.3 Battery lightweight technology

Battery lightweighting focuses on battery pack casing materials, processing, and design. For example, Baumeister used aluminum foam composite sandwiches to produce a 20kWh battery pack lower casing, reducing weight by 10-20%[6]. Choi used nylon 6 (PA6) as a matrix with carbon and glass fibers (total fiber content ≤40%) to reduce casing weight[7]. Mao Zhanwen collaborated with FAW to develop a carbon fiber battery pack casing, reducing weight from 110kg to 19kg[8]. Shao Mingding used glass fiber-reinforced composites (glass fiber woven fabric with epoxy vinyl ester resin) via prepreg compression molding for lightweight battery casings[9]. Welding technology also plays a crucial role in lightweight battery pack manufacturing; optimized welding methods and precision processes reduce weight while improving energy/power density[10]. Tesla’s Model 3 uses an optimized crash-resistant design to transfer impact loads and innovatively adopts a shallow tray-shaped aluminum plate for the battery pack lower casing, reducing the 80.5kWh battery pack weight to only 478kg[11].

4.2 Motor Technology Development

Permanent magnet synchronous motors currently dominate, with power densities exceeding 4kW/kg and efficiency reaching 97%. Oil-cooling technology increases continuous torque output by 20%. In-wheel motors are also advancing rapidly, using mature distributed drive technology for four-wheel independent control (e.g, lateral movement and crab walking modes), but their cost is twice that of traditional motors, making cost reduction a key focus[12]. Hairpin motors use flat wire windings to increase winding density, improving power density. This reduces motor size, lowers DC resistance, enhances heat dissipation, and extends range[13].

4.3 Electronic Control Technology Development

Electronic control technology is evolving in multiple directions. Rule-based energy management strategies for hybrid vehicles reduce equivalent fuel consumption by 10% compared to traditional vehicles[14]. X-by-wire chassis technology is another major trend, providing a physical platform for software-based functional and performance upgrades, essential for vehicles to become mobile intelligent terminals. BYD’s Yangwang U8 uses the "Yi Sifang" platform with four-motor distributed drive for extreme stability and agile steering; Huawei’s Turing intelligent chassis integrates drive, braking, and suspension control to enhance vehicle motion capabilities[15].

4.4 Intelligence and Connectivity Development

Intelligent connected vehicles represent the deep integration of the automotive industry with AI and big data, driven by technological innovation, policy support, and an improving industrial chain[16]. The core direction is autonomous driving, building a "vehicle-road-cloud" integrated connectivity system based on 5G or faster networks to create safer and more efficient intelligent transportation.

4.5 Lightweight Technology Development

NEVs are heavier than traditional fuel vehicles due to batteries, making weight reduction a key challenge for manufacturers. Current efforts focus on materials and processes. Body structures using aluminum alloys or carbon fiber-reinforced composites achieve over 30% weight reduction compared to traditional steel bodies; chassis components using aluminum or magnesium alloys reduce weight by over 20%[17]. Integrated aluminum alloy die-casting for vehicle bodies is a recent lightweight hotspot. Compared to traditional steel stamping-welding bodies, large die-casting machines produce integrated bodies in one step, reducing manufacturing processes, improving efficiency, and achieving 5-8% weight reduction[18].

5 ANALYSIS OF CORE TECHNOLOGIES FOR SUSTAINABLE NEV DEVELOPMENT

A deep understanding of NEV technologies highlights the need to leverage NEVs’ advantages and address weaknesses for sustainability. Key focus areas include lightweighting (battery and vehicle), solid-state batteries, autonomous driving, and data security.

5.1 Lightweight Technology

Weight reduction is critical to overcoming NEV weaknesses. Reducing weight enhances range, lowers energy consumption and carbon emissions, optimizes performance, cuts costs, and drives technological innovation and industrial upgrading. This "multi-win" choice (technical, economic, environmental, and user experience) is revolutionary, promoting advancements in materials science, manufacturing processes, and design, supporting the industry’s move toward high-end and intelligent development.

5.2 Solid-State Battery Technology

Solid-state batteries significantly address range anxiety, charging time, lifespan, and safety issues in NEVs, especially BEVs. As a core next-generation battery technology, they use non-flammable solid electrolytes (e.g., oxides, sulfides, polymers) to eliminate thermal runaway risks. High energy density reduces battery pack size and weight, improves handling, lowers per-kilometer costs, and promote electric vehicles to move toward "price parity with fuel-powered vehicles" and even lower costs.

5.3 Autonomous Driving Technology

Autonomous driving transforms transportation and profoundly impacts social efficiency, safety, economic structures, and lifestyles. Integrating AI, sensors, communications, and automotive engineering, it enhances travel experience, frees hands, improves traffic safety by reducing human error, optimizes traffic flow, and drives trillion-level market growth, reshaping the automotive industry.

5.4 Data Security

Increasing vehicle intelligence and connectivity generates massive data, critical to privacy protection, traffic stability, and national security. Personal data (e.g., trajectories, in-vehicle images, voice interactions, payment info) risks exposure, fraud, or misuse if compromised. In terms of social transportation, if the linkage between the internet of vehicles, intelligent traffic signals, and road sensors is maliciously interfered with, it may cause large-scale congestion or accidents. High-definition cameras and precision positioning in connected vehicles could threaten national security if exploited for mapping or military target identification. Ensuring data security is therefore paramount for NEV development.

Sustainable development requires high-quality, healthy, and safe progress. Only by meeting these standards can China’s NEVs and key components gain a global competitive edge.

6 CONCLUSION

Driven by "dual carbon" goals, NEV development is inevitable but faces significant challenges. Thanks to the efforts of Chinese automotive professionals and effective policy guidance, progress is being made. NEV usage environments have improved, with better infrastructure and enhanced user convenience. There is reason to believe in the sustainable development of China’s NEV industry.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

REFERENCES

[1] Xinhua News Agency. In 2024, the production and sales volume of new energy vehicles in China both exceeded 12 million units. 2025. http://www.xinhuanet.com/fortune/20250113/815a44be04094bb6a1c770f0cff5daaf/c.html.

[2] Chinese Government Website. In the first five months, the sales volume of new energy vehicles in China accounted for 44% of the total sales volume of new cars. 2025. https://www.gov.cn/yaowen/liebiao/202506/content_7027336.htm.

[3] CCTV News. Global electric vehicle sales are expected to exceed 20 million units in 2025, with the Chinese market showing strong growth momentum. 2025. https://auto.cctv.com/2025/05/16/ARTIBawLC7s06qqSmYDasUBT250516.shtml.

[4] Wenyuan Zhen. BYD: Megawatt flash charging opens the era of “fuel and electricity at the same speed”. Auto Review, 2025(4): 80-82.

[5] Qin Liu. Solid-State Batteries: New Hope and Challenges in NEV Batteries. Automobile and New Power, 2025, 8(3): 1-4.

[6] Baumeister J, Weise J, Hirtz E, et al. Applications of Aluminum Hybrid Foam Sandwiches in Battery Housings for Electric Vehicles.Procedia Materials Science,2014. DOI:10.1016/j.mspro.2014.07.565.

[7] Choi C H, Cho J M, Kil Y, et al. Development of Polymer Composite Battery Pack Case for an Electric Vehicle. SAE Technical Papers, 2013. DOI:10.4271/2013.01.1177.

[8] Zhanwen Mao, Wei Li, Yuqiang Liu. Application and Analysis of Composites in EV Battery Packs. Chinese Journal of Power Sources, 2016, 40(05): 977-978.

[9] Mingding Shao, Ming Yang. Lightweight Battery Enclosures. Modern Automobile, 2020(20): 93-94.

[10] Shanglin Zhang, Shouhui Wu, Ying Qin, et al. Research on Welding Technology in Lightweight Battery Pack Manufacturing. Automotive Era, 2025(11): 144-146.

[11] Yi Feng, Deliang Zhang, Xiang Gao. Development of NEV Battery Pack Housings for Multi-Objective Optimization: Safety, Lightweight, and Reliability. Chinese Journal of Automotive Engineering, 2024, 14(02): 155-167.

[12] Meng Wang. Application Analysis of In-Wheel Motor Technology in NEVs. Popular Automobile, 2025(03): 49-51.

[13] Haifeng Lu, Xiangyu Zhang. Review of High-Performance Electric Drive Technologies for NEVs Under "Dual Carbon" Goals. Journal of Xinjiang University (Natural Science Edition, Chinese & English), 2025, 42(02): 129-144.

[14] Jichen Deng, Yanhua Wang, Yaoxun Wang, et al. Research on Rule-Based Energy Management Strategy for Hybrid Vehicles. Journal of North University of China (Natural Science Edition), 2025, 46(03): 326-332.

[15] Lu Xiong, Bo Leng, Xinjie Zhang, et al. Current Status and Development Suggestions for Automotive X-by-Wire Chassis Technology. Frontier Science and Technology, 2025, 4(02): 99-114.

[16] Rongsen Jiang. Analysis of Development Trends and Challenges of Intelligent Connected Vehicles. Automobile Maintenance and Repair, 2025(09): 98-99.

[17] Xuping Cao. Application of Lightweight Materials in NEV Body Design and Crash Safety. Auto Maintenance, 2025(6): 122-124.

[18] Bo Liu, Yongxin Tang, Yi Wu, et al. Study on Lightweight Design of Integrated Mega-casting Aluminum Alloy Vehicle Body Components. Automotive Engineering, 2024, 46(12): 2154-2163.