

Research Progress of New Energy Vehicle Diffusion Model

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Abstract

With the continuous destruction of the environment and the continuous deterioration of the global climate, new energy vehicles, as a substitute for traditional vehicles, can effectively solve the shortcomings of traditional petroleum-fueled vehicles with high energy consumption and high emissions, and are becoming a non-negligible part of the automotive market. However, compared with the hot sales of new energy vehicles abroad, the sales of new energy vehicles in China have encountered huge difficulties. This article describes the development status and bottlenecks of new energy vehicles, and summarizes the research on the diffusion process of new energy vehicles by modeling methods, which in order to provide suggestions for the government to promote new energy vehicle.

Keywords

New Energy Vehicle, Innovation Diffusion, Agent-based Innovation.

1. Introduction

According to the regulations issued by the Ministry of Industry and Information Technology of the "New Energy Vehicle Manufacturers and Product Access Management Guidelines" officially implemented on July 1, 2009, new energy vehicles refer to the use of unconventional vehicle fuels as power sources or the use of conventional vehicle fuels, the use of new on-board power devices, and the integration of advanced technologies in vehicle power control and driving. The technical principles are advanced, with new technologies and new structure of the car. New energy vehicles mainly include four types of pure electric vehicles, hybrid electric vehicles, alternative energy fuel vehicles, and fuel cell electric vehicles [1, 2]. In the first half of 2020, the global sales of new energy passenger vehicles (BEV+PHEV) was 974,000, of which China, the United States, the European Union, Japan, and other countries sold 313,000, 110,000, 324,000, 12,000, and 175,000 respectively, corresponding to their respective proportions 33.5%, 11.8%, 34.77%, 1.33%, 18.8%. In general, the manufacturing technology of new energy vehicles in China is becoming increasingly mature, but there is still a big gap with the world's advanced level.

2. The Development Bottleneck of New Energy Vehicles

2.1. Technical Bottleneck

At present, there are still technical problems in the manufacture of high-performance storage batteries and the construction of a large number of charging equipment. Hybrid electric vehicles in China have greatly improved in terms of fuel-saving and reliability, and the technology of ordinary hybrid vehicles has matured, which can be used as one of the directions for the development of new energy vehicles at this stage. However, there are still some deficiencies in some core technologies such as cylinders. The principle of alternative fuels is to use other energy sources such as compressed natural gas, liquefied petroleum gas, biodiesel, etc. to replace fossil fuels as the power source of automobiles, but other energy sources are mostly non-renewable energy sources, and they also face the crisis of energy exhaustion.

Therefore, it is not the mainstream direction of future development. Fuel cell vehicles have the advantages of high energy efficiency and low pollution, but currently there are problems such as high purchase costs and imperfect supporting facilities that hinder the development of fuel cell vehicles [3].

2.2. Incomplete Infrastructure

The promotion and use of new energy vehicles requires a series of supporting facilities, which involves the coordination and cooperation of the government and enterprises, and the distribution of benefits. The "chicken and egg" problem between new energy vehicles and supporting facilities is also a factor restricting their development. At present, the supporting facilities of new energy vehicles are not perfect and the convenience is poor. The number of gas stations is still very scarce. On the contrary, the distribution of gasoline and diesel in traditional gas stations is spread all over the country and still accounts for most of the proportion. The limited number of energy stations has become a major obstacle restricting the promotion of new energy vehicles in China.

2.3. Lack of Vendor Marketing

Although companies such as BYD can produce new energy vehicles that are as good as, or even better than other companies, however, compared with the aggressive publicity and marketing measures of foreign companies such as Toyota and Tesla, the marketing methods and methods of my country's new energy vehicle manufacturers are obviously far behind, mainly reflected in the lack of brand trust, model awareness, consumer attention, etc., which are still obstacles to the development of China's new energy vehicle manufacturers.

3. Traditional Innovation Diffusion Theory

New energy vehicles are in the early stages of development and are an innovation compared with traditional petroleum-fueled vehicles. In the early stage of the emergence of innovative things, the diffusion process is full of competition with traditional things. How to spread innovation and make people understand and accept it has always been the focus of marketing research. The research of innovation diffusion theory is to reveal how new ideas and products are spread through certain channels and are recognized and accepted by members of society. Bass established the Bass model based on Rogers' theory in 1969, which is a model that uses the diffusion ratio of innovation as an infectious process, and was selected as one of the ten most influential theories in the first 50 years of scientific management. The core idea of the Bass model is that the adoption decision of innovation adopters is independent of other members of the social system. In addition to innovative adopters, the time for adopters to adopt new products is affected by the pressure of the social system, and this pressure increases with the number of early adopters [4]. The Bass model takes the entire society as a research whole, and studies the spread of innovation from another height, providing a simplified and easy-to-analyze way for subsequent scholars to look at the entire market and explain behavior.

4. Agent-based Innovation Diffusion Model

With the continuous deepening of research and application, the limitations of the aggregate model have been summarized by more and more scholars. Weak forecasting ability, inability to explain reality, and inability to reflect the heterogeneity of consumers, etc., make it difficult for traditional models to continue research on innovation diffusion. With the increasing popularity of computers, agent-based innovation diffusion research has begun to attract more and more scholars' attention. In order to overcome the various shortcomings and limitations of traditional models (such as consumer behaviors are rational consumption, the model lacks interactive behavior, etc.), scholars began to use computers to simulate consumer behavior and

social impact to continue their previous research [5]. A key factor of consumer behavior based on Agent-based simulation modeling (ABM) is to accurately reflect the consumer's decision-making process, especially when the decision is about whether the consumer accepts or rejects innovation. The influence of social influence on innovation diffusion is mainly manifested from two aspects. The first is the three different levels of social influence methods, and the second is the different influences of different social network types on the communication process [6]. Social influences at different levels are intertwined and interact with each other, which has played an important role in the sales of new energy vehicles.

To establish an agent-based simulation model for the diffusion of new energy vehicles, it is necessary to grasp the mechanism of the diffusion of new energy vehicles, and to show the diffusion process of new energy vehicles by defining Agent subjects with different behavior rules and the interaction rules between various subjects. However, because consumer decision-making behaviors are also affected by individuals and the environment in many ways, there are many influencing factors in the whole process, and the mechanism of action is complex, making it difficult for the model to completely describe the true situation. Usually the research will use simplified irrelevant or weakly related factors, and use the method of highlighting the research object to construct an approximate real model. Some scholars use the three attributes of price, fuel consumption, and subsidies to build a car agent.

5. Conclusion

In the traditional energy economic and technological system optimization model, the proliferation of new energy vehicles is the result of technological substitution strategies that should be adopted to minimize the total cost of the economic system over a long period of time, such as one year, under a series of restrictive conditions. In the future research work, it is still necessary to add more entities to the model, and their behavior will affect the decision function of the driver and the fuel station, including the government's regulatory policies, the impact of other new energy vehicles, And the combination of the model with geographic information system and traffic system simulation software, etc. We believe that in the near future, the diffusion model of new energy vehicles will be continuously improved and put into practical applications, and finally an optimization strategy will be given to accelerate the pace of the diffusion of new energy vehicles.

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