The Economic Impact of Different Government Policies on Hybrid Electric Vehicles (HEV) In Major Automobile Consumer Countries

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Abstract. Under the background of the rapid increase in the number of cars, a series of problems such as environmental pollution, shortage of oil resources and destruction of the atmosphere gradually appear, which is closely related to the fuel engine. Protecting the environment, saving energy and reducing emissions, and vigorously developing low carbon economy has become a world trend. Therefore, the automotive industry has been challenged by unprecedented challenges. Traditional fuel vehicles cannot meet the increasing environmental requirements, and hybrid electric vehicles have become an important development direction of the automotive industry. However, government policies for hybrid electric vehicles are different in different countries, which will inevitably lead to differences in the development progress of hybrid electric vehicles between countries. The purpose of this study is to discuss the differences in relevant policies for hybrid electric vehicles in major automobile consuming countries, and to explore the economic impact caused by the differences in relevant policies for hybrid electric vehicles in the United States, China and Japan.

Keywords: Hybrid Electric Vehicles (HEV), Economics, Policy, Energy Saving, Emission Reduction.

1. Introduction

As with the Green Revolution of the 1960s, agricultural production techniques have been reformed; The development of hybrid electric vehicles (HEV) can be called the "Green Revolution" of the automobile industry. Hybrid electric vehicle are a major innovation in the automotive sector because it combines both the traditional energy gasoline and electricity [1]. Compared with new electric vehicles and traditional fuel vehicles, hybrid electric vehicles have the advantages of environmental protection, energy saving and high-performance cost ratio. In terms of environmental protection, hybrid electric vehicles adopt the compound driving formula of two driving forces, which optimizes vehicle power and reduces emissions. According to research, the emissions of hybrid cars are only 50% of those of conventional gasoline cars. Talking more about energy saving, the engine efficiency of fuel vehicles is about 20%, while the hybrid electric vehicles can ensure efficient operation under the best working conditions, and the average engine thermal efficiency efficiency can reach 40% after nearly 50 years of development [2]. As for cost performance, hybrid electric vehicles reduce the amount of fuel used, while also providing mobility - the use of electricity. The emergence and development of hybrid electric vehicle (HEV) has brought considerable economic benefits to major automobile consumer countries. Different countries have different policies for the use of hybrid electric vehicles and such differences also affect the development of hybrid electric vehicles in the countries respectively.

2. Government policies of hybrid electric vehicles in America, China and Japan

2.1. American government policies towards hybrid electric vehicles

When President George W. Bush was in office, the federal government provided funding to support research into fuel cells to power hybrid electric vehicles. In 2005, the US Congress allowed a tax break of up to $3,600 for HEV purchases by consumers. President Bush once boldly predicted, “A child born in 2003 will drive a hydrogen car with no pollution.” [3] Now, it is clear that his

prediction did not work, indicating that mankind still has a long way to go in the growth of new energy vehicles. From a practical perspective, the research on hybrid electric vehicle fuel cells approved by President Bush has been successful, which has also promoted the development of hybrid electric vehicles in the United States.

By the time President Obama was in office, the federal government had updated its policies. They abandoned support for research into fuel cells and instead offered support for research into hybrid electric vehicles. This has proved to be a wise and effective approach, and there are huge sales of hybrid cars on the market.

Under the Trump administration, the government provided financial subsidies to buyers of new energy vehicles, with each buyer receiving $7,500 in subsidy funds to purchase new energy vehicles. This has greatly stimulated the consumer market of new energy vehicles, especially the sales of hybrid electric vehicles and electric cars [4]. However, in the later period of the Trump administration, the subsidy policy became smaller and smaller, and the hybrid car market suffered a backlash.

In today's world, during the Biden administration, Joe Biden made drastic changes to the old policies. First, the Biden administration provided $174 billion for the growth of new energy vehicles and the construction of car charging piles. Reinstating the Trump administration's policy of subsidizing new-energy vehicle buyers to $12,500; On August 16, 2022, the Biden administration enacted the Inflation Reduction Act, which directs about $370 billion to climate and clean energy investments [5].

The implementation of various policies shows the comprehensiveness of the consideration of hybrid electric vehicles in the United States, as well as the increasing importance.

2.2. Chinese government policies towards hybrid electric vehicles

Since 2005, our country has put forward the importance of promoting the growth of new energy vehicles in a number of related plans, and actively introduced a series of policies related to hybrid electric vehicles.

In 2006, China issued an early economic subsidy policy, and the central government allocated funds to promote hybrid electric vehicles. [6]. This policy aims to strengthen the management of financial subsidies for the demonstration and promotion of energy-saving vehicles and improve the efficiency of fund use. Electric vehicles have many bottlenecks in technology and operation capacity. In terms of energy saving and emission reduction, the performance of electric vehicles is also far worse than that of hybrid electric vehicles. Therefore, this policy focuses on hybrid electric vehicles, making the development of hybrid electric vehicles further.

In June 2010, China officially launched the pilot work of subsidies for private purchases of new energy vehicles, providing direct economic subsidies. In the same year, a number of pilot cities in China issued a series of implementation rules, including Beijing, which further clarified the number of subsidies for various types of new energy vehicles. In the policy of hybrid electric vehicles, the details of implementation in each pilot city are also different. The Beijing municipal government's preferential subsidy for each hybrid electric vehicle is up to about 14,000 US dollars (including state subsidies), the Shanghai municipal government's policy subsidy is about 9,500 US dollars (including state subsidies), and the Shenzhen municipal government's policy subsidy is about 10,500 US dollars (including state subsidies) [7].

In September 2017, Five of the Chinese administration jointly issued the "Measures for the Parallel Management of the average Fuel Consumption of Passenger Car Enterprises and the points of new-energy Vehicles" (namely, the "double points" policy). As an important support policy for the diminishing of new energy vehicle subsidies, the "double integral" policy is of great significance to the structural adjustment and transformation and upgrading of the entire car industry. Its main implementation effect is first reflected in urging automobile enterprises to accelerate the application and research and development progress of energy-saving technology, promoting the average fuel consumption of new passenger cars in our country to decline year by year, and significantly promoting the development of new energy vehicles.

China plans to reduce subsidies for hybrid electric vehicles from 2019, and plans to completely eliminate the preferential policy and fully implement the "double points" policy in 2022 [8]. The "double points" policy refers to CAFC points (average corporate fuel consumption) and NEV points (new energy vehicles). The purpose of this is to encourage automobile companies to reduce the fuel consumption of new energy vehicles and achieve technological breakthroughs and industrial cultivation. In 2021, hybrid electric vehicle sales in China reached 597,000 units; In the first half of 2022, sales reached 382,000 vehicles. This shows that the implementation of the new policy has not affected the purchase of hybrid cars.

2.3. Japanese government policies towards hybrid electric vehicles

Since April 2009, the Japanese government began to implement the "green tax system" and "environmental protection vehicle tax reduction" policy, mainly for the new energy vehicles and low fuel consumption and low emission vehicles on the market at that time to provide subsidies. With the "green tax system" as the standard, the car tax will no longer be charged on the less polluting cars, and more taxes and fees will be charged on the more polluting cars to encourage people to buy low fuel consumption and low emission cars. At the same time, with the "environmental protection vehicle tax reduction" as the standard, the new energy vehicle inspection tax reduction [9].

Japanese hybrid vehicles have been industrialized. At present, Toyota, Honda, Nissan and other Japanese manufacturers' hybrid vehicles not only sell well in China, but also make other foreign manufacturers look up to it in the international market [10]. For a long time, Japan has been committed to the development of hybrid electric vehicles, and its technical level is ahead of Europe and the the U.S. Toyota is a pioneer in the development and production of hybrid vehicles in Japan. After introducing the first Prius in 1997, Toyota continued to ramp up its research. After the launch of the third generation Prius in May 2009, the price dropped significantly, and the driving distance per liter of gasoline reached 38 kilometers, 2 to 3 times that of European and American countries. Toyota sold more than 200000 cars that year, ranking first in Japan's new car sales. By February 2011, Toyota had sold 3 million Prius.

In 2012, the Japanese government invested more than 40 billion yen in the development and technology research of new energy vehicles. Large subsidies for hybrid electric vehicles (HEVs) and the construction of charging piles.

In order to promote the development of the hybrid electric vehicle industry, especially the research and development of lithium-ion batteries, the core technology, the New Energy Industry Technology Comprehensive Development Institute under the Ministry of Industry and Industry of Japan has established the "all-Japan" system. In addition to five automobile companies including Toyota and Nissan, seven battery companies including Sanyo Electric and 10 research institutes including Kyoto University, Waseda University and Tohoku University participated in the project. It established a research and development base at Kyoto University, which has more than 50 resident staff, and invested 210 trillion yen over seven years to carry out battery material aging research using cutting-edge equipment such as large radiation equipment in Hyogo Prefecture.The company plans to develop a hammer ion battery that can store three times the amount of energy and reduce the cost of hybrid cars to one-sixth of the current cost by 2015. By 2020, the range of hybrid vehicles on a single charge will increase threefold [11].

3. Comparison in government policy of hybrid electric vehicles among countries above

Since 1990s, the United States, Japan and other developed countries have successively issued a series of economic policies, legal documents and industrial development plans on hybrid electric vehicles. After realizing the importance of new energy vehicles, the Chinese government also vigorously developed new energy vehicles in the early 21st century, formulating subsidy policies and providing funds to help hybrid electric vehicle enterprises develop new technologies. Driven by these

incentive policies, the hybrid electric vehicle industry in many countries has entered a period of rapid growth, among which China, the United States and Japan are among the top three in the world in terms of the number of policies [12].

In the supply end of the hybrid electric vehicle, the United States is still the most national government attaches great importance to the use of "push" force, for the new energy automotive industry upstream of the focus on the technology research and product manufacturing, especially in the United States in the "investment in science and technology", "financial support" and "tax" three aspects of policy text more than 28, more than the China and Japan. This situation is justified from the perspective of social institutions. The Chinese government has the characteristics of strong intervention, and the same is true of the Japanese government, which fundamentally controls the development of national enterprises. In contrast, China's auto companies are relatively free to develop, with the government encouraging them to develop new technologies, providing more financial support and relatively loose regulations. Compared with the United States, the supply-side management policies of hybrid electric vehicles with strong government intervention in China and Japan do more harm than good to enterprises. Too much government intervention in the development of supply-side hybrid electric vehicle enterprises will affect the upsurge of technological innovation and cause market disorder. When government interference is reduced, more companies will have greater freedom to spend money on research into new technologies. China and Japan have a gap in policy maturity on the supply side of hybrid electric vehicles compared with the United States.

In terms of environmental support, China, Japan and the United States pay more attention to the environmental construction of the industry norms and supporting facilities of the new energy vehicle industry. In particular, China has as many as 11 policy texts involving only "normative regulations", while Japan and the United States are more mature than China in the setting of "access rules". In the early stage, China attached importance to the development of industrialization and neglected the awareness of environmental protection. In the present era, China vigorously advocates energy conservation and emission reduction, aiming to protect nature, attach importance to economic development and environmental protection, and has set up the world's most advanced policy in terms of regulations on hybrid electric vehicles. In terms of "access rules", Japan and the United States adopt a more open attitude and actively absorb feasible plans and new technologies. China has adopted more independent research methods. Due to the limitations of technological development, the three countries have no clear policy on "public services". As for the direction of "public facilities" construction, the Japanese government took the lead in the construction of public facilities related to hybrid electric vehicles and formulated relevant policies. This phenomenon reflects that the Japanese government attaches great importance to social construction and advocates harmonious public order.

On the demand side of hybrid electric vehicles, the government policies of China, Japan and the United States are relatively unified, and the implementation policies are also highly similar, that is, to subsidize the purchase of hybrid electric vehicles. The world's top three demand-side policies are still China, the United States and Japan. The Chinese government has a total of 26 policies on the three aspects of "publicity and education", "government subsidies" and "government procurement". The United States and Japan government followed suit and provided more policy support for the development of hybrid electric vehicles in the aspect of "financial subsidies". However, due to the specificity of the social system, the United States and Japan do not formulate any policies on "government procurement" and other aspects.

There are similarities and differences in the policy making of hybrid vehicles in the three major car-consuming countries. Surprisingly, hybrid electric vehicles in China, the United States and Japan are all thriving and leading the world with different policies in all three countries. This shows that a country's policy making for hybrid electric vehicles should be based on specific analysis, rather than blindly learning from other countries' policies, it should focus on analyzing its own national conditions and formulating relevant policies that best match its own national system.

4. Conclusion

At the state, major automobile consuming countries, the United States, China and Japan described above, are paying increasing attention to the development and utilization of new energy vehicles. Among the many new vehicles, the most advanced is the hybrid electric vehicle. Different countries and even different regions have different policies for hybrid electric vehicles. China, the US and Japan are the world's top three countries in terms of the number of policies introduced. China's policies on hybrid electric vehicles are at the forefront of the world, especially the bold reform in 2019. China's policies focus on regulating relevant regulations and government functions, and the government has strong intervention; The number of policies related to the hybrid electric vehicle industry in the United States and Japan is less than that in China, but the depth of policy influence and the actual number of hybrid electric vehicles promotion are far ahead in the world, highlighting their emphasis on financial support and tax subsidies. The number of policies reflects the importance a government attaches to the relevant field and the development situation of the country in this field, which also explains why China, the United States and Japan are at the forefront of the development of hybrid electric vehicles in the world.

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