Research on Sales Forecast of New Energy Vehicle: Based on the Perspective of Government Subsidy

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Abstract: By studying the development status of the new energy vehicle (NEV) industry, establishing a system dynamics scenario of NEV sales, using Vensim software for scenarioing and simulation, analyzing the impact of technology innovation, infrastructure and other related variables on the NEV market sales, and simulating the future development trend of NEVs. This paper concludes that the future sales of NEVs will keep growing, which is mainly due to the increase of government subsidies and improvement of infrastructure. Finally, based on the simulation results and combined with the actual situation, reasonable suggestions are made for the future development of the NEV industry. The suggestions include: improving infrastructure construction; enhancing the role of policy leadership and strengthening government regulation.

1 INTRODUCTION

In order to improve low-carbon transformation capacity and create green prosperity, we should gradually reduce our dependence on coal under the premise of improving the clean and efficient utilization of coal power, continuously optimize the energy structure, increase the proportion of renewable energy power in the terminal energy consumption, vigorously develop new energy technologies, increase the investment in new energy research, and strongly support the development of new energy vehicle (NEV) industry. The "NEV Industry Development Plan (2021-2035)" issued by the State Council requires the implementation of preferential tax policies related to NEVs, financial support for the construction of charging piles as public facilities, and preferential policies for parking and charging of NEVs. The country is strongly supporting the development of the NEV industry, and the tax incentives and basic measures related to NEVs are being gradually improved. However, according to the CCA, as of the end of December 2021, the number of NEVs in China was 7.84 million, and the number of public charging piles was 1.147 million, with a vehicle-pile ratio of 6.83:1, with an average of 7 vehicles having one charging pile, which is still a certain distance from the goal of one vehicle with one pile. The lack of public charging facilities makes consumers hesitant about NEVs.

According to the development experience of NEVs, government investment and support are necessary to promote the development of NEVs. In terms of policy evaluation, Ari Kokko studied the role of national policies in the development of NEV industry and pointed out that national technical support and industrial policy support are important pillars to promote the development of NEV industry (Liu & Kokko 2012, Hood & Margetts 1983). Sierzchula pointed out that charging infrastructure is more closely related to the adoption of electric vehicles, and a good infrastructure can lead to a high adoption rate of electric vehicles (Sierzchula et al. 2014). The results of McKinsey & Company show that financial subsidy policies play an important role in promoting and using NEVs. To some extent, the level of government support affects the future development trend of NEVs. Based on this, this paper establishes a system dynamics model of NEV sales, uses Vensim software for modeling and simulation, analyzes the impact of technology innovation, infrastructure and other related variables on NEV market sales, simulates the future development trend of NEVs, and provides suggestions for the future development of the NEV industry.

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2 METHOD AND METHODOLOGY

The development of NEVs is influenced by a combination of national policies, technological innovation, infrastructure, economic situation and other factors, while these factors interact with each other and influence each other. System Dynamics is a methodological approach and a combination of qualitative and quantitative analysis of socio-economic problems, which was first proposed by Professor Forrester(Wang 1986). Therefore, this paper adopts the system dynamics approach and uses Vensim software to study the impact of national policies, technological innovation and infrastructure on the sales of NEVs.

The attractiveness of NEV products is influenced by the level of technology, that is, technological innovation is the main influencing factor for the improvement of NEVs (Liu & Song 2013), which in turn affects innovation capacity and ultimately acts on the level of technology. It is worth mentioning that government R&D investment can stimulate enterprises' R&D enthusiasm on the one hand, but on the other hand, it can also lead to enterprises' dependence on government subsidies and innovation inertia, which reduces the innovation capacity and affects the improvement of technology level (Cai 2022). Consumer purchasing is influenced by many factors, which are summarized in this paper by product attractiveness (Zhou & Liu 2021). Product attractiveness is mainly determined by a combination of the level of infrastructure development (vehicle-to-pile ratio) and the level of technology.

2.1 Feedback Loops and Cause-Effect Loop Diagrams of Model

This paper studies the construction of a systematic feedback between technological innovation, infrastructure and the NEV industry, which mainly includes the following feedback loops.

1. consumer purchasing → NEV Annual Sale → NEV Holding → vehicle-pile ratio →NEV Ease of Use → Product Appeal

2. Government subsidy → government R&D → innovation capacity → technology innovation → technical level → product appeal → consumer purchasing → NEV Annual Sale→ NEV holding

3. government subsidy → government R&D → Creative inertia → innovation capability → technology innovation → technical level → product appeal → consumer purchasing → NEV Annual Sale → NEV Holding

Based on this, the study constructs a causal loop diagram between technological innovation, infrastructure and the NEV industry, as shown in Figure 1.

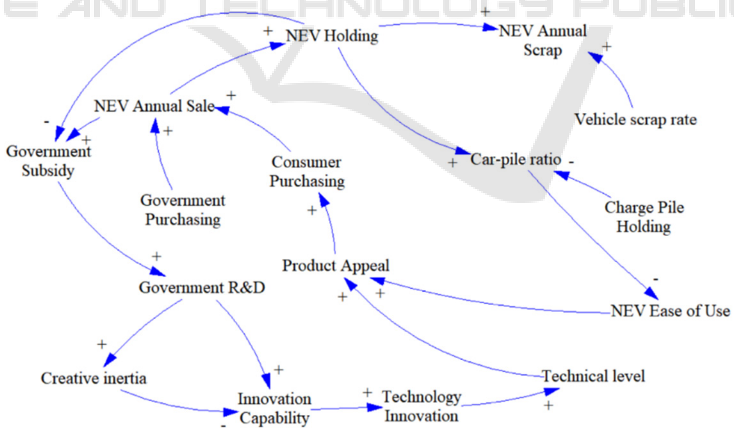

Figure1: Cause-and-effect loop of technological innovation, infrastructure and the NEV industry.

2.2 Determining System Boundaries of Model

Based on the clarification of the problem, the system scenario needs to establish the system behavior boundary and the time boundary. In determining the system behavior boundary, this paper is to study the influence of government subsidies and infrastructure construction on the sales of NEVs. Considering the development of the NEV industry and the reasonable time for the predictable development of new technologies, the scenario simulation time is set from 2015 to 2025.

2.3 Scenario Assumptions

Due to the complexity of the evolution of the NEV industry, not all factors can be taken into account, so assumptions need to be established to discard irrelevant factors and highlight the problem under study. For the sales forecasting scenario of NEVs, this paper will be based on the following three assumptions.

1. consumer demand is sufficient and market supply capacity is strong. That is, the manufacturers of NEVs can roughly meet the purchase demand of consumers and achieve a balance between supply and demand in the market.

2. In the forecast time frame, China's macroeconomic conditions are good, with no major changes or economic policy turns at present. From a long-term perspective, some uncertain influences (e.g., the new crown outbreak in early 2020) will not be taken into account.

3. Since this paper is based on a government subsidy perspective study, only public charging stake holdings are considered when considering charging stake holdings. Given the availability of data and the limited space, this paper studies the key influencing factors and certain secondary factors (e.g., government investment in regulatory mechanisms) will not be considered.

2.4 System Dynamics Flow Diagram of Model

Based on the above causal loop diagram and the system boundary of the scenario, the system dynamics flow diagram of technological innovation, infrastructure and NEV industry was constructed by Vensim software, as shown in Figure 2.

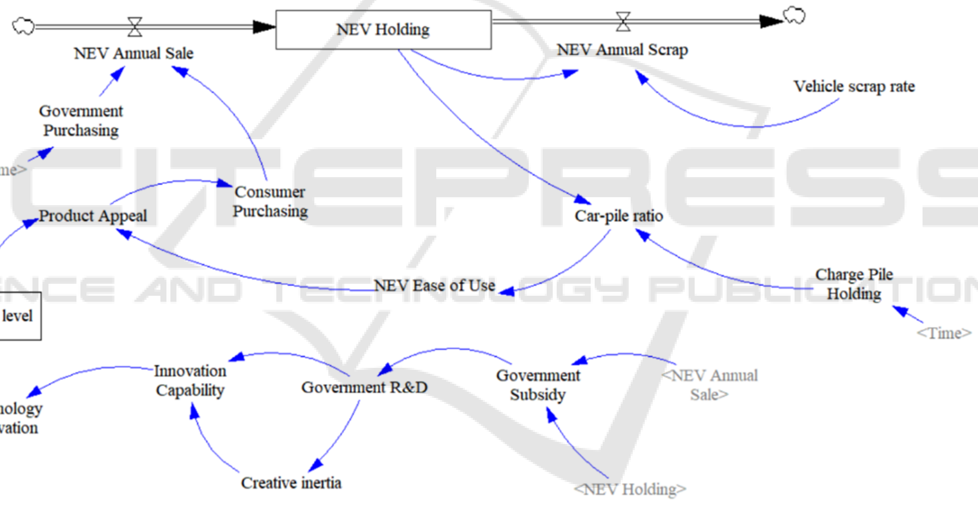

Figure2: System dynamics flow diagram of the NEV, technology innovation and infrastructure.

The data in this simulation study were compiled from the CAAM, CBIRI, and data from the China Public Charging Pile Industry Research Report by Ariadne Consulting. The formulae of the main variables in the scenario are shown in Table 1.

Table 1: Main variable equations of the scenario.

No.	Equation of variables	Unit
1	Product appeal = technical level * 0.91 + NEV Ease of Use * 0.43	dmnl
2	Creative inertia= LN ("government R&D")	dmnl
3	Technical level= INTEG (technology innovation,1.02)	dmnl

4	Government subsidy=IF THEN ELSE (NEV holding<=500, NEV Annual Sale *0.5, IF THEN ELSE (NEV holding>500:AND: NEV holding <=1000, NEV Annual Sale *0.3, NEV Annual Sale *0.1)	million
5	NEV Holding = INTEG (NEV Annual Sale - NEV Annual Scrap,15)	million units
6	NEV Annual Scrap = NEV holding * vehicle scrap rate	million units
7	NEV Annual Sale = government purchasing + consumer purchasing	million units
8	Vehicle-pile ratio = NEV holding /charge pile holding	dmnl

3 SIMULATION ANALYSIS OF THE SCENARIO

3.1 Stability Check of the Scenario

The system dynamics model of technology innovation, infrastructure and NEV industry constructed in this study is suitable for stability testing and simulation analysis because the portrayal and fitting of technology innovation, infrastructure and NEV industry are basically in line with the actual situation. In this paper, the simulation time is 10 years, and the initial values of NEV ownership for models 1, 2, 3, 4 and 5 are assumed to be 50,000, 10,0000, 15,0000, 20,0000 and 250,000, respectively. As can be seen from Figures 3 and 4, increasing or decreasing the initial values of the variables within 10 years, although the annual sales and annual scrapping of NEVs do not increase at the same rate, they still generally maintain an upward trend, so this study is consistent with the requirements of the stability test.

3.2 Simulation Analysis of the Scenario

The simulation study in this paper uses Vensim software, and the model is simulated in annual steps with a simulation period of 10 years. This paper sets up three different combinations of government subsidies to study the impact of government subsidies on the sales of NEVs. The initial value of government subsidies in scenario 1 is 3000 RMB when the ownership of NEVs is less than 5 million, 1500 RMB when the ownership of NEVs is more than 5 million and less than 10 million, and 500 RMB when the ownership of NEVs is more than 10 million, Scenarios 2 and 3 increase the amount of government subsidies in turn. From Figure 5, we can see that the higher the government subsidy, the higher the annual sales of NEVs, therefore, the government should increase the amount of government subsidy.

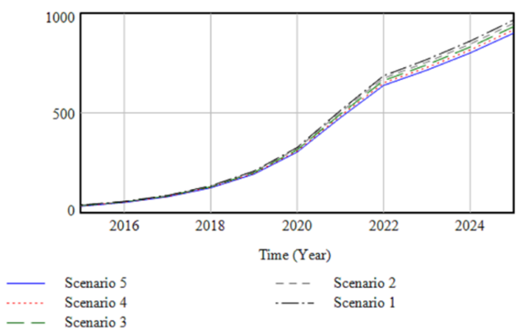

Figure 3: Annual sales trend of NEVs.

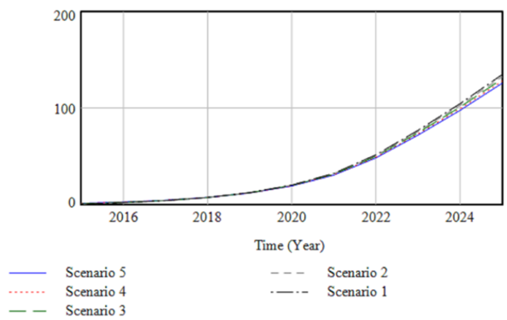

Figure 4: Trend of annual scrapping volume of NEVs.

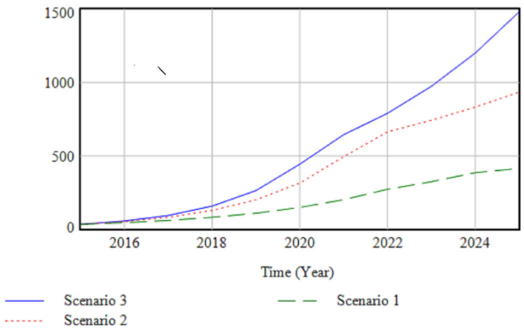

Figure 5: Trends in annual sales of NEVs when changing government subsidies.

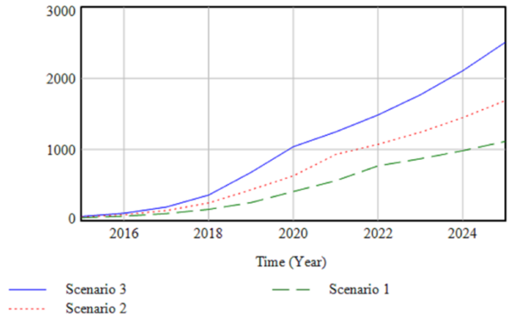

Figure 6: Trends in annual sales of NEVs when improving infrastructure.

In this paper, three different charging pile retention table functions are set to study the impact of infrastructure construction on NEV sales. On the basis of the original scenario, scenario 2 increases the retention of charging piles, and scenario 3 is to increase the retention of charging piles on the basis of scenario 2. From Figure 6, we can see that with the increase of the retention of charging piles, the vehicle-pile ratio is decreasing and the annual sales of NEVs are increasing.

4 CONCLUSIONS

First, although the development of an industry cannot rely on government support, the current lack of technology and infrastructure of NEVs, if the government increases the subsidies for NEVs, it will increase consumer demand for NEVs, thus promoting the increase of NEV sales. It is suggested that the price authorities of the local governments promoting NEVs can formulate reasonable charging policies according to the actual situation, so that the cost of using NEVs is lower than that of traditional vehicles, thus increasing consumers' willingness to buy NEVs.

Secondly, from the simulation analysis, it can be seen that the sales of NEVs increase as the number of charging piles increases, i.e., the infrastructure continues to improve. Therefore, in terms of service platform, it is suggested that the government should make use of the existing technology to actively develop the "Internet+Charging Infrastructure" platform to help the owners of NEVs to achieve charging navigation and fee settlement, so that consumers can feel the convenience of using NEVs and further increase the sales of NEVs.

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REFERENCES

Cai, J., Jia, L., Wu, C., Shou, Y. (2022). R&D capital investment in new energy vehicle enterprises: the different moderating roles of financial redundancy and government subsidies. Journal of Management Engineering, 36:11-24.

Hood, C.C., Margetts, H. Z.,1983. Exploring Government's Toolshed. Macmillan Education UK, London.

Liu, L., Song, F. (2013). The NEV technology innovation policy at home and abroad. Science Management Research, 31: 66-70.

Liu, Y Q, Kokko A. (2012). NEV technology in China. Chinese Management Studies, 6: 78-91.

Sierzchula, W., Bakker, S., Maat, K., Wee, B. (2014). The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy Policy,68: 183-194.

Wang, Y.,1986. Systems engineering. Machinery Industry Press, Beijing.

Zhou, Z., Liu, M. (2021). The impact of double credit type industrial policy on new energy vehicle industry: A modeling based on firms' policy adaptation behavior. Science and Technology Management Research,41:47-57.