Development Status and Characteristics of Electric Vehicle Infrastructure in Beijing

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Abstract. The effective promotion of electric vehicles cannot be separated from the good development of the infrastructure. As the premise and foundation of electric vehicle promotion, the construction and development of the infrastructure are the important links in the process of commercialization and industrialization of electric vehicles. On the basis of the existing research, this paper analyzes the development situation of the electric vehicle infrastructure in Beijing from four aspects: the policy and regulations, the current construction situation, the operation body and the system service. Through the analysis, we can know that the Beijing electric vehicle infrastructure policy system is more perfect, the construction condition is good, nature of operation body is rich and the system service is payed enough attention. At the same time, Beijing need to pay more attention to infrastructure planning and layout and increase financial subsidies.

Introduction

In the face of the growing energy and environmental pressures, many countries in the world have chosen to develop the electric vehicle industry as one of the most effective ways to reduce oil consumption and carbon dioxide emissions and have given strong support to the policy. After years of rapid development, electric vehicles industry have achieved certain results in the technical and market share\[1\]. As the premise and foundation of electric vehicle promotion, the construction and development of the infrastructure are the important links in the process of commercialization and industrialization of electric vehicles\[2\].

In recent years, the domestic research on the electric vehicle infrastructure is more and more advanced, the research angle is more extensive. In terms of development research, many domestic scholars analyze the construction and development of the electric vehicle infrastructure in the United States, Japan, Israel, France, Britain, Portugal, Denmark and other countries, and then to compare with the status quo of the infrastructure construction in whole China or cities of China (Shenzhen, Hangzhou, Beijing, etc.). Then based on the comparison, summarize the successful experience of foreign electric vehicle infrastructure construction, put forward the factors that affect the development of China's electric vehicle infrastructure and suggestions on the construction and development of China's electric vehicle infrastructure. (Lu Mang, etc., 2010; Zhao xiaohua, etc., 2011; Chen liangliang, 2011; Cheng guangyu, 2012; Li Yang, etc., 2014; Wang xiaoqian, etc., 2015)\[2,3,4,5,6,7\].

However, the domestic research on the current situation of infrastructure construction in the centralized level, rarely from the aspects of policy, operation body etc. On the other hand, due to the rise and development of electric vehicles and infrastructure is relatively short, the relevant research literature is not very rich. Therefore, this paper provides a new perspective for the research of the infrastructure and rich the study of the literature at the same time.

Development Status of Electric Vehicle Infrastructure in Beijing

In 2009 "ten city 1000" project started, Beijing was selected as one of the first batch of new energy vehicle demonstration city in China. After that, Beijing is very concerned about the development of new energy vehicles industry, especially electric vehicle industry, and constantly introduce the
relevant favorable policies, such as "The new energy vehicles subsidy pilot program in the field of private purchase of Beijing", "Interim Measures of municipal subsidies on the promotion and demonstration of pure electric vehicles in Beijing" and "The action plan of Beijing electric vehicle promotion and application in 2014-2017". In addition, in order to promote the electric vehicle in the private sector, Beijing has held "Beijing Electric Partnership Program" and constructed a new energy car experience center. The favorable policy support, the effective implementation of various measures make the promotion of electric vehicle in Beijing achieving good results. The sales revenue of pure electric vehicle in Beijing in 2015 exceeded 15 billion yuan. As of the end of 2015, Beijing has promoted 35,800 pure electric vehicles, 23,300 of which are sold in 2015. The promotion of pure electric vehicles in Beijing ranked first in the country. Beijing has built a complete electric vehicle core industry chain, involving vehicle, battery, motor, electric control and other related enterprises which is more than a hundred.

Good promotion of electric vehicles can not be separated from the effective support of the infrastructure. In the national provinces and cities, Beijing is one of the few cities which pays more attention to the construction of the infrastructure in the early promotion of new energy vehicles and the development of infrastructure in Beijing is in the forefront of the country. On the basis of the existing research, this paper analyzes the development situation of the electric vehicle infrastructure in Beijing from four aspects: the policy and regulations, the current construction situation, the operation body and the system service.

**Policies and Regulations**

With promoting the development of electric vehicle industry, Beijing began to actively carry out the construction of infrastructure at the same time. Beijing has issued supportive policies on development strategy and objectives, construction planning, electricity price guidance, operating conditions, financial subsidies and the proportion of the allocation and other aspects, as shown in figure 1.

![Figure 1. 2010-2015 Beijing electric vehicle infrastructure related policies.](image)

**Strategic Level**

In March 6, 2010, the Beijing Municipal People's government issued the "The action plan of ‘Green Beijing’ in 2010-2012", which gave clear indication of supporting the construction of charging stations and other new energy vehicles related facilities. In August, 2011, the Beijing Municipal People's government issued "Development and construction plan of green Beijing in ‘Twelfth-Five Year Plan period’". It cleared that Beijing would continue to improve the supporting facilities, expansion Panda Huandao charging station and built new charging station in Xiao Ying, South Sanhuan and Sihui. After that, many documents,such as "New energy and renewable energy development plan of Beijing City in the period of Twelfth Five Year Plan", "The development plan of high technology industry of Beijing in the period of Twelfth Five Year Plan".
Implementation plan on energy saving and emission reduction fiscal policy integrated of the clean demonstrative transport in Beijing (2012 - 2014)”, “Assessment of the implementation of the clean air action plan in Beijing city from 2013 to 2017”, are proposed to accelerate and improve the development of the charging facilities and the construction of charging network in Beijing, to meet the development needs of new energy and clean energy vehicles.

Development Goal

In November 2010, the Beijing Municipal Science and Technology Commission, Beijing Municipal Bureau of Finance jointly issued the “The subsidy pilot program on new energy vehicles in private purchase field of Beijing”. This document proposed Beijing would adopt a model of "slow charging pile based, fast charging stations and battery replacement stations supplemented ". According to the demonstration scale of electric vehicle, Beijing began from the pilot area, plan to construct 36 thousand slow charging piles (car &pile ratio is 1:1.2), one hundred fast charging stations, one battery replacement station, two battery recycling and dealing stations, ten professional maintenance service stations and two information acquisition processing stations .to establish the system of fast, medium and slow charging network and form multi-level charging architecture within three years.

According to the data of "The promotion plan on new energy vehicles in the field of public transportation of Beijing, Tianjin and Hebei Province (2014-2015)", as of the end of 2013, Beijing has built five large and medium-sized Charging stations, two bus DC fast charging stations, and 2883 charging piles by making full use of bridge space, P+R parking lot. The document also set up the infrastructure construction goals and tasks of Beijing from 2014 to 2015 .That is, Beijing would built three new charging stations, one or two hydrogen stations for fuel cell vehicles and all kinds of charging piles 6748.

On May 7, 2015, the Beijing Municipal Development and Reform Commission held a news conference on the construction and policy of electric vehicle public infrastructure in Beijing. The conference proposed in 2015, Beijing would continue to adhere to the principle of "a car, a pile " in the construction of private used charging facilities and actively explore "a pile for multiple vehicles " and other sharing mode to ease the charging problem caused by the shortage of parking resources; in accordance with the "government support, market operation" principle, make intensify efforts to promote the construction of public charging facilities; build new charging piles 2000 and achieve the construction goal of the public charging facilities average service radius of 5 km within the city's six ring. At the same time, Beijing is actively communicating with Tianjin and Hebei province, to strive to realize the breakthrough of charging service integration among Beijing, Tianjin and Hebei by build charging station on G1 Beijing-Haerbin highway, G4 Hong Kong and Macao to Beijing highway and G6 Beijing-Tibetan highway.

Electricity Regulation

On November 23, 2011, the Beijing Municipal Bureau of Finance, Beijing Municipal Science &Technology Commission, Beijing Municipal Commission of City Administration and Environment and Beijing Municipal Commission of Development and Reform jointly issued the "The interim measures of municipal subsidies on pure electric vehicle demonstration and promotion in Beijing". This document stipulates that the electricity price of pure electric vehicle charging facilities in Beijing should be in accordance with the general industrial and commercial electricity prices of corresponding voltage level, which is clearly regulate Beijing city directory table. This is one of few domestic clear provisions on electricity and charging service fee in the early period of new energy vehicles promotion.

"The notice on electric vehicle charging service fee in Beijing ", which was issued by Beijing Municipal Commission of Development and Reform on April 24, 2015, regulated that the operating units of infrastructure providing electric vehicle charging services can charge electricity and charging service fees facilities at the same time. Charging service fees charged by charging power,
the upper limit of per kilowatt hour can’t exceed 15% of per liter of No. 92 gasoline’s highest retail price on the same day of Beijing. After the completion of the basic adjustment of the valuation system, Charging pile (station) operators in Beijing began to charge service fees from August 1, 2015. Based on the original electric bill (0.8745 yuan / kWh), charging service fee is surcharged according to 0.8 yuan / kWh.

Financial Subsidies and Distribution Ratio

According to "The promotion plan on new energy vehicles in the field of public transportation of Beijing, Tianjin and Hebei Province (2014-2015)", Beijing Municipal Commission of Development and Reform would provide 30% of the total project investment funds to the enterprises who construct infrastructure in the field of public service and build private use infrastructure in public places.

"The allocation index of residential public service facilities in Beijing" and "The implementation opinions on allocation index of residential public service facilities in Beijing", issued by the Beijing municipal government in February 2, 2015, clear new buildings and renovated building should be built with charging infrastructure in accordance with the proportion of not less than 18% of the parking space.

Enterprise Standard and Private Sector Construction Requirements

In order to better promote the development of electric vehicle infrastructure, Beijing introduced many documents to make provision for relevant enterprises participate in the production, construction and operation of, such as "The construction management rules of self use charging infrastructure of demonstrated and applied new energy passenger car in Beijing".

In the aspect of promoting the construction of charging piles for units and personal use, "Notice on promoting the installation of charging facilities for new energy passenger cars in existing residential areas" was introduced on July 1, 2014. It clear the rights and obligations of user, property, charging facilities construction units and other parties. All related stakeholders should coordinate to promote the construction of charging facilities.

Current Situation of Construction

According to the principle of "the construction of slow charging pile in private areas as the main body, fast charging pile in public areas as an auxiliary", Beijing build charging facilities in the personal use area with "a car, a pile", and actively carry out the construction of public infrastructure in all kinds of public parking areas. As of the end of 2015, Beijing has built 21,000 charging piles (port), 234 public charging stations.

As shown in Figure 2, Beijing has built private use charging piles 12,000 with the vehicle purchased and mainly installed in the individual parking spaces. Meanwhile, Beijing has constructed social charging piles 5,008, more than 50% layout in the six ring road and preliminary formed the fast charging network, whose average service radius is 5 kilometers to the center of Beijing. What’s more, Beijing also has built public charging stations 234 and charging piles 3,700 in bus, taxi, postal, logistics and other public areas.

![Figure 2. Current situation of Beijing electric vehicle infrastructure.](image)
Operation Body and System Service

Operation Body. To further display the market mechanism, Beijing actively attract and encourage the community resources to participate in the construction of public charging infrastructure in multi-ways. So far, the Operation main body is mainly consist of the State Grid, China Potevio, China Petrochemical and other central enterprises; Beijing Jingneng New Energy Co. Ltd, SHOUGANG GROUP and other State-owned enterprises of Beijing; BAIC BJEV, Tesla Motors and other Complete Vehicle Enterprises; Tellus Power, TGOOD and other Private enterprises. BAIC BJEV, China Potevio, Beijing Huashang Sanyou New Energy Technology CO.,LTD actively promote the construction of charging facilities in various fields relying on its resource advantages. China Petrochemical and CNPC carry out a pilot of charging infrastructure according to the safety standards. SHOUGANG GROUP and Tellus Power actively promote the construction of "three dimensional garage + charging station".

System Service. To make users find and use public infrastructure faster and more convenient and maximize the use efficiency of charging facilities in Beijing City, Beijing on the one hand built a unified logo in the various charging outlets, on the other hand, Beijing Municipal Commission of Development and Reform continues to update the city's electric car charging pile layout, according to the construction progress of public infrastructure. And it’s regulated that infrastructure users can access the layout for free in electric vehicle 4S shop, electricity sale place and charging outlets.

In addition, the Beijing Municipal Commission of Development and Reform also set up a unified platform on charging infrastructure service of the city, to promote all kinds of infrastructure shared, payed simple and fast. The owners of electric vehicle can log on "e charging network" (http://www.evehicle.cn/) or use the related APP client on mobile phone to query the distribution and location of the charging station, the number of charging piles, which charging piles idle and other information to find the nearest charging point for "supplementing power in travel".

Characteristics of Electric Vehicle Infrastructure in Beijing

As ownership of electric vehicle has increased, the charging infrastructure network has constructed, Beijing electric vehicle infrastructure development has formed its own characteristics on police system, construction, operation and system service.

The More Perfect Policy System

The development of the electric vehicle and its infrastructure construction relies on the powerful support of government policy. With the development of the electric car industry, the development of the infrastructure, the necessary supporting facility, has got more and more attention from the national and local governments. After 2014, the level of infrastructure support policies both in breadth and in depth is growing. Beijing is one of the cities which attached importance to the development of infrastructure in policy in the early time. Through the above analysis, the infrastructure support policy is no longer simply mention on the level of strategy, but has extended to some feasible measures such as development goals, electricity regulation, financial subsidies, infrastructure construction proportion and enterprise regulations. With the expansion in the scale and field of the infrastructure construction, the Beijing government's support for infrastructure policy system will be more perfect, which will provide more reliable guarantee for for the reality of infrastructure construction.

Good Construction Condition

From "slow charging pile based, fast charging stations and battery replacement stations supplemented " to "the construction of slow charging pile in private areas as the main body, fast charging pile in public areas as an auxiliary", Beijing build charging facilities in the personal use area with "a car, a pile", and actively carry out the construction of public infrastructure in all kinds of public parking areas, as shown in Figure 3.
Beijing pays particular attention to the construction of private sector infrastructure. The construction of charging infrastructure needs to consider planning, land, electricity and other preconditions, involves a number of competent authorities and related enterprises in the implementation process. In order to promote the construction of infrastructure in the private sector, Beijing has been introduced "The construction management rules of self use charging infrastructure of demonstrated and applied new energy passenger car in Beijing" and "Notice on promoting the installation of charging facilities for new energy passenger cars in existing residential areas". In the efforts of all parties, the construction of the private sector in Beijing has made leaps and bounds in 2015. The proportion of field construction by 22% at the end of 2014 rose to 58% by the end of 2015, as shown in Figure 3.

More Different Operation Body

With the perfect electric vehicle demonstration operation effect in the taxi, bus and other public areas, Beijing began to intensify support for electric car rental time field in 2014, and particularly in the private sector. The electric vehicle industry and the development of infrastructure is complementary to each other, therefore, the effective promotion of electric vehicles in the traffic field in Beijing also led the field of infrastructure construction and development, particularly in the public domain.

Compared with other cities, the number and nature of management of operating body in Beijing is constantly increasing, which has brought more possibilities for the infrastructure business model innovation. Alongside new stakeholders would have to be integrated, a variety of potential business models result for the different application cases, for which the participating companies and their share in the value creation have to be newly defined\[8\].

Pay More Attention to System Services

January 18, 2016, Beijing government announced the public service management platform of electric vehicle infrastructure (e-charging network) will be promoted on line in the near future. This platform will contain all electric vehicle infrastructure operators in the Beijing area and contribute to promote the interconnection between operators. This platform will be synchronized with the implementation of the national standard, achieve a unified payment and settlement, real-time data updates, charging pile reservation and navigation and other functions.

Using the Internet thinking and combined with user reviews, E charging network expect to achieve rapid feedback of consumer experience, to guide the user how to charge effectively and improve the quality of service operators. This platform will become the largest coverage and most comprehensive App of Beijing City.
Conclusion

The development of electric car industry relies on the effective support of the infrastructure. Therefore, the study of the present situation of the electric car infrastructure is necessary. On the basis of existing research, this paper analyzed the present situation of the development of the electric car infrastructure from the four aspects of the policy level, construction situation, main operational actors and system service. Through the analysis, we found that the electric car infrastructure develop well in Beijing, and will make great progress in the aspect of the policy, charging technology, business model innovation, intelligent system services and public awareness.

The electric car infrastructure construction in Beijing performed very well, but for the sake of better and faster development. We should take the proposed improvements for the insufficient development of the electric car infrastructure. Through the above analysis, this paper puts forward the following suggestions:

The Infrastructure Planning Layout Should be Given More Attention

Both in Beijing and around the whole country, the unreasonable electric car infrastructure layout is a big factor in the development of electric vehicles and infrastructure. Through the analysis of the electric vehicle infrastructure policy level in Beijing, we found that although the current policy system of Beijing has plans for the construction of infrastructure in all areas, lacking of the relevant provisions of the specific layout. Therefore, the government of Beijing should pay more attention in the policy layout of infrastructure, and should introduce detailed policies and regulations as soon as possible.

The Intensity of Fiscal Subsidies Should be Increased

At present, the electric car infrastructure subsidies in Beijing are numbered, and the form is single. So relative to the electric car fiscal subsidies, the infrastructure is a bit thin and weak. In order to make a great promotion for the development of the electric car industry and arouse the enthusiasm of social capital operation of infrastructure construction, the government of Beijing should increase the intensity and the ways of the financial subsidies to the electric car infrastructure.

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Reference


