Research and Analysis on the Development of Electric Vehicles in the World

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Abstract: Research on the development history of the global new energy vehicle industry shows that a diversified regional development pattern dominated by China, Europe, and the United States has been formed for new energy vehicles worldwide. In terms of technological innovation, the energy density of power batteries has significantly increased from 80-100 watt hours/kg to the current 250-300 watt hours/kg. the integration of intelligent technology is accelerating, and the penetration rate of L2 level autonomous driving has exceeded 40%. From the perspective of market trends, the annual compound growth rate of global sales of new energy vehicles exceeds 55.6%. the combined market share of China, Europe, and the United States has now exceeded 90%. However, there are significant differences in policy coordination and target positioning for new energy vehicles in different regions. Global new energy vehicles are facing challenges such as the safety of the industry chain, the standardization of technology, and innovative business models. This article discusses the technological evolution, market challenges, and policy coordination of global new energy vehicles, and proposes some suggestions to strengthen international cooperation, optimize policy combinations, and improve industrial ecology, which will help promote the healthy development of new energy vehicles.

Keywords: Electric Vehicles; Technological Evolution; Market Challenges; Policy Coordination

1. Introduction

In the context of global initiatives aimed at combating climate change and facilitating energy transition, the new energy vehicle industry stands as a pivotal breakthrough in low-carbon transportation, currently experiencing unprecedented transformations and advancements. According to the International Energy Agency (IEA), global sales of electric vehicles are projected to surpass 14 million units in 2023, representing 18% of new car sales. This milestone signifies a significant shift in the industry's evolution from being policy-driven to market-oriented. This transformative process encompasses intricate technological route selection, reconstruction of industrial chains, and adjustments in international competitive dynamics. It urgently necessitates comprehensive academic research to provide both theoretical foundations and practical guidance for stakeholders involved [1-4].

Existing research predominantly concentrates on individual countries or specific technological domains, this result in a lack of comprehensive analysis with the global development of Electric Vehicles. Ouyang Minggao (2024) offered insights into the cyclical and structural trends of China's Electric Vehicles over the next decade; however, this perspective did not fully integrate an international comparative framework [5]. Chan Kin et al. (2025) examined the risk challenges posed by intelligent competition, there remains insufficient exploration of the collaborative mechanisms among technology, market dynamics, and policy frameworks [6]. While Xing Weibo (2025) analyzed industrial policies and international strategic interactions, further elaboration on technological evolution is necessary [7]. Moreover, with advancements in disruptive technologies such as solid-state batteries and autonomous driving systems—coupled with escalating trade restrictions imposed by the United States and Europe on China—the global new energy vehicle industry is encountering both novel opportunities and significant challenges. This situation necessitates timely updates to existing research findings.

This study aims to systematically analyze the current state and future trends of the global new energy vehicle industry by focusing on three core questions: *a)* What are the primary pathways and future directions for technological evolution within the global new energy vehicle sector? *b)* How do regional markets differ in their developmental dynamics and driving factors? *c)* In what ways do various countries' policy systems influence industrial development, and how can they be optimized moving forward? By exploring these issues, this article seeks to provide valuable insights for industrial policy formulation and corporate strategic decision-making.

2. The Evolution Path of New Energy Vehicle Technology

2.1 Breakthrough and Iteration of Power Battery Technology

As a core component of electric vehicles, the technological evolution of power batteries directly influences both the overall performance and market acceptance of these vehicles. Currently, the energy density of lithium-ion batteries has reached 300 Wh/kg, nearly three times higher than in 2010, with an average annual technological advancement rate of 8% to 10%. Ouyang Minggao (2024) noted that China has established a global leading position in the field of lithium batteries, accounting for 75% of worldwide production in 2023; however, it faces significant challenges regarding the next generation technology roadmap [8]. Solid-state batteries are widely considered to be the future direction for development due to their enhanced safety (eliminating risks associated with electrolyte leakage) and theoretical energy density (up to 500 Wh/kg). Toyota plans to commercialize all-solid-state batteries by 2027, while China aims to establish a "National Solid State Battery Industry University Research Collaborative Innovation Platform" in 2024 to tackle technological competition [9].

It is noteworthy that the battery technology roadmap is exhibiting a trend towards diversified development. Pei Ruilin's research (2024) indicates that innovations in silicon steel materials also present new opportunities for enhancing motor system efficiency [10]. Ultra-thin silicon steel (with thickness <0.1 mm) can reduce iron loss in high-speed motors by over 40%, while amorphous alloy materials can limit losses to one-fifth compared to traditional silicon steel levels. GAC Aion has introduced motors utilizing amorphous and nanocrystalline materials with a power density of 12 kW/kg, showcasing how material innovation can significantly enhance system performance [11].

Table 1. Comparison of Technical Parameters of Main Power Batteries

Battery Type	Energy Density(wh/kg)	Life (cycles)	Cost (USD/kWh)	Commercialization
Lithium iron phosphate	160-200	3000-5000	90-110	mature
Ternary lithium	250-300	1500-2500	120-150	mature
Solid-liquid mixture	350-400	1000+	150-180	demonstration
All solid state	400-500	unknown	>200	R&D

2.2 Maintaining the Integrity of the Specifications

The development of Electric Vehicles is transitioning from the initial phase of "electrification" to the latter phase of "intelligence" (Chan Jian et al., 2025). This transformation fundamentally alters the characteristics of automotive products, evolving them from traditional modes of transportation into intelligent mobile terminals that integrate personnel, information, and energy. the cumulative testing mileage of Tesla's Full Self-Driving (FSD) system has surpassed 300 million miles, with its visual algorithm route paralleling that of ChatGPT, thereby illustrating the disruptive influence of artificial intelligence on the automotive industry [12].

Chinese companies have made remarkable strides in the realm of intelligence; by 2023, urban NOA (autonomous assisted navigation driving) functions are set to be mass-produced across multiple vehicle models. However, Chan Kin et al. (2025) highlight a significant challenge facing China: a pronounced issue regarding "chip shortages and soul shortages. " Currently, the localization rate for automotive-grade chips stands at less than 5%, while intelligent operating systems are predominantly developed based on foreign cores. This external reliance on core technology presents a risk for the industry characterized by an approach where one may "wake up early but rush to gather late. "

2.3 Integration of Vehicle Network Interaction and Energy System

The widespread adoption of Electric Vehicles (EVs) is poised to transform the landscape of the

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energy system. Ouyang Minggao (2024) introduced the concept of an integrated ecosystem known as "vehicle energy road cloud, " wherein Electric Vehicles can function as distributed energy storage units for the power grid through bidirectional charging and discharging technology, commonly referred to as Vehicle-to-Grid (V2G). China has initiated a pilot program for vehicle-network interaction across ten cities, allowing individual vehicles to generate an annual income ranging from 1, 200 to 2, 000 yuan by capitalizing on peak-valley price differences. This model not only enhances the capacity for new energy consumption but also creates novel value streams for vehicle owners.

the integrated photovoltaic energy storage charging station has emerged as a new form of infrastructure. Comprehensive energy stations that incorporate "photovoltaic energy storage and charging" along highways are designed not only to meet the demands of electric heavy-duty truck battery swapping but also to achieve self-sufficiency in energy through photovoltaic power generation. Estimates suggest that by 2030, over 5, 000 such power stations will be established in China, forming a green energy network that spans major transportation corridors [13-14].

2.4 Refactoring the Ecosystem and Transforming it from a 'Single Product' to an 'Open Collaboration' System

Ecologization represents an inevitable trend in the evolution of the new energy vehicle industry; this shift fosters a new industrial ecology characterized by "cross-domain integration and cross-subject collaboration. " Cross-disciplinary integration involves deepening synergies between automotive engineering and various fields such as renewable energies (e. g., photovoltaic-integrated vehicles), artificial intelligence (e. g., generative AI applications for intelligent driving training), materials science (e. g., carbon fiber structures and solid-state battery electrolytes), among others—thereby expanding functional boundaries within automotive design (including concepts like "mobile energy storage stations" and "intelligent mobile terminals"). Concurrently, cross-subject collaboration sees automotive companies transitioning from traditional manufacturing enterprises into technology-driven entities; exemplified by BYD's commitment to invest over 40 billion yuan in research and development by 2025 while partnering with tech firms [15-16].

3. Trends and Challenges in the Global Electric Vehicle Market

3.1 World Electric Vehicle Market Trends

The global electric vehicle (EV) market continues to expand rapidly, but the pace of growth is slowing as key markets mature. In 2024, global EV sales surpassed 17 million units, accounting for over 20% of all new car sales—a milestone driven by China's dominance and emerging market uptake. For 2025, projections indicate sales will exceed 20 million units (IEA, BloombergNEF), capturing a 24–25% global market share. However, year-over-year growth has decelerated significantly: from 60% in 2022 to 26% in early 2024, and further to 15% in August 2025. This slowdown reflects maturing markets, policy shifts, and economic pressures, though EVs remain on a long-term growth trajectory. [17]

Table 2. Global and Major Regional Overview

time	scope	indicator	Sales (million)	growth
2024	global	electric vehicles	17	+25%
2025y, 1-10m	global	electric vehicles	16.5	+23%
2025y, 1-10m	China	electric vehicles	10.3	+22%
2025y, 1-10m	Europe	electric vehicles	3.7	+32%
2025y, 1-10m	North America	electric vehicles	1.4	+4%

China continues to assert its position as the undisputed leader in the electric vehicle (EV) market, with EVs comprising over 50% of domestic car sales in 2024, amounting to 11 million units sold. Its share of global EV sales is on an upward trajectory, bolstered by a range of affordable models and a robust charging infrastructure. Emerging markets in Asia—such as Thailand and Vietnam—and Latin America, particularly Brazil, are witnessing a surge in demand for EVs, with sales increasing by over 60% in 2024. This growth is primarily driven by government incentives and enhanced affordability. In contrast, Europe has experienced stagnation in growth at approximately 20%, attributed to the phasing out of subsidies in countries like Germany and Norway alongside unchanged CO_2 targets. the U. S. market saw a significant decline in growth from 40% in 2023 to just 10% in 2024 due to policy rollbacks and high upfront costs [18].

Battery electric vehicles (BEVs) are increasingly outpacing plug-in hybrids (PHEVs) as the dominant segment within the EV market. By early 2025, BEVs accounted for approximately 66–67% of plug-in sales—a rise from 63% recorded in 2024—driven by plummeting lithium-ion battery costs and an influx of affordable models into the marketplace. While PHEVs continue to serve as a transitional option for regions hesitant about full electrification (notably Europe), their market share appears to be stabilizing. This shift underscores consumer preferences favoring pure electric driving experiences along with automakers' strategies aimed at complying with stricter emissions standards.

Chinese manufacturers such as BYD and Geely are spearheading global expansion efforts by introducing affordable EVs into emerging markets while challenging established players within the industry. For instance, BYD plans to enhance its overseas production capabilities and increase sales targeting regions like Southeast Asia and South America. Meanwhile, traditional European and American automakers are reassessing their EV objectives amid sluggish demand coupled with subsidy reductions; Stellantis has abandoned its ambition of exclusively producing electric vehicles within Europe by the year 2030, while Volvo and Nissan have postponed ambitious launches related to their EV lineups. These developments highlight not only the growing dominance of Chinese automotive firms but also underscore the challenges faced by traditional manufacturers as they strive to adapt amidst this ongoing revolution within the automotive sector [19].

Table 3. global Car Companies in Terms of Sales from January to August 2025

ranking	automaker	sales(million)	growth	market share
1	BYD	2.556	+14.1%	19.9%
2	Geely Group	1.315	+67.8%	10.2%
3	Tesla	0.985	-10.9%	7.7%
4	Volkswagen Group	0.854	+41.8%	7.1%
5	SAIC Motor	0.72	+28.1%	6.5%

Policy uncertainty is a major headwind for the global EV market. the US IRA’s 2025 revisions (e. g., ending EV subsidies after September 30) have created consumer hesitation, while Europe’s phase-out of subsidies has reduced immediate incentives. China’s tightened subsidy programs have slowed growth in its domestic market. Trade tensions, particularly between the US and China, are also impacting the market. China’s exports of EVs (1.25 million units in 2024) have grown rapidly, but US tariffs and local production requirements (e. g., IRA’s 40–50% local content rules) are forcing automakers to rethink their supply chains. These policies are reshaping the competitive landscape and creating barriers to entry for some players.

3.2 World Electric Vehicle Development Challenges

1) Trade barriers and policy protectionism

In the current thriving global electric vehicle industry, several countries have established trade barriers through measures such as imposing tariffs and conducting anti-subsidy investigations, casting a significant shadow over the healthy development of the sector. the European Union has implemented temporary countervailing tariffs on Chinese electric vehicles, while the United States has taken unprecedented actions against cars imported from China. Although these measures may appear to be aimed at protecting local industries, they are fundamentally manifestations of trade protectionism.

Chinese electric vehicles have emerged in the international market with advantages in technology and cost-effectiveness; however, trade barriers present substantial challenges for Chinese automotive companies. the EU's tariffs have considerably increased the costs associated with Chinese electric vehicles in the European market, diminishing product competitiveness and disrupting existing market structures and supply chain collaborations. Similarly, actions taken by the United States have raised entry thresholds for Chinese automobiles into its market and heightened uncertainties regarding market access. These trade measures not only render China's electric vehicle export prospects uncertain—forcing companies to expend considerable resources addressing trade disputes and adjusting their strategies—but also severely impede coordinated development within global industries. the global electric vehicle industry chain is intricately interconnected; countries rely on one another for technology, resources, and markets. Trade barriers undermine this collaborative relationship by hindering technological exchange and resource sharing, which is detrimental to efficient and innovative growth within the global electric vehicle sector. Countries should abandon trade protectionism in favor of promoting free trade to foster shared prosperity within the global electric vehicle industry.

2) Economic and demand side pressures

In recent years, the slowdown in global economic growth has emerged as a significant factor influencing the demand for electric vehicles (EVs) in the market. the decline in consumer purchasing power has led to increased caution among buyers when considering vehicle purchases, particularly impacting demand for relatively expensive electric vehicles, especially high-end models. Concurrently, economic uncertainties such as inflation and rising supply chain costs have prompted both businesses and consumers to adopt a more conservative approach toward investing in and purchasing electric vehicles.

The suppression of this demand exhibits distinct characteristics across different markets. Taking Europe as an example, the reduction of subsidies has directly resulted in stagnant demand. In 2024, Germany experienced a decrease of approximately 25% in electric vehicle sales. While overall passenger car sales within the European Union saw a slight increase of 0.8%, sales of battery electric vehicles (BEVs) declined by 5.9% during the same year, with an alarming drop of 10.2% recorded in December alone. In July, the market share of EU BEVs fell from 14.5% to 13.6%, while BEV sales in Germany faced a substantial decline of 37%.

The U. S. market is also encountering challenges; new electric vehicle sales reached 310, 839 units in the second quarter of 2025—a year-on-year decrease of 6.3%. Although there was a slight uptick in sales since early this year, consumer concerns regarding pricing and charging infrastructure have dampened purchasing enthusiasm significantly. Furthermore, at the beginning of 2025, the average transaction price for new electric vehicles in the United States stood at approximately $55, 614—considerably higher than that of gasoline-powered cars priced at around $48, 641. Elevated interest rates further constrain consumers' purchasing power; most consumers express a preference for vehicles priced below $50, 000—making price their primary consideration when selecting brands [20]. Faced with weak demand, car manufacturers have adjusted their strategies one after another. Volkswagen has stated that it will increase production of plug-in hybrid vehicles, while Mercedes Benz has slowed down or suspended battery factory projects, and Tesla's sales in Europe have also dropped significantly. However, the policy level is also actively responding, and the European Commission is preparing to launch EU wide incentives for electric vehicle purchases to stabilize market demand. Overall, in the short term, the electric vehicle market still faces many challenges, as factors such as price, policies, and infrastructure are intertwined and determine the future direction of the market.

3) Insufficient charging infrastructure

The inadequate charging infrastructure is emerging as a significant bottleneck in the global adoption of electric vehicles. Despite the rapid growth of the electric vehicle market, the development of charging networks is evidently lagging behind. the distribution of public charging stations worldwide is highly uneven, predominantly concentrated in urban areas, while rural and remote regions face severe shortages of such facilities. This disparity leads to hesitance among consumers in these areas regarding their purchase of electric vehicles. Moreover, there exists a considerable variation in the prevalence of fast-charging technology; for instance, the coverage rate of fast-charging stations every 50 kilometers on European highways exceeds 75%, whereas it stands at only 35% in the United States. This discrepancy poses a significant challenge for long-distance travel among electric vehicle users.

The inconvenience associated with charging directly influences consumer decision-making, particularly for those who have stringent requirements concerning battery life and energy replenishment efficiency. If a reliable and convenient charging experience cannot be ensured, the appeal of electric vehicles will be significantly diminished. Therefore, expediting the construction of charging networks—especially enhancing coverage in remote areas and advancing fast-charging technology—has become crucial for fostering growth within the electric vehicle industry. It is imperative that both government entities and enterprises increase investment and optimize the layout of charging infrastructure to genuinely unlock the market potential for electric vehicles.

4) Technical and cost bottlenecks

Battery technology continues to be the primary bottleneck in the advancement of electric vehicles. the current energy density of liquid lithium batteries has approached the theoretical limit of 300 Wh/kg, making it challenging to significantly enhance the range of electric vehicles. Range anxiety remains a key factor limiting consumer adoption of electric vehicles. Although emerging technologies such as solid-state batteries are viewed as potential breakthroughs, they have yet to achieve large-scale commercialization. Challenges related to complex production processes and high costs still need to be addressed, indicating that substantial progress is required before widespread application can occur [21].

Simultaneously, concerns regarding the supply of battery raw materials are becoming increasingly prominent. the availability of critical materials such as lithium, cobalt, and nickel is highly concentrated; for instance, the Democratic Republic of Congo produces approximately 70% of the world's cobalt supply, resulting in significant price volatility. These raw materials constitute a considerable portion of total battery costs—typically accounting for 30% to 40% of the overall cost structure for electric vehicles. Consequently, increases in raw material prices directly elevate the overall cost associated with electric vehicles, thereby diminishing their price competitiveness.

Table 4. Raw Material Prices and Battery Costs

time	Lithium salt price (per ton)	LFP cathode price (RMB/kg)	LFP battery cell cost (yuan/Wh)	Percentage of battery pack cost
2021-01	68, 000	78.4	0.497	35
2021-06	120, 000	90.0	0.550	36
2022-01	300, 000	120.0	0.620	38
2022-06	500, 000	150.0	0.680	40
2023-01	250, 000	110.0	0.580	37
2023-06	150, 000	110.0	0.550	36
2024-01	120, 000	95.0	0.520	35
2024-06	110, 000	94.0	0.510	35
2025-01	110, 000	92.0	0.510	34
2025-06	105, 000	90.0	0.505	34

These factors are intertwined, limiting the improvement of electric vehicle performance and raising production costs, ultimately affecting the market competitiveness of the product. Breaking through battery technology and stabilizing the supply chain has become the key to promoting the development of the electric vehicle industry.

5) Supply Chain and Resource Risk

The global electric vehicle supply chain exhibits a highly concentrated nature, which poses significant risks to the stable development of the industry. China occupies a dominant position within this supply chain, accounting for 70% of global battery production capacity and 85% of positive electrode material production. This high level of concentration implies that any disruptions within the Chinese supply chain could have far-reaching consequences for the global electric vehicle sector.

Geopolitical instability represents another major threat to the integrity of the supply chain [22]. Changes in mining policies across Africa and trade tensions in Southeast Asia may lead to interruptions in the availability of essential minerals. Africa is a key global producer of lithium, cobalt, and other critical minerals; thus, modifications to its mining regulations will directly impact mineral extraction and export activities. Similarly, Southeast Asia plays an integral role in both the production and trade of electric vehicle components; trade frictions can obstruct normal component circulation.

Concurrently, market demand for vital minerals such as lithium and nickel has surged dramatically. Projections indicate a potential shortfall of 1 million tons of lithium by 2030. As electric vehicle production continues to rise steadily, so too does the demand for these crucial minerals; however, both resource development and supply are struggling to keep pace with this escalating demand over a short timeframe. Furthermore, current battery recycling systems remain inadequate; their contribution toward alleviating resource supply pressures is limited prior to 2030. A well-established recycling framework could facilitate the recovery of key minerals while reducing dependence on newly mined resources; however, existing deficiencies in recycling processes exacerbate resource supply risks further still. These interrelated factors present formidable challenges to achieving sustainable development within the global electric vehicle industry.

6) Market competition and differentiation

At a time when the wave of electric vehicles is sweeping across the globe, traditional fuel vehicle manufacturers are making slow progress in their journey toward electrification, facing the challenge of insufficient competitiveness in the "oil to electric" product market. Established automotive companies such as Volkswagen and General Motors, despite their strong foundations and significant brand influence in the realm of fuel vehicles, are struggling to transition effectively to electric vehicles. Many European automakers' electric vehicle models are generally operating at a loss, and their "oil to electric" offerings lack appeal compared to emerging electric vehicle brands in key performance indicators such as range and intelligent driving capabilities. This shortfall makes it increasingly difficult for them to meet rising consumer expectations while continuously eroding their market share.

In stark contrast, Chinese automobile manufacturers are accelerating their overseas expansion by capitalizing on their comprehensive industry chain advantages. Companies like BYD and Geely have made remarkable advancements in battery technology, electronic control systems, and intelligent driving features, thereby establishing a complete industrial chain closed loop. They have seized opportunities by actively entering emerging markets such as Southeast Asia and Latin America. In Southeast Asia, Chinese car manufacturers have introduced cost-effective electric vehicles that cater to local consumers' demands for economical and practical transportation; meanwhile, in Latin America, they have garnered favor among local consumers through advanced intelligent driving technologies and reliable battery performance [23].

The sluggish transformation of traditional giants juxtaposed with the rapid expansion of Chinese automotive firms has created a pronounced contrast between the two sectors. the competition between these entities within emerging markets is intensifying significantly. As a result, the competitive landscape of the global electric vehicle market is undergoing substantial reshaping; competition has entered an exceptionally heated phase.

4. Coordination of World Electric Vehicle Development Policies

At present, the global electric vehicle industry is in a critical period of rapid growth and deep adjustment, with accelerated technological innovation, differentiated market demand, rising trade protection, and supply chain restructuring intertwined. It is urgent to break down barriers and build consensus through policy coordination to promote healthy and sustainable development of the industry. Based on global practices and challenges, policy coordination needs to focus on five directions: rule unification, trade openness, technology sharing, supply chain resilience, and ecological co construction. Specific suggestions are as follows:

4.1 Promote the Coordination of Rules and Standards, Eliminate Technical Barriers and Market Segmentation.

Establish a globally unified technical standard system for electric vehicles, concentrating on critical areas such as charging interfaces, battery safety, and the definition of intelligent driving functions. For instance, promote compatibility and mutual recognition between China's GB/T charging standards and the European Type 2 and American CCS standards to reduce compliance costs for enterprises. Collaboratively develop mandatory technical specifications for battery thermal management, collision safety, among others, while establishing global benchmarks through platforms like the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). This approach aims to mitigate duplicate testing and eliminate market access barriers arising from fragmented standards.

Develop internationally recognized carbon accounting methods and standards that encompass the full lifecycle carbon footprint of electric vehicles—covering raw material extraction, battery production, usage, and recycling. Encourage synergy between the EU's "New Battery Law" (which mandates declaration of battery carbon footprints), China's "dual credit" policy, and California's ZEV regulation in the United States. Establish a unified model for calculating carbon footprints along with a comprehensive database to provide a scientific basis for global carbon trading initiatives, carbon tariffs, and other related policies. This will help prevent "carbon wall barriers" from evolving into new tools of trade protectionism.

4.2 Strengthen Trade Policy Coordination and Maintain an Open and Fair Market Environment

Relying on the dispute settlement mechanism of the World Trade Organization (WTO), we must resist unreasonable tariffs—such as the 100% tariff imposed by the United States on Chinese electric vehicles and the European Union's proposed countervailing duty of 35.3%—as well as non-tariff barriers, including data localization and technology blockades. It is essential to promote dialogue among major economies, namely China, the United States, and Europe, to reach a consensus on core issues such as transparency in subsidy policies and conditions for market access. This can be achieved through bilateral or multilateral dialogues, exemplified by initiatives like the China-U. S. Automotive Industry Working Group and the China-EU High-Level Economic and Trade Dialogue. Such efforts aim to prevent "subsidy competition" from distorting global competitive dynamics [24]. By leveraging regional trade agreements such as the Regional Comprehensive Economic Partnership (RCEP) and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), we seek to reduce both tariffs and non-tariff barriers related to electric vehicles and their components among member countries; for instance, RCEP has already reduced tariffs on certain automotive components to 0%. We encourage more nations to join frameworks for new energy vehicle trade cooperation by incorporating an "electric vehicle chapter" into Free Trade Agreements (FTAs). This chapter should clarify provisions regarding battery material circulation, charging facility interconnection, etc., thereby promoting regional market integration.

4.3 Promote Technological Cooperation and Sharing, Accelerate the Global Innovation Process

Focusing on cutting-edge fields such as solid-state batteries, vehicle-road cloud integration, and intelligent driving algorithms, we advocate for the establishment of joint laboratories or innovation alliances among enterprises, research institutions, and governments. Notable examples include the China-Europe Battery Technology Innovation Center and the China-US Intelligent Driving Joint Laboratory. By sharing foundational research achievements—such as breakthroughs in materials science—and collaborating on research and development costs—like joint investments in pilot lines for solid-state batteries—we can mitigate technological risks associated with individual countries and expedite the commercialization of disruptive technologies.

We encourage leading nations—including China, Germany, and Japan—to transfer mature technologies—such as battery manufacturing processes and charging network management expertise—to emerging markets like Southeast Asia and Latin America. This initiative aims to enhance the industrial capabilities of host countries through technical training programs and the establishment of localized research and development centers. For instance, when Chinese automotive companies invest in building factories in Thailand or Hungary, they could also establish battery recycling technology training centers to nurture local talent. Additionally, developed countries can assist developing nations in improving their charging infrastructure standards and management systems through initiatives such as a "Technical Assistance Fund. "

4.4 Collaborate to Ensure Supply Chain Security and Build a Resilient Global System

In light of the significant regional concentration of essential resources such as lithium, cobalt, and nickel in power batteries—exemplified by the Democratic Republic of Congo's 70% share of global cobalt production and Chile's 50% stake in lithium reserves—and the inherent fragility of the supply chain, it is imperative to establish a "producer-consumer" dialogue mechanism. An example could be the "International Coordination Committee for Lithium Resources, " which would facilitate coordination on mineral extraction quotas, export restrictions, and price stability policies. Furthermore, resource-rich countries should be encouraged to enter into long-term supply agreements with consumer nations while simultaneously supporting enterprises in expanding research and application efforts for alternative resources (such as sodium-ion batteries and cobalt-free cathode materials) to mitigate dependence on any single resource. Additionally, promoting the standardization of global battery recycling standards—such as the European Union's "New Battery Law, " which mandates a battery recycling rate of 70% by 2030—is crucial. Establishing a cross-border recycling network along with a traceability system will enhance these efforts. It is also vital to support leading companies like CATL and Tesla in setting up recycling facilities within both resource-rich and consumer countries. This initiative aims to achieve efficient material recycling through mechanisms such as "trade-in" programs and "battery passports" that record comprehensive lifecycle data. the overarching goal is to utilize over 50% recycled materials in battery production by 2035, thereby reducing reliance on primary minerals [25-26].

4.5 Building an Industrial Ecosystem and Promoting the Integration of Globalization

and Localization

Supporting vehicle and component manufacturers from China, Europe, the United States, and other countries in their integration into local markets through various means such as overseas factory construction, technology licensing, joint venture cooperation (for instance, BYD establishing a new energy passenger vehicle base in Hungary and CATL partnering with Ford to build a battery factory in the United States). This approach not only meets local production requirements—such as the "North American Assembly" rule outlined in the US IRA Act—but also promotes the upgrading of the host country's industrial chain. In terms of policy support, host countries can offer tax incentives (like Hungary's 10-year tax reduction for battery projects), streamline approval processes, and encourage investors to commit to technology transfer and job creation to achieve mutually beneficial outcomes.

Establishing an international alliance for the new energy vehicle industry—akin to a World Organization for the Development of New Energy Vehicles—would bring together government policymakers, automotive companies, energy firms, research institutions, and other stakeholders. This alliance would regularly publish global industry trend reports, coordinate major technological research directions, and develop cross-border standard drafts. For example, by promoting initiatives like the "Global Charging One Network" plan—which includes a unified payment system and interconnection protocols—this platform could address compatibility issues related to charging during cross-border travel. Additionally, jointly establishing a 'Sustainable Development Fund for Electric Vehicles' would provide support for charging infrastructure development and technology research in emerging markets.

5. Conclusions

The rapid development of the global electric vehicle industry is not only an inevitable outcome driven by technological innovation but also a crucial lever for worldwide efforts to combat climate change and facilitate energy transformation. However, beneath the current market expansion and technological advancements lie deep-seated challenges such as high trade barriers, fragmented standard systems, heightened supply chain risks, and inadequate policy coordination. These issues are becoming significant obstacles that hinder the high-quality development of industries. History has demonstrated that any globally influential technological revolution requires a foundation of open cooperation—ranging from integrated circuits to photovoltaic technologies, communication standards to biomedicine. Only through collaboration rather than confrontation, and sharing rather than monopolization, can we unlock the greatest benefits.

In the context of the electric vehicle industry, policy coordination transcends mere unification of rules; it involves establishing a global governance framework that is "open, inclusive, fair, just, and mutually beneficial, " while respecting each country's developmental stages and core interests. This necessitates that governments worldwide move beyond short-term interest games and adopt a long-term perspective on industrial competition and cooperation: eliminating technological barriers through mutual recognition of standards so that innovative achievements can benefit the world more swiftly; maintaining market fairness via trade coordination to prevent protectionism from stifling industrial vitality; bridging developmental gaps through technology sharing to assist emerging markets in overcoming traditional path dependence; enhancing resilience through supply chain collaboration to ensure stable access to critical resources and materials; and fostering ecological co-construction by mobilizing multiple forces to promote the transition from "single manufacturing" to "full-chain prosperity. "

As the world's largest producer and consumer of electric vehicles, China has always adhered to the principle of "consultation, co construction, and sharing", and is willing to work with other countries to jointly solve development problems through policy coordination, technological innovation, and market demand. We firmly believe that as long as countries work together and abandon zero sum thinking, the global electric vehicle industry will break through bottlenecks, move steadily and achieve long-term goals. It will not only provide solid support for the achievement of carbon neutrality goals in the transportation sector, but also contribute green momentum to building a community with a shared future for mankind.

The future is here, only those who collaborate win. Let us embrace change with an open heart, work together towards the future with the power of cooperation, and jointly write a new chapter in the high-quality development of the global electric vehicle industry.

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