Research on the Incentive Mechanism of China's Hydrogen Station Development

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Abstract. The World’s energy problems have promoted the development of fuel cell vehicles; slow construction of hydrogen stations has become a bottleneck of its development. The paper starts from the status of hydrogen station construction, In-depth analysis of the main problems faced by China's hydrogen station construction, such as, the overall plan is missing, the top-level design is lack, the centralized management is not clear, the approval process is complex, the construction and operation costs is high, enterprises’ burden is heavy, the technical reserves is insufficient, the technical standard is inconsistent and so on. On this basis, the conclusion is drawn about the driving force of China's hydrogen station construction. National and local cooperation, rapid development of fuel cell vehicles and backward of hydrogenation facility construction promote the development of China's hydrogen stations.

1. Introduction
Energy issues have become a topic of common concern in the world today. With the continuous increase of car ownership, the world's energy crisis and climate issues have caused widespread attention in various countries. Hydrogen energy, as a green and efficient secondary energy, has the advantages of wide sources, high combustion heat value, clean and pollution-free, storable, etc. It is an important part of clean energy in the future. Globally, as an important technological innovation direction, hydrogen fuel cell vehicles are gradually becoming an important area for large-scale commercial application of hydrogen energy. Many countries in the world are actively studying hydrogen fuel cell vehicles. Currently, developed countries represented by Japan, South Korea, the United States, the European Union, etc., in addition to in-depth research on the key technologies of hydrogen fuel cell vehicles, the investment in infrastructure facilities of hydrogen stations that severely restrict the commercialization of hydrogen fuel cell vehicles has also been increased. In China, the construction of hydrogen stations has become the focus of attention of the country and major automobile companies.

2. Development status of China's hydrogen station industry
According to relevant department statistics, in 2018, the production and sales of hydrogen fuel cell vehicles in China reached 1,619, including 710 passenger cars and 909 special vehicles, an increase of 27.28% over the previous year. In 2016, the production and sales of fuel cell vehicles in China was only 629, the rapid growth of fuel cell vehicles has promoted the construction of hydrogen stations. According to incomplete statistics, there are currently 25 hydrogen stations in operation in China, including 11 fixed stations and 14 skid-mounted stations, 18 hydrogen stations under construction. According to the plan of the National Energy Saving and New Energy Vehicle Technology Roadmap, the number of hydrogen stations in China is expected to reach 100 by 2020.
From the perspective of development layout, the fastest growing provinces are Guangdong and Jiangsu. Among them, 7 hydrogen stations have been built in Guangdong, and 5 have been built in Jiangsu, less construction in other provinces. The main reason for the uneven development of hydrogen stations is the acquisition of hydrogen. At present, there are two main ways to produce hydrogen: industrial by-product hydrogen and renewable energy electrolyzed water to produce hydrogen. The distribution of industrial by-product hydrogen is relatively scattered, mainly concentrated in eastern China, which has become one of the reasons for the rapid development of hydrogen stations in eastern China.

3. Development bottleneck of China's hydrogen station industry

3.1. Lack of overall plan and top-level design
As mentioned in the 《Report on the Work of the Government 2019》, "To maintain stable automobile consumption, we will continue preferential policies on the purchase of new-energy vehicles and facilitate the building of charging and hydrogenation facilities." The construction of hydrogenation facilities was first written in the Report on the Work of the Government, it indicates that China attaches importance to the development of hydrogen stations to the national level.

Subsidies for hydrogenation facilities can be went back to 2014, in November 2014, the four ministries and commissions jointly issued the "Notice on the Reward for the Construction of New Energy Vehicle Charging Facilities", from 2013 to 2015, it had rewarded 4 million yuan for each new fuel cell vehicle hydrogenation station that meets national technical standards and which has a daily hydrogenation capacity of not less than 200 kg. In March 2019, the four ministries and commissions jointly issued the "Notice on Further Improving the Financial Subsidy Policy for the Promotion and
Application of New Energy Vehicles”, it is pointed out that after the transition period, new energy vehicles will no longer be subsidized for purchase, and will be used to support the construction of charging (hydrogenation) infrastructure and supporting operating services.

Looking at the current relevant documents on hydrogen stations, the main focus is on subsidy policies, and the overall planning for the construction of hydrogen refueling stations is still missing.

### 3.2. Unknown central management, complicated approval process

The development of hydrogen energy is more and more favoured by local governments; however, the central management unit for the construction of the hydrogen station is not clear. Whether the hydrogen stations are energy management or hazardous chemical management, the state does not clearly define. With the ambiguity of centralized management, the approval process for the construction of hydrogen stations is extremely complicated, problems will be encountered in planning, project approval and operation supervision. The imperfect system, the unclear management, and the uncertainty of the functional departments have brought great trouble to the enterprises in the construction of hydrogen stations.

### 3.3. High costs of construction and operation, overburden of enterprises

High construction cost is the same dilemma facing the development of the global hydrogen energy industry, according to public information, in consideration of safety and versatility, the initial investment in the construction of a hydrogen station is about 16 million to 20 million yuan (excluding land costs), more than three times the investment in charging station construction.

In terms of operating costs, hydrogen account for a large proportion of hydrogen station operating costs. Due to the small number of hydrogen fuel cell vehicles and the small demand for hydrogen, the fixed costs of hydrogen station operation are high. The superposition of two reasons has brought greater difficulties to the operation of hydrogen stations, and the current operation of hydrogen stations is at a loss stage.

### 3.4. Insufficient technical reserves, inconsistent technical standards

During the rapid development of hydrogen stations, China still has technical weaknesses in hydrogen compressors, stainless steel materials, hydrogen station temperature and hydrogen transportation. In addition, the field of hydrogen detection conditions and standard methods is still blank, which seriously hinders the construction of hydrogen infrastructure and the development of products.

At the level of technical standards for hydrogen stations, there are also major controversies in the industry, and there is no uniform standard worldwide. At present, most domestic hydrogen stations are 35MPa, and most of them in Japan are 70MPa. 35MPa compared with 70MPa, its power consumption and utilization are significantly reduced. And 35MPa cannot meet the requirements of long distance and high load, but 70MPa is higher in terms of equipment, material costs and energy consumption. In terms of applicability, 70 MPa is based on fuel cell cars, and the driving mileage of more than 500 km can only be 70 MPa, but its use in commercial vehicles is extremely limited. Therefore, the inconsistency of construction standards has become an important issue facing our country.

### 4. Analysis of the driving force for the development of hydrogen station industry

#### 4.1. Policy Drivers: National and Local Cooperation

In September 2001, the Ministry of Science and Technology issued the "National 863 Major Scientific and Technological Special Plan for Electric Vehicles", which included the research and development of fuel cell vehicles for the first time. In order to better promote the development of fuel cell vehicles, the state has launched a series of policies to promote infrastructure construction, "Made in China 2025", "Energy Technology Revolution and Innovation Action Plan (2016-2030)", "13th Five-Year Plan" National Strategic Emerging Industry Development Plan, "Medium and Long-term Development Plan for the Automotive Industry", and "Notice on Further Improving the Financial
Subsidy Policy for the Promotion and Application of New Energy Vehicles" have listed the construction of hydrogen stations as a key development direction. The promulgation and implementation of national policies have effectively guided the construction of hydrogen stations and industrial development. The "National Energy Saving and New Energy Vehicle Technology Roadmap" requires the active promotion of hydrogen stations. By 2020, more than 100 hydrogen stations are planned to be built, more than 300 by 2025 and more than 1,000 by 2030.

Under the guidance of national policies, local governments have also issued corresponding supporting facilities planning, management methods, guidance, etc., forming a mechanism and system to promote the development of hydrogen stations.

4.2. Market Drivers: rapid development of fuel cell vehicles

In the past two years, hydrogen fuel cell vehicles has increased unprecedentedly, from the establishment of China's hydrogen energy and fuel cell industry innovation strategic alliance in early 2018, the first time that hydrogen energy has been written into the government work report in 2019, from local government to central government, the emphasis on fuel cell vehicle development has been mentioned at the strategic level. With the increasing attention, the development of the market has also entered a new era.

According to the statistics of China Automobile Association, in 2019, the production and sales of hydrogen fuel cell vehicles in China were 2,833 and 2,737 respectively. In the future, with the maturity of technology, the production and sales of hydrogen fuel cell vehicles will continue to increase. According to the plan, the number of hydrogen fuel cell vehicles in China will exceed 10,000 by 2020, 50,000 by 2025, and one million by 2030.

The vigorous development of hydrogen fuel cell vehicles will place higher requirements on the construction of hydrogenation facilities, the insufficient construction of hydrogen stations has become the primary problem restricting the promotion of hydrogen fuel cell vehicles. The further promotion of hydrogen fuel cell vehicles is inseparable from the vigorous development of hydrogen stations.

4.3. Industry Drivers: relatively backward construction of hydrogenation facilities

Until now, China has built 25 hydrogen stations and 18 under construction, but compared with foreign countries, there is still a large gap. As of the end of 2018, the number of global hydrogen stations reached 369, of which 152 were in Europe, 136 in Asia, and 78 in North America.

There is still a large gap between China's current completion situation and planning requirements. From the source of hydrogen, industrial by-product is an important means of hydrogen production, but the utilization rate is low, the willingness of enterprises to participate in the construction of hydrogen stations is not strong, and the high construction and operating costs of hydrogen stations have also limited the willingness of companies to invest, coupled with the lack of top-level design and inadequate technical reserves, the construction of China's hydrogen stations is far behind other countries. From the current stage of development, there is still a lot of room for the construction of hydrogen stations in China.

5. Conclusion

Based on the current status of the construction of hydrogen stations in China, this paper analyses the main factors restricting the construction of hydrogen stations, including the lack of overall planning, and top-level design, unclear central management, complicated approval procedures, high construction and operation costs, overburdened enterprises, insufficient technical reserves, and inconsistent technical standards. Although facing many development bottlenecks, the construction of China's hydrogen stations has also entered a stage of rapid development, mainly driven by policies, markets and industries. At the policy-driven level, the state and the local government are working together to promote. At the market-driven level, fuel cell vehicles are developing rapidly. At the industry-driven level, China's construction of hydrogenation facilities is relatively backward. The construction of
China's hydrogen station will usher in a period of rapid development because of the multi-factor superposition.

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