Analysis and Evaluation of Energy and Environmental Benefits of New Energy Vehicles

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Abstract. At present, China's oil and natural gas external dependence is increasing, the energy security situation is increasingly grim, the automobile industry is an important reason for the rapid growth of crude oil consumption, the development of new energy automobile industry has become a global consensus. This paper aims to study the development strategy of China's new energy vehicle industry through cost-benefit analysis, so as to provide reference for China's NE vehicle demonstration and promotion vehicle selection and the next step of technology research and development, which has certain reference significance for China's NE vehicle technology research and development and promotion. From a macro perspective, this paper firstly analyzes the problems existing in the industrialization process of NE vehicles in combination with the current development status of China's NE vehicle industry. Secondly, the cost-benefit analysis theory is introduced into the strategy research of China's NE vehicle industry, and the cost-benefit index of China's NE vehicle development is identified and selected to construct the index system. Thirdly, the ahP is used to analyze the cost-benefit index and predict its development trend. Finally, according to the results of the previous analysis, the policy recommendations for the rational development of China's NE vehicle industry are put forward, and the development priorities and tasks of China's NE vehicles are clearly put forward.

Keywords: New Energy Vehicle, Environmental Benefits, Cost-benefit Analysis, Development Strategy

1. Introduction

At present, China has become the world's largest importer of crude oil and natural gas [1]. The import volume of natural gas is 125.4 billion cubic meters, with a year-on-year increase of 31.7%, and the external dependence rate rises to 45.3% [2-3]. As the world's largest energy consumer, China still faces huge challenges in energy supply and transportation [4]. In addition, under the pressure of air pollution prevention and environmental protection, how to ensure effective energy supply, increase the proportion of clean energy and promote the use of clean energy have also become an important part of China's energy security [5]. On the whole, China's energy security is becoming more and more serious, and it is in urgent need to improve its energy independent security capability, ensure national
energy security, and provide a solid guarantee for China's sustainable and healthy economic and social development [6].

In recent years, China's car ownership has been growing rapidly, and automobile exhaust has led to serious air pollution and greenhouse gas emission [7-8]. The comprehensive and systematic regulation of the development of NE automobile industry promotes the transformation of China from an automobile power to an automobile power. The research on the development strategies of the NE automobile industry can help to integrate various elements and resources, build a systematic industrial development system, establish a reasonable consumption and use environment, overcome the weak links in the industrial chain, and achieve a reasonable development of the NE automobile industry [9-10].

The research in this paper combines theory with practice, adopts qualitative and quantitative analysis method, and analyzes the cost-benefit of the NE automobile industry to obtain the development strategy of China's NE automobile industry, so as to provide reference for China's NE automobile demonstration and promotion of vehicle selection and the next step of technology research and development.

2. Cost and Benefit of NE Vehicle Industry

2.1 Cost of NE Vehicles

(1) Development cost
Research and development costs. Research and development cost refers to the cost of product promotion and research and development in the early-stage development and research of the NE automobile industry.

(2) Policy cost.
Policy cost refers to that the state increases subsidies to the upstream suppliers and downstream consumers of the NE automobile industry through policy subsidies or other policies.

(3) Production cost
Battery cost. Procurement and production activity costs. The purchase cost of NE vehicles refers to the funds consumed by automobile enterprises in the process of purchasing raw materials needed for production, which constitutes the most direct and basic part of the total cost of NE vehicles.

2.2 Efficiency of NE Vehicles

(1) Economic benefits
Economic benefit refers to the lowest possible labor cost to obtain as much business performance as possible, or the same labor cost to obtain more business income. According to Schumpeter's innovation theory, new technologies inevitably lead to new investments.

(2) Energy efficiency
With the economic growth, China's energy consumption is also on the rise, and the total consumption ranks the first in the world, accounting for about 20% of the world's total consumption. If the structure of energy consumption is not changed. In the international energy market, the era of high oil prices has arrived. The development of NE vehicles can make full use of its energy efficiency and ensure China's energy security. The energy efficiency brought by NE vehicles includes two aspects: oil substitution efficiency and energy saving efficiency.

(3) Environmental benefits
Environmental benefits refer to the benefits of demonstration applications of NE vehicles in reducing emissions of greenhouse gases such as carbon dioxide (CO2) and carbon monoxide (CO), nitrogen oxides (NOX) and hydrocarbons (HC). Compared with traditional fuel vehicles, there are no sulfur and nitrogen compounds in the exhaust of NE vehicles, which is conducive to the sustainable development(SD) of the environment. Compared with traditional fuel vehicles, there are no sulfur and nitrogen compounds in the exhaust of NE vehicles, which is conducive to the SD of the environment.
3. Construction of Index System for Cost-benefit Analysis of NE Automobile Industry

3.1 Principles of Indicator System Construction
(1) Scientific principles. The index system should be established on a scientific basis, that is, it should be based on the recognized scientific theories to select indexes, determine the weights of indexes and select data. At the same time, the indicators should reflect the current cost and efficiency of NE vehicles.

(2) Principle of overall completeness. As an organic whole, the evaluation index system should be able to reflect the operation status of NE vehicles from different aspects.

(3) Principle of practicality. The establishment of the index system is for the comprehensive evaluation of NE vehicles. Only on the basis of the evaluation can it reflect its strategic significance for future development. Therefore, each index should be operable and the whole evaluation index system should be concise and easy to operate.

(4) The objectivity principle. In the process of setting the index system, we should attach importance to the objectivity of the evaluation index, and the result is the fundamental guarantee of the objectivity and accuracy of the final evaluation result. In addition, it is necessary to ensure the reliability and accuracy of data sources.

3.2 Construction of Indicator System
In this paper, on the basis of determining the overall objective, the evaluation index is extended downward into several sub-objectives, and then each sub-objective is extended downward into criteria, until quantitative or qualitative analysis. The selection of indicators should be related to the target, have levels, and can be expanded with the increase of the target. The cost-benefit measurement index system of China's NE automobile industry development in this paper is shown in Table 1.

| Target layer | Rule layer |
|--------------|------------|
| Cost Measurement Index System (A) | Development cost (A1) |
| | Production cost (A2) |
| Benefit Measurement Index System (B) | Economic benefits (B1) |
| | Environmental benefits (B2) |
| | Energy efficiency (B3) |

4. Cost - benefit Development Trend Analysis of NE Vehicle Industry

4.1 Comprehensive Cost Input Trend Analysis
China lacks core technologies in the mainstream NE automobile field and lags behind the world's advanced level. The construction of industrial chain and the initial realization of industrialization of NE automobiles by qualified enterprises, the state plans to allocate 1 billion to 2 billion yuan per year from 2010 to subsidize production. "Energy conservation and NE vehicles industry development planning" the performance of the key components for NE vehicles put forward the requirements as shown in Figure 1, said should strengthen technology research and development.
For a long time, developed countries have monopolized most mature industries in terms of technology. As a developing country, China still faces an arduous task in terms of technological foundation and economic strength compared with developed countries. In accordance with relevant national policies, the r\&d investment in key technologies and components of NE vehicles should be increased. In addition, the government should also provide financial support in public technology and basic research. Each production link of power battery can be used as the main line of investment in NE vehicles, including electrolyte, positive and negative electrode, battery production, etc. In addition, key component enterprises and resource enterprises with good technical foundation should also be paid attention to. It can be seen that the development cost of NE vehicles will be on the rise.

4.2 Analysis of the Development Trend of Environmental Benefits
The pollution of automobile exhaust to environment is increasing gradually, which accelerates the trend of global warming. Of the major air pollutants in Beijing, 23.3 percent of PM2.5 comes from vehicle exhaust, according to the Beijing Municipal Environmental Protection Bureau. More than 50% of nitrogen oxides, carbon monoxide and other pollutants come from vehicle exhaust. Vehicles with serious tail gas pollution are the primary target. The inclusion of PM2.5 in the national standard means more efforts in environmental monitoring. According to the source of PM2.5 index in Shanghai, motor vehicle exhaust pollution accounts for 25%, ranking first and cannot be ignored. In order to avoid environmental deterioration, NE vehicles with low pollution emission during driving will show its unique advantages. Although NE vehicles need to consume a certain amount of electric energy to transfer the pollution to the power production link, this transformation also makes the centralized treatment of pollutants possible.

Seventeen percent of the world's carbon emissions are CO2 from cars, and this proportion will increase year by year with the increase in the total number of private cars with traditional internal combustion engines. To achieve the goal of reducing carbon emission per unit of GDP by 40%~50%, the development of NE vehicles is one of the ultimate attribution of low-carbon economy. Under certain assumptions, each NE vehicle will reduce the amount of CO2 emissions by about 520kg per year compared with traditional fuel vehicles, which is not large (including CO2 emissions in the process of electricity production). It can be seen that the CO2 emission reduction achieved by NE vehicle technology in the near future is limited. The diversified sources of electricity are shown in Figure 2.
NE vehicles have unlimited emission reduction potential. With the promotion of NE vehicles, they will play a more and more important role in emission reduction.

4.3 Development Strategies and Suggestions for China's NE Automobile Industry

In order to reduce the cost of China's NE automobile industry to a greater extent, promote better development of the industry, and achieve better benefits, this paper puts forward strategies and suggestions for the development of NE automobile industry from the three aspects of perfecting the legal system, perfecting the mechanism and optimizing the system:

1. To strengthen the market supervision of NE and NE vehicle related enterprises, it is suggested to implement the exclusive system for alternative fuels, so as to ensure the market order and product quality. China's NE industry to improve the standard system, step by step with the international standards.

2. The fundamental measure to reduce the purchase cost of NE vehicles is to improve the r&d system of NE vehicles and rely on technological breakthroughs.

3. Optimizing the development system of the NE automobile industry. The energy-saving and emissions-reduction effects of new-energy vehicles are worthy of recognition. However, in order to reduce their price to the level of ordinary cars, properly deal with the integration of the automobile industry and the electric power industry, as well as the infrastructure construction of new-energy vehicles, appropriate business models are still needed.

5. Conclusion

The ultimate purpose of this paper is to do preliminary empirical research on the development of China's NE automobile industry through cost-benefit analysis, so that the comprehensive benefits generated by the healthy development of NE industry can serve mankind and make the social and economic development of the surrounding areas more coordinated. This paper summarizes the existing problems in the development of NE automobile industry in China, and puts forward that the development of NE automobile industry should be improved from the following aspects: We will improve the development system for the NE automobile industry. NE automotive industry cost - benefit analysis and evaluation is not only for NE automobile industry development present situation, to review and summarize their experience and shortage, more important is how to service for the future of NE vehicles industry development, how to produce the comprehensive benefit evaluation of NE vehicles industry development model as the objective function to achieve the optimal allocation of
NE vehicles industry, this is the NE automotive industry comprehensive benefit quantitative evaluation and NE automotive industry investment combined (cost) will be a important research direction in the future.

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