



Current status and future development of electric vehicle in China

Ying Han^{1*}, Yan Liu², Guoqiang Zhang² and Xiang Zhao²

¹College of Civil and Architectural Engineering, Hebei United University, Tangshan, Hebei, China

²Beijing Electric Power Company, Beijing, China

ABSTRACT

The problem of energy saving and environment protection has become more and more crucial in China. China's energy development process shows that the development of pure electric vehicle to China's energy structure optimization and the construction of the ecological environment. New promising technology that makes the problem solved is reviewed in this paper, including current status of electric automobiles, electric vehicle charging systems and future development. It is given the group of customers and charging mode of electric automobiles in China. It is suggested the matches between charging modes and vehicle types. In the short term, conventional gasoline or diesel vehicles is the most realistic and effective, while in the long run, China will meet the urgent challenges of energy crisis and greenhouse gas reduction. It needs technology breakthroughs in battery, public awareness and government input to the development of electric automobiles.

Key words: current status; electric vehicle; charging system; future development

INTRODUCTION

As the energy saving and environment protection, green and environment-friendly technology are paid more attention. With the rapid increase of vehicle population, vehicular emissions were found to be major sources of air pollutants such as CO, NO_x, Volatile Organic Compounds (VOC) and Particulate Matter (PM) in many cities in China [1-5]. The electric vehicles which are the best substitution as the zero pollution vehicles are promoting in the future. In a research, reductions in primary energy consumption, fossil fuels use and CO₂ emissions of up to 3%, 14% and 10%, respectively, were verified from the transportation and electricity sectors [6]. Electric automobiles are vehicles that derive their power from electric motors. It is not a fairly new invention, actually there were earliest automobiles powered by electric batteries. A lot of researches are done by automobile research center or companies in developed countries. At the same time, with the resultant development, vehicle charging systems are developing, such as vehicle charging station and charging point. However, electric automobiles still have a long way to go before they reach the mainstream market.

HISTORY OF ELECTRIC VEHICLE

It is considered that the electric vehicle is a fairly new invention. Actually, some of the earliest automobiles produced were already powered by electric motors that were fueled by batteries in 1830s. American Thomas Davenport is credited with building a small locomotive considered the first practical electric vehicle. Until 21st century, there are a lot of automobile companies investing for the research and production of electric automobiles.

CURRENT STATUS OF ELECTRIC VEHICLES

With the shortage of petroleum resources, new energy vehicles have become the future development direction. As the use of private cars is growing rapidly in China in recent years, to satisfy the skyrocketing energy demand and reduce the emission of carbon dioxide, the government initiated efforts to promote the development of electric automobiles. There were 129 million private automobiles till the end of 2008, which is account for 76.14% of total

automobiles [7]. Accordingly, the tradition energy petroleum consumption was increasing rapidly. The Chinese government has taken various actions to improve alternative-fuel vehicle technology to open markets for this technology. These actions include alternative-fuel vehicle promotion policies, funding for R&D and marketing. Today, advancements in electric automotive technology have produced a number of battery types such as advanced lead-acid batteries, lithium polymer batteries and nickel metal hydride. Huge capital is invested in research on the batteries of electric automobiles in some developed countries such as Japan, Germany, France and so on. The American Recovery and Reinvestment Act of 2009 allocate \$2 billion for development of electric vehicle batteries and related technologies. The Department of Energy adds another \$400 million to fund building the infrastructure necessary to support plug-in electric vehicles in 2009. There is small gap between China and the developed countries in this field. There are 41 pure electric automobiles produced through independent research and development during “10th five years”.

TYPE OF ELECTRIC VEHICLES

ELECTRIC BICYCLE

Electric bicycle is a bicycle with an integrated electric motor which can be used for propulsion. In China, electric bicycles currently come under the same classification as bicycles. It is generally about 300RMB to 1500 RMB. The electric bicycles usually charge at home, hence there is no need to build charging facility for electric bicycles alone. Due to the rise in electric-bicycle-related accidents, caused mostly by inexperienced riders who ride on the wrong side of the road, run red lights, don't use headlights at night etc., the Chinese government plans to change the legal status of illegal bicycles. It is so dangerous that the top speed of most electric bicycles can reach 30 km/h to 40 km/h.

MUNICIPAL VEHICLES

Most of municipal vehicles powered by electric are electric buses and electric sanitation trucks. As the capital of China, there are more than 1000 electric municipal vehicles available to use in Beijing at the end of 2010. It shows the Composition ratio in Fig. 1.

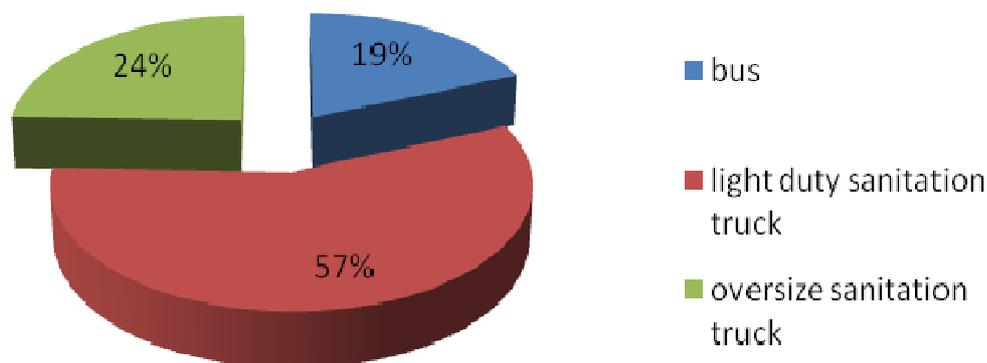


Fig. 1: Composition ratio of municipal electric vehicles in Beijing.

OFFICIAL STATE CARS

Official state cars account for very great proportion of urban vehicles. These vehicles usually drive in government, enterprise, national community, group and organization, where there are fixed parking lots, and they also have the character of relative concentration of running time. Furthermore, the official state cars have demonstrate function, therefore, the market of official state cars have great potential for promoting the development of electric automobiles.

TAXI

Because taxi has the character of long distance and wide range travel, as well as high frequency of charging battery, it needs short-time charging. At the same time, it should consider the charging cost, since the reliability of battery is very important for taxi. There are 40 taxis in Shenzhen and 50 taxis in Beijing putting into service in 2011. The taxi drivers and customers gave good comment on electric taxi.

DOMESTIC CARS

The rapid growth of domestic cars has caused the continuing growth of demand for oil. The growing demand have been a major factor affecting the future price and availability of oil as well as a major contributor to increasing the greenhouse gas in China[8]. In 1990, there were only 0.8 million domestic cars in China, but in 2011, the total amount of domestic cars reached 72 million, the stock of domestic cars has increased approximately 90 times between 1990 and 2011. If the situation continues, by the year 2030, there will be 400 million domestic cars in China [9]. It is predicted that the annual oil demand of China's road vehicles will reach 363 million tons by 2030 [10]. Therefore, the domestic electric automobiles are the most important part of marketing promotion. Domestic electric cars are usually micro cars, subcompact cars or compact cars, of which the market maintenance is great and the demand are rapidly increasing. It will be the main source of profit from the domestic electric cars.

CHARGING MODE OF ELECTRIC VEHICLE**LARGE-SCALE CENTRALIZED CHARGING STATION**

Construction of the large-scale centralized charging station is centered on transportation junction. Safety and reliability is the base of construction. Level of the load is grade 2, distribution capacity is over 3000 kVA. The advantages of these charging stations are quick battery replacement, great charge performance, large site area and large amount of labor employment.

Table 1: Mode of large-scale centralized charging station.

Charge mode	Advantages	Disadvantages
Battery swap mode primarily	Great contemporary charge performance	Large investment
Vehicle charging mode supplementally	Easy management and distribution	inflexible

MEDIUM-SIZE DISTRIBUTED CHARGING STATION

Medium-size distributed charging station is constructed around fixed parking spot. Level of the load is grade 2 as well as large-scale centralized charging station, but the distribution capacity is over 300 kVA. The advantages of these charging stations are vehicle charging mode, large site area and supply charging service. However, the charge frequency is low.

Table 2: Mode of medium-size distributed charging station

Charge mode	Advantages	Disadvantages
AC slow charge primarily	Easy selection of construction site	Long charging time
DC fast charge supplementally	Easy management and distribution	Single customer

SMALL-SCALE DISTRIBUTED CHARGING SPOT

Small-scale distributed charging spot is constructed around charging station, community parking lots, underground parking and department parking. Level of the load is grade 1. The distribution capacity is less than 100 kVA. The operation form of small-scale distributed charging spot is customer self-help service. The advantages of these charging stations are simple steps, convenient operation, which is the important supplement of centralized charging station and distributed charging station. But the coverage is limited, because there is no condition to set unattended charging spot.

Table 3: Mode of Small-scale distributed charging spot.

Charge mode	Advantages	Disadvantages
AC slow charge primarily	Large coverage	Difficult to manage and maintain
DC fast charge supplementally	Convenient self-help service	Difficult to be large-scale in short time

SMALL-SIZE PORTABLE CHARGING POINT

The principle of small-size portable charging point construction is multi setting point, and the charge mode is mainly battery swap mode. The charge time is about 5-10 minutes, so it makes the maximum extent possible to meet customer demand. This kind of charging station mainly meet small-size vehicle, which it faces the frontier of the electric automobile charging market. Through battery swap service in short time, it can improve the runtime of electric automobile substantially. Because of absolute advantage of the customer retention, it will be the focus of competition. On the other hand, it will be the main source of profit.

Table 4: Mode of Small-size portable charging spot.

Charge mode	Advantages	Disadvantages
Battery swap mode primarily	Large coverage	Large amount of work for distribution
Value-added service supplementally	Short charge time	Difficult to be large-scale in short time

REFERENCES

- [1] Yi, H.H.; Hao, J.M.; Tang, X.L., *Energy Policy*, **2007**, 35, 907–915.
- [2] Barletta, B.; Meinardi, S.; Rowland, F.S.; Chan, C.Y.; Wang, X.M.; Zou, S.C.; Chan, L.Y.; Blake, D.R., *Atmospheric Environment*, **2005**, 39, 5979–5990.
- [3] Bo, Y.; Cai, H.; Xie, S.D., *Atmospheric Chemistry and Physics*, **2008**, 8, 7297–7316.
- [4] Liu, Y.; Shao, M.; Lu, S.H.; Chang, C.C.; Wang, J.L.; Fu, L.L., *Atmospheric Environment*, **2008**, 42, 6261–6274.
- [5] Xie, S.D.; Liu, Z.; Chen, T.; Hua, L., *Atmospheric Chemistry and Physics*, **2008**, 8, 2701–2716.
- [6] C. Camus; T.Farias; J.Esteves, *Energy Policy*, **2011**, 39, 5883–5897.
- [7] “China 12th five year” Planning Report for Electric Automobiles Charging Facilities of Beijing Electric Power Company, Beijing Electric Power Company, Beijing, China, **2011**.
- [8] Yan, X.; Crookes, Roy J., *Energy Policy*, **2009**, 37, 658–668.
- [9] Hu, X.; Chang, S.; Li, J.; Qin, Y., *Energy*, **2010**, 35, 4289–4301.
- [10] He, K.; Huo, H.; Zhang, Q.; He, D.; Wang, F.; Walsh, M.; Michael, P., *Energy Policy*, **2005**, 33, 1499–1507.