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Adjustment of the Market Share of New Energy Vehicles

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Abstract

As new energy vehicles (NEVs) process energy in a more concentrated manner and are easier to regulate than fuel vehicles, and their production and consumption processes produce relatively less carbon dioxide than traditional vehicles, they can serve as a current solution for addressing carbon emissions. Increasing the market share of NEVs is solving current environmental challenges. The market share of NEVs is influenced by multiple reasons and perspectives, and investing in different aspects will yield different market share outcomes and cost performance results. Therefore, we combine theory with actual data quantification for market simulation to ensure the rationality of investment.

Keywords

New energy vehicles; market share; carbon emissions; market policy; competitive landscape

1. Introduction

Against the backdrop of global warming, automobiles as a means of transportation are a major source of carbon emissions, thus necessitating a transition toward low-carbon emissions to meet current environmental demands. New energy vehicles, characterized by low carbon emissions, can become an important pathway to address environmental pressure. However, despite continual technological advances in NEVs today, their actual market share is still constrained significantly by factors such as price, range, and charging convenience. How to adopt the most economical and cost-effective investment approach to drive market share is a concern for enterprises or national governments. This paper combines market models and real data to simulate the impact of different investment methods on the market, providing theoretical support and decision-making assistance for promoting NEV adoption.

2. Literature Review

Current studies of NEVs mainly focus on market competition, consumer behavior, infrastructure, and government policies. For example, Cao Hanxi analyzed the competitive landscape and future trends of NEVs, noting that the industry is currently transforming under national policy drive, with market share concentrated in leading enterprises, and future competition will focus on intelligence and range (Zeng, 2022). Guo Xiangyu's study suggested that sustained R&D investment significantly improves the market share of NEVs, and automotive R&D can translate into market advantages (Guo, 2023). Almansour analyzed the performance of sustainability and digital marketing in NEV sales, pointing out that low information transparency leads to consumer hesitation (Almansour, 2022).

Shao Tianlin's research focused on vehicle purchase tax exemption/reduction policies and found that such government policies can stimulate consumption and encourage enterprises to increase R&D in NEVs (Shao, 2024). Zhang

Lu et al. used system dynamics models to analyze the impact of different policies on the NEV market and found that combinations of different policies are stronger than single policies in promoting NEV adoption (Zhang et al., 2024).

Fan Zhidan's research stated that in China's three northeastern provinces, the NEV market is constrained by multiple factors, including climate, charging pile deployment, and public awareness, therefore, local policies and infrastructure in the three provinces should be further strengthened (Fan, 2022). Zhu et al.'s research showed that users are simultaneously influenced by factors such as technological trust and face (mianzi) psychology when purchasing vehicles, and strengthening policies and social recognition can improve consumer satisfaction and loyalty (Zhu, Ma, & Li, 2024).

3. Problem Description and Quantitative Modeling

The competition in the NEV market is essentially competition for user purchase intention (Sanguesa et al., 2021). User decisions are based on a comprehensive evaluation of multiple vehicle attributes, including price, range, comfort, appearance, energy replenishment convenience, and social ideas. Enterprises optimize specific attributes through investment (such as price subsidies, technology R&D, and infrastructure construction), thereby influencing user purchase intention, ultimately changing market share and enterprise revenue (Sun et al., 2019). To accurately evaluate the effects of different investment strategies, we establish a multi-attribute decision-making (MADM) model.

The model follows the following four core steps:

Attribute standardization: Convert various attributes of all vehicle models, which span different physical units (RMB, kilometers) and ratings (1-10 points), into standardized scores between 1 point and 10 points via linear normalization functions to ensure comparability.

Positive attributes (higher is better): $Score = 1 + 9 \times \frac{Value - Min}{Max - Min}$

Negative attributes (lower is better, such as price): $Score = 1 + 9 \times \frac{Max - Value}{Max - Min}$

Calculation of comprehensive attractiveness score: Use provided weights to compute the weighted sum of standardized attribute scores for each model to obtain a comprehensive attractiveness score (S_i).

$$S_i = \sum \left(w_j \times \text{Score}_{ij} \right)$$

Dynamic market share allocation: Use the softmax function to convert all models' comprehensive attractiveness scores into dynamic market shares that sum to 100%. Compared to the vague logic of "ranking changes leading to share changes," this can precisely reflect how much share a model will "seize" from all competitors when its score improves.

$$\text{Market Share}_i = \frac{e^{k \cdot S_i}}{\sum_{j=A}^{I} e^{k \cdot S_j}}$$

By adjusting the sensitivity coefficient k, we ensure the model's baseline is accurate.

Precise return on investment (ROI) calculation: Based on dynamically changed market shares and sales volumes, we calculate the real profit impact of each scheme and derive ROI.

4. Case Analysis

Suppose the market has nine types of vehicles: A, B, C, D, E, F, G, H, and I, representing low, medium, and high-end electric vehicles, low, medium, and high-end fuel vehicles, and low, medium, and high-end hybrid vehicles, respectively. Users rank their purchase intentions for the nine types of vehicles as follows (1-9):

Table 1. purchase intentions for the nine types of vehicles

Violation type	Ranking	Purchase intention share
A	1	20%
B	2	17%
C	3	15%
D	4	12%
E	5	11%

Table 1 Continued

F	6	9%
G	7	7%
H	8	5%
I	9	4%

Attributes influencing vehicle purchase intention include price, range, comfort, appearance, energy replenishment convenience, social ideas, and their respective weights. A search of China's total automobile market sales revealed 31.436 million units in a year, from which we can derive absolute market shares.

Table 2. China's total automobile market sales

	Price/RMB (0.3)	Range/km (0.2)	Comfort/1-10 (0.2)	Appearance/1-10 (0.1)	Energy replenishment convenience/1-10 (0.1)	Social ideas/1-10 (0.1)
A (BYD Seagull)	70,000	300km	4	5	4	6
B (XPeng P7)	210,000	600km	6	7	4	8
C (Tesla Model S)	800,000	700km	8	8	5	9
D (Wuling Hongguang)	50,000	600km	3	3	10	4
E (Toyota Corolla)	130,000	850km	6	6	10	6
F (Mercedes-Benz E-Class)	450,000	750km	9	9	10	9
G (BYD Qin Plus)	90,000	1200km	6	6	10	7
H (Honda Accord Hybrid)	200,000	1000km	7	7	10	8
I (Lexus ES300h)	420,000	1100km	9	8	10	9

Now, we simulate three investment schemes of RMB 100 billion each and use the above model for precise evaluation.

Scheme I: Price Subsidy (RMB 100 billion)

This scheme provides an average price subsidy of RMB 38,000 per vehicle for three NEV models: A, B, and C.

Model A (BYD Seagull)'s price drops from RMB 70,000 to RMB 32,000, and its standardized price score soars from **9.76** to **10.0**. Model B (Xpeng P7)'s price drops from RMB 210,000 to RMB 172,000, and its price score improves from **8.08** to **8.54**. Model C (Tesla Model S)'s price drops from RMB 800,000 to RMB 762,000, and its price score improves from **1.0** to **1.46**. Model-derived results are shown in Fig. 1.

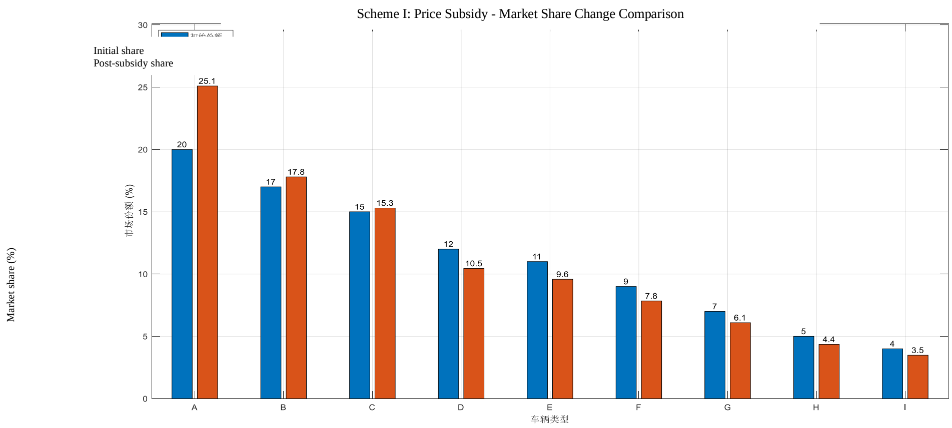

Figure 1. Scheme I: Price Subsidv - Market Share Change Comparison.

Violation type

From Fig. 1, Model A's comprehensive attractiveness score leads significantly, with its market share surging from **20%** to **25.1%**, a net increase of 5.1 percentage points. Models B and C also show slight share increases, reaching **17.8%** and **15.3%**, respectively. These gains primarily come from conversions from fuel and hybrid models D, E, and F. Total sales of the three models increase by about **2.105 million units**. However, for every model A and B sold, the RMB 38,000 subsidy far exceeds their original per-vehicle profit, causing them to "lose money on every sale." Even though Model C's profit improves, the enormous subsidy cost causes the scheme's overall profit to decrease. Calculations show that this scheme **reduces** total enterprise profit **by about RMB 58 billion** (specific figures depend on initial profit assumptions, but the conclusion is a substantial loss). Therefore, its **ROI is -58%**.

Price subsidies can quickly stimulate sales of low-priced models, bringing significant market share growth, but their high costs directly erode or eliminate per-vehicle profits, leading to catastrophic financial consequences. This is a "losing money for buzz" short-term strategy.

Scheme II: Charging Infrastructure Construction (RMB 100 billion)

Investing RMB 100 billion to build 165,000 public fast chargers improves the "energy replenishment convenience" scores of models A, B, and C by 2 points each. Models A and B's convenience scores improve from 4 to 6 points. Model C's convenience score improves from 5 to 7 points. Derived results are shown in Fig. 2.

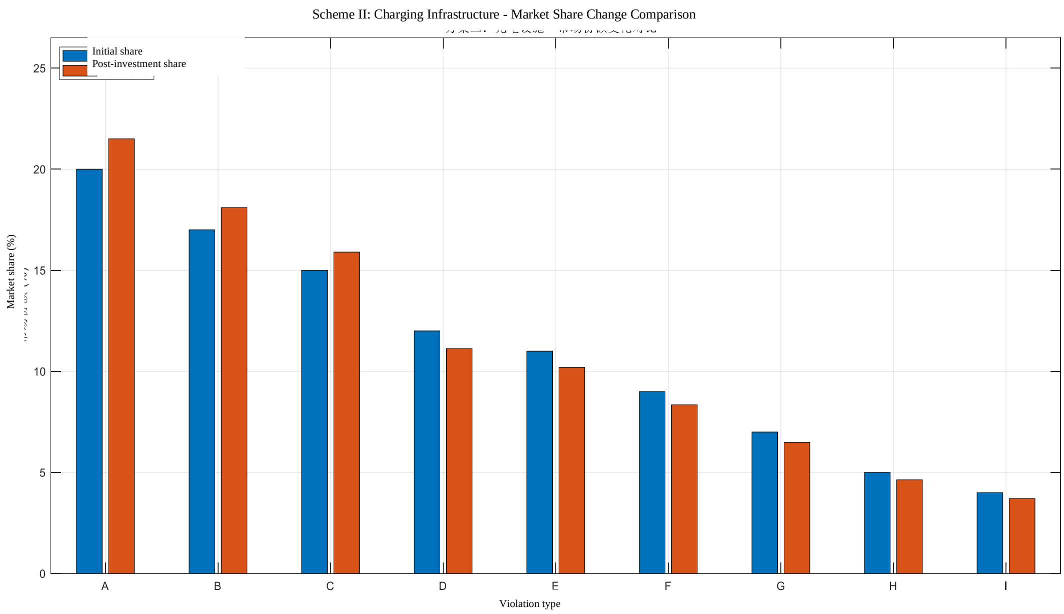

Figure 2. Scheme II: Charging Infrastructure - Market Share Change Comparison.

From Fig. 2, all three models' comprehensive attractiveness scores improve. The model shows that total market share increases from **52%** (20+17+15) to **55.5%**, up **3.5 percentage points**. Model A's share increases to 21.5%, Model B to 18.1%, and Model C to 15.9%. Total sales increase by **1.1 million units**. As per-vehicle profit remains unchanged, this additional sales volume brings pure profit growth. Assuming the three models' weighted average per-vehicle profit is RMB 20,000, the incremental profit is **RMB 22 billion**.

Return on investment (ROI): $ROI = 22 \text{ billion}/100 \text{ billion} = 22\%$

Compared with price subsidies, investing in charging infrastructure has a gentler effect on market share improvement, but it does not harm per-vehicle profits, bringing healthy profit growth and positive ROI. More importantly, it builds a long-term ecosystem moat that benefits all future electric vehicle models and enhances brand image.

Scheme III: Battery Technology R&D (RMB 100 billion)

Invest RMB 100 billion in battery R&D to increase the range of models A, B, and C by 240 km. Model A's range increases from 300 km to 540 km, and its standardized range score improves from 1.0 to 3.67. Model B's range increases from 600 km to 840 km, and its range score improves from 4.0 to 6.40. Model C's range increases from 700 km to 940 km, and its range score improves from 5.0 to 7.40.

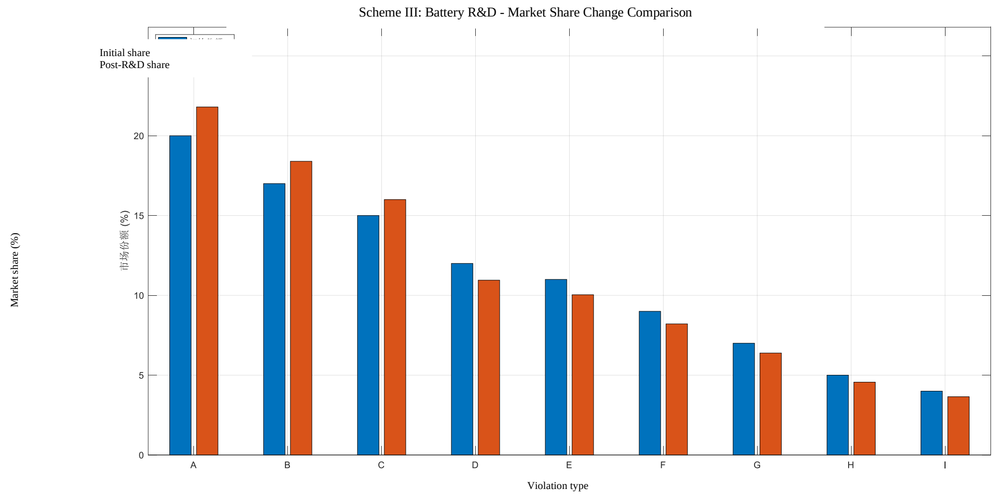

Figure 3. Scheme III: Battery R&D - Market Share Change Comparison.

Range is the core pain point second only to price, therefore, the score improvement effect is significant. The model shows that the three models' total market share increases from 52% to 56.2%, up 4.2 percentage points. Total sales increase by 1.32 million units. Similarly, with unchanged per-vehicle profits, the incremental profit is about RMB 26.4 billion (based on the RMB 20,000 average single-vehicle profit assumption).

Return on investment (ROI): $ROI = 26.4\text{ billion}/100\text{ billion} = 26.4\%$

Investment in core technology (battery range) delivers the highest ROI in the current model. It directly addresses users' core anxiety, builds strong product competitiveness through technological innovation, and efficiently promotes both market share and profit growth.

Comparison of the three schemes is shown in Table 1:

Table 3. Comparison of Three Investment Schemes

Investment scheme	Total market share increase	Total sales growth	Total profit change	ROI	Strategic value
Price Subsidy	**+7.2%**	~2.105 million units	**~-RMB 58 billion**	**~ -58%**	Short-term effect, extremely high financial risk
Charging Infrastructure	+3.5%	~1.1 million units	~+RMB 22 billion	~ 22%	Long-term value, ecosystem building, steady returns
Battery R&D	**+4.2%**	~1.32 million units	**~+RMB 26.4 billion**	**~ 26.4%**	Core competitiveness, high efficiency, high returns

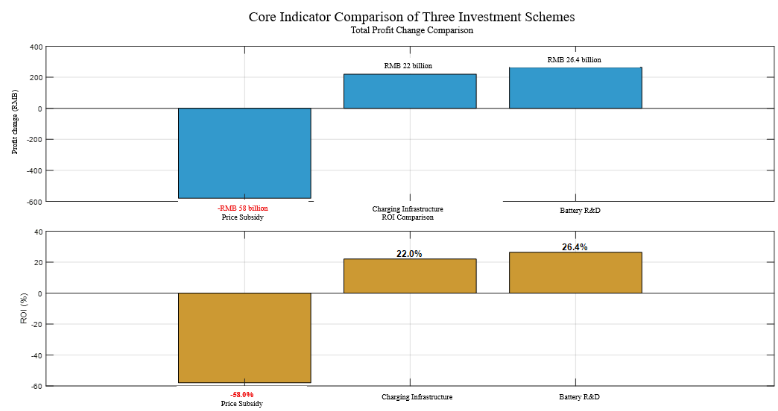

Figure 4. Core Indicator Comparison of Three Investment Schemes.

Overall, under equal investment, building charging stations and extending battery life produce relatively balanced economic effects, both superior to price subsidies. Currently, charging infrastructure construction yields more consistent returns than extending range. As charging infrastructure has broader spillover impacts on infrastructure development, can support future models, and benefits image and customer experience, it has greater long-term strategic value. In contrast, although extending battery life can generally enhance product capabilities, it requires substantial upfront capital investment with limited short-term returns. Price subsidies produce short-term effects, but subsidy-induced new returns are weakening, insufficient to drive market scale development. As a result, at critical junctures, charging infrastructure development should take priority. Deploying ultra-high-power fast charging sites in major city locations where electric vehicle utilization is highest can potentially attract more users and greatly enhance electric vehicle value. Furthermore, forming a comprehensive network can provide supplementary benefits to both consumers and manufacturers. To support this, in addition to gradually reducing prices and investing in long-term sustainable technologies, planned and coordinated investment planning should be developed to maximize market returns within existing funding constraints. To sum up, the price subsidy scheme has high costs but obvious market reactions, the charging infrastructure scheme yields limited market improvement, whereas the range R&D scheme produces the highest ROI with relatively low investment costs, efficiently boosting NEV market share and validating that technological innovation is a key factor in NEV competition.

5. Conclusion

The above analysis shows that different investment models produce significantly different effects in the NEV market. This paper concludes that the charging infrastructure deployment strategy is superior to the battery range development strategy, and the battery range development strategy is superior to the direct price subsidy strategy. Beyond the reasons analyzed herein, let us further analyze the strengths and weaknesses of these investment strategies from the following perspectives.

Firstly, from the perspective of investment payoff timing, these three strategies have different investment effect periods. Charging pile construction requires large upfront investments and long construction cycles, but once completed, it can provide continuous, long-term, and stable returns, continually increasing market share and sustaining company brand value. Power battery R&D investment produces returns later than charging pile construction, involves long-term technology accumulation and market validation cycles, and does not show quick short-term effects, but can create certain technical barriers in the long run. Direct price subsidies take quick effect but last short and are unstable, with decreasing capital use efficiency over time.

Secondly, from the perspective of industry chain extensibility and economic driving, the three differ much in their affected objects. Direct price subsidies in the terminal market only affect terminal sales, with no direct impact on upstream and downstream enterprises in the industry chain. Battery R&D investment can drive battery manufacturers, terminal NEV makers, and upstream raw material enterprises to form industrial clusters. Charging infrastructure construction has the strongest industrial driving force, not only driving the entire NEV industry chain to develop infrastructure construction enterprises, operations management, and intelligent management platforms, but also stimulating many other related industries, including the future development of the low-altitude economy, such as drone charging stations, smart grid planning and construction, and urban infrastructure intelligent transformation.

In conclusion, in terms of industrial development and industry chain cultivation, the charging infrastructure construction strategy can not only directly improve NEV market penetration but also contribute to in-depth collaboration across the NEV industry chain, as well as broad economic promotion. This strategy creates high strategic value and significant economic benefits. Based on each strategy's characteristics, this study recommends that enterprises and governments prioritize the charging infrastructure construction strategy and then gradually coordinate with medium and long-term strategic planning for range and energy storage R&D, supplemented by price subsidies as short-term market incentives. The combination of these three can promote the long-term, sustainable development of the NEV market.

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