



Analysis of China's New Energy Truck Industry from a Supply Chain Perspective

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Abstract. This paper provides a comprehensive analysis of the Chinese New Energy Truck industry from the perspective of chain flexibility and resilience. This research covers the industry's current development situations, including rapid market growth, technological diversity, powerful policy support, and a highly competitive landscape. This research also indicates some crucial challenges that hinder deeper integration into supply chains, including high initial costs, limited driving range, inadequate charging infrastructure, and variation in economic understanding among entities across the supply chain. To deal with these significant problems and challenges, this paper proposes a multiple perspectives set of recommendations. This paper suggests developing customized powertrains and charging solutions for the technical section based on the scenario. At the policy level, it advocates the implementation of differentiated road access rights and incentive mechanisms for green supply chains. For the supply chain part, it suggests building a collaborative multi-warehouse logistics network and energy station network. The consumer side benefits from the transition to leasing and subscription models. The findings aim to provide actionable insights for logistics enterprises and policymakers to aid in the efficient integration of electric trucks into modern supply chains, leading to the creation of a more environmentally friendly and efficient logistics system.

Keywords: Electric Trucks, Supply Chain Flexibility, New Energy Commercial Vehicles

1 Introduction

1.1 Overview and Industry Background of Supply Chain Transportation

The full-process activity of moving products or services from origin to destination via various modes to achieve efficient, low-cost, and timely circulation is going through a profound transformation in supply chain transportation [1]. Key drivers include economic globalization, digitalization, and consumption upgrading, which are shifting logistics demand from single-mode transport to integrated, full-link collaboration. By utilizing automated guided vehicle (AGV) robots and intelligent sorting systems, electronics manufacturers in the Yangtze River Delta have been able to triple their order processing efficiency [2].

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The industry's transition to greener practices is being accelerated simultaneously by regulatory and market pressures. China's 14th Five-Year Plan for Modern Logistics prioritizes developing a logistics system that is digital, intelligent, and environmentally-friendly, as well as addressing carbon emissions from transportation through mechanisms such as the EU's Carbon Border Adjustment Mechanism (CBAM). Traditional logistics operators are still struggling with structural problems like fuel costs exceeding 35% of total expenses, multimodal transportation penetration being lower than 15%, and digital adoption among SMEs being less than 30% despite this [3].

These dynamics are reshaping core requirements for supply chain transportation—from a narrow focus on timeliness toward a multi-dimensional balance of efficiency, cost, resilience, and low-carbon performance. An *Less-Than-Truckload* carrier faced with profit erosion when a 12% fuel price increase was only offset by a 5% freight hike, and a food company experienced 30% spoilage because of inadequate temperature-controlled logistics are just two examples [4]. A shift away from diesel trucks and towards green alternatives like electric trucks has become an operational imperative as logistics accounts for roughly 10% of national carbon emissions [3, 5].

1.2 Application Background of Electric Trucks

Definition and Core Characteristics of Electric Trucks. Electric trucks refer to "new energy vehicles powered by on-board power sources, driven by electric motors to rotate wheels, and specifically designed for cargo transportation. They possess technical characteristics such as zero exhaust emissions, low noise, high energy efficiency, and simple structure with easy maintenance" [3]. Compared with traditional fuel trucks, their core advantages lie in the low-carbon nature and cost controllability during the operation stage. For example, the carbon emissions per kilometer of pure electric trucks are 70% lower than those of diesel trucks, and annual maintenance costs are only 60% of those of fuel trucks [4, 6]. However, in the early stage, they also had limitations such as "high power costs and driving range dependent on battery technology" [7]. This contradiction has gradually been alleviated with the maturity of lithium battery technology. For instance, relying on the lithium battery cell technology of its parent company AT Group, ABC Company has increased the battery cycle life of electric trucks to over 2,000 cycles [8].

Classification of Electric Truck Models and Adaptation to Supply Chain Scenarios. Based on application scenarios and functional positioning, electric trucks can be divided into two core categories: First, "high-speed road-legal vehicles" suitable for open supply chain scenarios such as urban distribution and inter-city logistics. They have a load capacity ranging from 0.5 to 15 tons and a cargo compartment width of 1.5 to 2.5 meters. Specifically, they include pure electric single-row small trucks, pure electric van-type light trucks, and pure electric dump trucks. Second, "non-licensed low-speed on-site transfer vehicles" specifically designed for closed supply chain nodes such as factories and ports. They have various structures such as single-bridge single-

drive and double-bridge double-drive, and can meet the demand for high-frequency cargo transfer in small areas [9].

This diversity of models precisely matches the differentiated needs of supply chain entities. Large manufacturing enterprises (such as those in the automotive and home appliance industries) prefer road-legal electric light trucks with a driving range of over 400 km to ensure the continuity of long-distance supply chains. Small and medium-sized logistics providers and community distributors tend to choose new energy micro-trucks with a load capacity of 0.5-1 ton, leveraging their flexible bodies to adapt to the "last kilometer" in cities. Factories, ports, and other closed scenarios rely on on-site low-speed vehicles to reduce range anxiety through fixed routes [6, 9]. According to statistics, in 2024, the sales proportions of pure electric light trucks and on-site low-speed vehicles in China reached 58% and 32% respectively, confirming the adaptation of models to supply chain scenarios [3].

1.3 Research Significance

Theoretically, this study addresses a gap in existing literature, which often focuses on isolated technical aspects of electric trucks or single supply chain links. It integrates supply chain transportation theory with electric truck characteristics to build a holistic framework analyzing their adaptability to the flexibility and resilience needs of various entities [5, 8, 9]. Practically, the research delivers actionable value by tackling key industry pain points. It guides enterprises in selecting cost-effective electric truck models for specific scenarios, shortening the payback period. Furthermore, it provides a pathway for entities to mitigate carbon emission pressures by integrating electric trucks with carbon trading mechanisms. Lastly, it proposes methods to enhance supply chain resilience against disruptions by optimizing logistics and charging networks [4, 10, 11]. Both corporate adoption and governmental policy formulation benefit from this study as a strategic reference, leading to a shift from high-energy consumption to high-efficiency, low-carbon logistics.

2 Analysis of Industry Development Status

2.1 Market Size and Growth Trends

Data released by China Merchants in September 2025 indicates a gradual expansion of the new energy truck market. Pure-electric light-duty trucks comprised 5.9% of all model types on the market, while pure-electric heavy-duty trucks comprised 10.4%. The penetration rate of 22% was achieved in the first half of 2025 with the sales of new energy-efficient heavy-duty trucks reaching 79,200 units. According to Market Share and Distribution of Commercial Vehicles in the September 2025 Report of Sinotrans Department, which released by China Merchants Group: by the end of August 2025, an additional 15,800 new energy heavy-duty trucks were added nationwide, representing a year-on-year increase of 169%. Models from China Merchants predict that China's electric heavy-duty truck fleet could reach 190,000 units by year-end, with total sales projected to rise to 500,000 units by 2028 (see Fig.1).

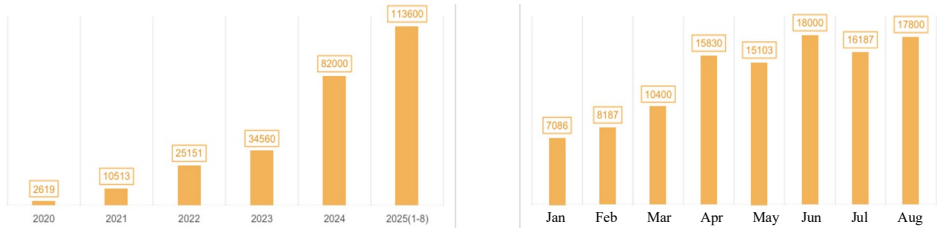


Fig. 1. New Energy Heavy-Duty Truck Market Development Section in the New Energy Truck Market Analysis Report of the Marketing Department of Sinotrans, September 2025. The table on the left shows annual sales figures for new energy trucks, while the table on the right presents sales data for January through August 2025. (Photo credit: Original)

The 2024 total cost of usage (TCU) White Paper for New Energy Urban Distribution Logistics Vehicles by LogResearch outlines three key industry penetration thresholds—10%, 20%, and 40%—corresponding to the growth, acceleration, and maturity phases of the new energy logistics vehicle market. For this study's focus on electric trucks and supply chain adaptation, these benchmarks directly reflect how electric trucks are integrating into supply chain transportation.

After surpassing 10% sales penetration in 2022, the market entered the growth phase: large logistics providers began adopting electric trucks to cut last-mile costs, supported by green freight policies like preferential road access. By late 2024, penetration exceeded 20%, marking a critical shift to the acceleration phase—this means electric trucks have moved from niche to mainstream supply chain use.

The 20% milestone signals electric trucks now meet most supply chain needs: 300–400 km ranges cover inter-city transportation, and improved charging/swapping infrastructure eases range anxiety. For supply chain entities, this brings practical value: electric trucks reduce fuel costs by 40–50% vs. diesel models (per LogResearch) and help meet carbon footprint requirements, boosting the supply chain's green competitiveness.

2.2 Product and Technology Development

Data from Sinotrans in September 2025 shows the emergence of diverse new energy logistics vehicle modules, covering various application scenarios such as port shunting, mining area transport, long-haul trucking, oversized cargo transport, medium/short-distance transport, and fresh cold chain distribution. Product differentiation primarily manifests in power type, battery capacity, and driving range.

China Merchants Group/Sinotrans's September 2025 New Energy Truck Market Analysis Report notes that among new energy commercial vehicle technology routes, pure electric models are the most mature, with hydrogen and methanol vehicles still exploratory. Electric heavy-duty trucks consume 100–150 kWh/100 km; their vehicle, battery, and electronic control technologies are mature, with fast/ultra-fast charging and battery-swapping advancing rapidly, but refueling/recharging infrastructure deployment needs acceleration. Electric trucks' carbon reduction depends on power generation mix. For example, Northwest China's power grid results in approximately 87 kg/km carbon emissions for heavy-duty trucks, but clean energy/green power can cut

this to near zero. Hydrogen and methanol vehicles have unique merits: methanol is low-cost and fast-refueling, while hydrogen is environmentally friendly and performs well in extreme conditions. However, both technologies lack maturity: hydrogen production and transportation are costly with limited green hydrogen scale, and methanol combustion poses safety risks.

2.3 Policy and Environmental Support

Regarding policy, the State Council's "Carbon Peak Action Plan by 2030" serves as the top-level framework promoting the transition to new energy logistics vehicles, covering the transportation sector as a core supportive policy [12]. In 2024, the General Office of the State Council issued the "Action Plan for Effectively Reducing Overall Social Logistics Costs," emphasizing the acceleration of logistics greening and expanding the application of new energy logistics vehicles in urban distribution, postal delivery, and express sectors [13]. In March 2025, the "Catalogue of Energy-Saving and New Energy Vehicle Models Eligible for Vehicle and Vessel Tax Reduction (71st Batch)" listed 343 new energy commercial vehicle models eligible for tax breaks [14]. Furthermore, reports from LogResearch estimate the average purchase prices of electric and fuel vehicles, indicating that electric truck costs are converging with those of fuel trucks. Vehicle replacement subsidy policies, such as those in the "Notice on Further Improving Vehicle Replacement Programs," can enhance new energy vehicle penetration [15]. Although a joint 2024 policy from the People's Bank of China and the National Financial Regulatory Administration did not include "0 down payment" for commercial vehicles, the truck market also requires lower down payments to stimulate demand [16]. By the end of 2024, typical sales terms involved a 10% down payment, a 3-year loan term, and interest rates between 10% and 14%. Beside, there are some differences between different areas. Here takes an example of major provinces in the southwest region in China.

Table 1. 2024 New Energy Urban Distribution Logistics Vehicles Total Cost of Use (TCU) White Paper

Category	Year	Transportation and Distribution Activities	Loading, Unloading, Handling and Storage Activities	Auxiliary Logistics Activities	Total
Energy Consumption (Billion Ton Standard Coal)	2020	3.6	0.22	0.12	3.93
	Proportion	91.5%	5.5%	3.0%	100%
Carbon Dioxide Emissions (Billion ton)	2021	3.86	0.25	0.12	4.22
	Proportion	91.3%	5.8%	2.9%	100%
	2020	7.36	1.02	0.43	8.80
	Proportion	83.6%	11.6%	4.8%	100%
	2021	7.89	1.16	0.44	9.48
	Proportion	83.2%	12.2%	4.6%	100%

Environmentally, International Energy Agency statistics show that in 2020, the transportation and logistics sector accounted for 21% of global CO2 emissions, a share

that is increasing, making it a key area for carbon reduction. The 2024 TCU White Paper notes that in 2020 and 2021, transportation and distribution activities contribute over 83% of the logistics industry's total carbon emissions (see Table 1). With growing freight volume and turnover rates, carbon emissions from China's logistics industry are also on an upward trend.

2.4 Competitive Landscape and Cooperation

The China Merchants September 2025 analysis report indicates that over 60% of shippers and logistics transporters have already implemented or plan to implement new energy heavy-duty truck projects. Among shippers, approximately one-quarter, while not yet implementing, have clear intentions to proceed; only 8% currently have no plans. The proportion of logistics transporters with no plans is slightly higher, at 18% (see Fig.2). The sales ranking of new energy heavy-duty truck manufacturers from January to August 2025 shows a fiercely competitive and vibrant market among leading players. XCMG, SANY, and Jiefang occupied the top three spots in sales, holding a cumulative market share of 46%. Companies like Shacman, CNHTC, and Foton also hold certain market shares, while sales from Dongfeng, Farizon, and Yutong are also considerable, indicating strong market participation and demand (see Fig.3). Simultaneously, LogResearch suggests that platform operators are pursuing maximum efficiency, with logistics operations control shifting towards enhancing transport efficiency. The trend towards platformization is accelerating disintermediation, pushing management control closer to the vehicle level, and directly managing the transportation process. This is expected to further intensify competition within the logistics transport sector.

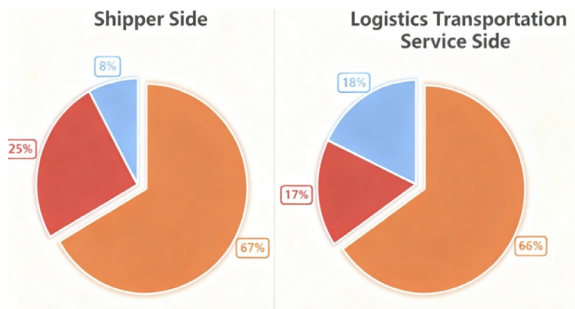


Fig. 2. Application of New Energy Heavy Trucks in China Merchants Group's September 2025 New Energy Truck Market Analysis Report. (Photo credit: Original)

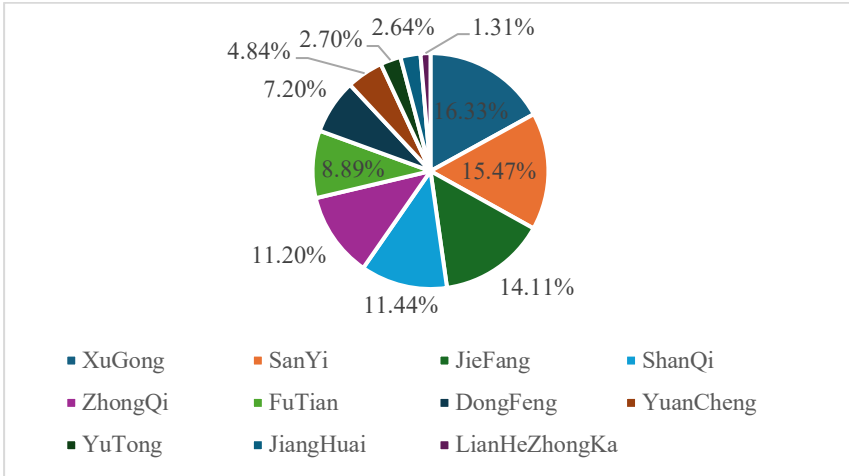


Fig. 3. Market Share of New Energy Truck Companies released by China Merchants Group's in September 2025 (Photo credit: Original)

3 Discussion of Potential Issues and Challenges

3.1 Economic Efficiency & Cost Analysis

Total cost of use (TCU) encompasses various costs, including purchase price, operating costs, insurance, and hidden costs. Explicit costs include asset costs (e.g., purchase price), operating costs (e.g., energy), insurance costs (base premium and discounts), maintenance costs, and asset disposal costs (residual value). Hidden costs involve management overhead and vehicle availability/uptime.

For supply chain entities considering electric trucks, this TCU breakdown is critical—it reveals that the "cost advantage" of electric trucks is not just about lower energy costs, but a holistic balance across the vehicle's lifecycle. For example, while electric trucks have a 30-50% higher upfront purchase price than diesel counterparts (explicit asset cost), their operating costs (e.g., electricity vs. diesel) are 40-60% lower, and maintenance costs (fewer moving parts) are roughly half. More importantly, hidden costs like downtime due to charging can be mitigated by matching electric truck models to supply chain scenarios—e.g., using swap-battery light trucks for high-frequency urban distribution to minimize availability losses. This holistic TCU perspective helps supply chain entities avoid short-sighted decisions (e.g., rejecting electric trucks over high purchase prices) and instead make choices aligned with long-term supply chain cost efficiency.

A 2025 China Merchants comparative analysis of energy consumption and costs clarifies a key cost reality for supply chain entities choosing alternative-fuel trucks: among mainstream options, diesel offers price stability but higher overall costs than methanol, while pure-electric energy costs fluctuate with electricity prices, and hydrogen remains the most expensive. Beyond direct energy costs, new energy trucks

(including electric models) face a notable insurance barrier—many insurers avoid covering them due to high claim rates, and those that do raise premiums yearly, adding significant risk-bearing costs for enterprises, a trend LogResearch data confirms as a threat to industry health.

While electric light-duty trucks have a clear edge in maintenance costs (around 40% of diesel trucks'), it is too early to declare new energy trucks universally cost-advantaged or disadvantaged. This uncertainty stems from two critical factors: first, long-term cost stability remains unproven, especially if policy support (e.g., subsidies, tax breaks) diminishes; second, according to Survey Results on Attitudes Toward New Energy Heavy Trucks Among Cargo Owners and Logistics Carriers released by China Merchants, perceptions of economic benefits vary sharply by supply chain role—75% of shipper-side electric truck clients see clear gains, yet 33% of logistics service providers cite insufficient financing and policy support, and nearly 67% worry about unclear economic returns.

For supply chain entities, these findings highlight a need for scenario-specific cost assessments: shippers (with stable long-haul demand) may better leverage electric trucks' maintenance savings, while logistics providers (facing tighter cash flow) may need more policy or financing support to overcome upfront and insurance cost concerns. This divergence also underscores that new energy trucks' cost competitiveness in supply chains is not a one-size-fits-all conclusion, but depends on stakeholder type, operational scenarios, and policy continuity.

3.2 Technical Bottlenecks

2025 China Merchants data about Survey Results on Attitudes Toward New Energy Heavy Trucks Among Cargo Owners and Logistics Carriers also indicates that among shippers, 25% of companies report limited market choices, with few suitable models meeting business needs; another 25% point to range and payload issues, such as short driving range and limited load capacity; 50% believe operational efficiency is affected by factors like long charging times and inconvenient refueling/recharging, and similarly, 50% perceive insufficient infrastructure, including inadequate charging/battery swap stations. Among logistics transporters, 25% also cite insufficient infrastructure, 33% express concerns about market choice, operational efficiency, and range/payload, and 20% have apprehensions regarding maintenance and repair technical capabilities.

3.3 Customer Insights

Data from the customer insights section of the China Merchants September 2025 analysis reveals that for large and medium-sized enterprises, the primary concerns when purchasing new energy trucks revolve around whether vehicle performance and range can meet the practical demands of their logistics chains. Over forty enterprises were concerned that preferential road access policies might not effectively reduce vehicle costs. For small enterprises, the focus is primarily on vehicle performance and range, vehicle cost, and the convenience of refueling/recharging facilities.

4 Future Application Development Suggestions

4.1 Technical Recommendations: Customized Powertrain and Scenario-Based Charging Solutions

Electric truck technology must be tailored to distinct supply chain scenarios. For urban distribution, battery-swapping models are highly recommended to minimize downtime. Data from Gao Tingting shows that swapping-based logistics vehicles reduce total distribution costs by 8.2% compared to charging-only models by eliminating waiting time [17]. For long-haul transport, optimizing the AMT powertrain is critical. Research by Chen Runfa indicates that adaptive shift strategies for AMT systems can reduce energy consumption by 8–10% under heavy-load conditions, effectively balancing power and efficiency [18].

4.2 Policy Recommendations: Differentiated Road Rights and Green Supply Chain Incentives

Policy frameworks should be refined to accelerate adoption and alleviate customer concerns. Implementing differentiated road rights, such as priority access for electric trucks in urban delivery zones, directly addresses operational efficiency concerns. Drawing on international practices, China could tie electric truck subsidies directly to verifiable carbon emission reductions [19]. Furthermore, introducing green procurement credit discounts would lower financial barriers, particularly for small and medium-sized logistics providers, aligning policy with the cost sensitivities identified in customer insights [20].

4.3 Supply Chain Recommendations: Multi-Warehouse and Charging-Swapping Station Synergy Network

Enhancing supply chain flexibility requires a collaborative logistics and energy infrastructure network. Zhou Tong's multi-warehouse route optimization model demonstrates that dispersing logistics hubs can reduce single-vehicle delivery radius by 40%, which directly alleviates range anxiety [11]. Complementing this, demand-prediction-driven infrastructure planning for charging-swapping stations is essential. Yu Zexia's research suggests that strategic station placement, such as one swapping station per 50 km on major routes, can significantly improve network resilience and reduce operational disruptions [12].

4.4 Consumer Recommendations: Transition to Leasing and Subscription-Based Services

To overcome the high upfront cost barrier, a shift from ownership to usership is crucial. Leasing and subscription models present a viable solution for logistics enterprises, especially SMEs. Industry reports released by LogResearch in 2024 show that subscription services can reduce upfront costs by 30–50% compared to outright purchases.

These models offer greater flexibility, with terms as short as 1-24 months compared to traditional finance leases, allowing enterprises to dynamically adjust transport capacity in response to supply chain fluctuations.

By integrating technical innovation, policy support, supply chain collaboration, and consumer-oriented business models, the electric truck industry can better meet the flexibility and resilience demands of modern supply chains, driving sustainable growth in logistics and transportation.

5 Conclusion

This study has analyzed the integration of China's electric truck industry into modern supply chains, focusing on enhancing flexibility and resilience. The analysis reveals that while the market is experiencing rapid growth and technological diversification, significant challenges related to economic efficiency, technical performance, and infrastructure adequacy remain. To address these, the paper proposed targeted recommendations: promoting flexible consumer models like leasing to mitigate costs, advancing scenario-specific technical solutions, implementing supportive policies such as differentiated road rights, and optimizing supply chain networks through synergistic infrastructure planning. The findings provide a strategic framework for enterprises to adopt electric trucks effectively and for policymakers to craft enabling regulations. However, this research is primarily based on existing industry reports and literature, which may not capture the most recent on-the-ground dynamics. Future research should incorporate extensive empirical data and case studies to validate the proposed recommendations and explore the long-term operational impact of electric trucks on overall supply chain performance and carbon footprint.

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