

# Research on Electric Vehicle Development Status, Policies, Trends and Issues in China

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**Abstract:** Electric vehicles are a well-known technology in the 21st century. It is the most popular transportation tool for the government and citizens in this era. Thus, most countries support to phase out fossil fuel vehicles with electric cars because according to the CNEV (China Electric Vehicle)'s "The Advantages of Electric Vehicles", electric vehicles have various benefits such as ultra-low emission of off-gas or even no off-gas, fast acceleration, low noise, and most importantly, the spread of electric vehicles could drastically reduce the use and extraction of fossil fuels. Since the 2015 Climate Conference in Paris, countries around the world have been implementing measures to reduce carbon emissions. Electric cars are a new means of transportation worth popularizing. This paper first introduces the basic concepts and properties of electric vehicles and analyzes the development and application of electric vehicles these years, including civil which means the facilities that can be used by the public and non-civil which means the facilities not accessible to the public like military. The difficulties encountered in the development of electric vehicle industry and the future development trend of electric vehicles are also discussed.

## 1. Introduction

In the 21st century, after experiencing many times of oil crisis and environmental pollution, many countries have found the instability of fossil fuels, so the globe is looking for alternative energy to solve these problems. For transportation, people gradually attach importance to electric transportation. In recent years, the electric transportation industry has been developed in various countries, and it has reduced part of the environmental pollution. According to the definition, an electric vehicle is a vehicle that is dependent on electricity. There are three main kinds of electricity: Battery Electric Vehicles (BEV), Hybrid Electrical Vehicle (HEV) and Fuel Cell Electric Vehicle (FCEV).

Nowadays, electric vehicles are very popular as the idea of protecting the environment is deeply rooted in people's minds. Many governments have introduced policies and guidelines to support the development of electric transportations and electric industry corporations. For example, the Chinese government in recent years has been ranked no.1 in the world in terms of sales of electric vehicles. However, while electric cars are selling well, they also have many problems to solve. The charging infrastructure is not perfect whereas safety risks still remain for electric cars. Besides, short battery life is still a big obstacle for further development. This paper concentrates on the development of electric transportation and the situation of electric transportation. Furthermore, the paper also expounds the problems in electric transportation.

## 2. Type of electric vehicle

### 2.1 Battery Electric Vehicles (BEV)

Compared with fuel vehicles, battery electric vehicles have many advantages. The first advantage is its cost is low. Without wear and maintenance cost, electric drive costs just between 3-5 cents per kilometre. One car can save nearly \$45000 if the car goes 150,000 kilometres. Besides, the driving quality of battery electric vehicle is improved. Compared with the engine, the battery can output the maximum current in a very short period so that the motor can reach the peak torque. Furthermore, with

less intermediate loss of transmission and the transmission shaft, the battery electric vehicles can achieve high acceleration [3].

In addition, battery electric vehicle can achieve better Noise Vibration and Harshness (NVH). Compare with the gas car when they are at low speed, the noise and vibration level of the motor in operation is far less than the traditional internal combustion engine. At low speed, the tranquility level of the battery electric vehicle is much higher than that of the traditional car, or the battery electric vehicle does not idle at all. When it is stationary, the motor stops working completely, and the battery pack can directly supply power to other devices.[4] However, battery life of battery electric vehicle is short. Even in cold regions, the endurance may be reduced by up to 50 percent [5].

## **2.2 Hybrid Electrical Vehicle (HEV)**

The most outstanding advantage of the hybrid electric vehicle is fuel saving, which is also the meaning of its existence. Hybrid electrical cars can use the battery to run first. After the power is used up, the vehicle will use fuel to run. Through this way, it can save a large part of the fuel consumption.

The disadvantage of battery electric vehicles is that they do not have satisfactory driving distance and have a long charging time, while gasoline-electric hybrid electrical vehicles do not have this worry. In the city, the battery is good enough. If people want to drive long distances, cars can run on fossil fuels. And because of the extra drive system, hybrid electric vehicle is much more expensive to build. As a result, hybrid electric vehicle is more expensive than fuel cell electric vehicle and battery electric vehicle.

## **2.3 Fuel Cell Electric Vehicle (FCEV)**

The hydrogen fuel cell is the mainstream in society, so this paper will cite hydrogen fuel cell as an example. Hydrogen fuel cell is a kind of fuel cell technology gets clean energy from hydrogen. A fuel cell is a device that uses an electrochemical reaction to generate electricity.[6] Unlike the combustion of fossil fuel of conventional gas vehicles, fuel cells combine hydrogen and oxygen to produce electricity, heat and water. Hydrogen has a higher energy density than gasoline, hundreds of times higher than lithium batteries. Oil and hydrogen both release energy through an oxidation process that involves either the oxidation of carbon or hydrogen. Gasoline and diesel are both hydrocarbons, while hydrogen contains only hydrogen, so its energy density is even higher [7]. It only takes three to five minutes to add hydrogen to a car, like filling it with gas. The hydrogen fuel cell reaction equation is very simple. It is just through burning hydrogen to produce water. Not only there is no nitrogen oxide, a toxic gas, and but also no carbon dioxide. The disadvantages of the fuel cell electric vehicle are also obvious. Fuel cell technology is not mature enough. Battery life is five to six thousand hours, and it will die soon. In addition, few countries in the world can produce these parts, and supply chains are severely short [7]

# **3. Electric transportation development in China**

## **3.1 Domestic electric transportation companies in China**

According to the statistics of the China Automobile Association and the statistics of the Ministry of Public Security, by the end of June 2021, the number of Electric vehicles in China had reached 6.03 million, accounting for 2.1% of the total number of vehicles. Among them, there were 4.93 million battery electric vehicles, accounting for 81.7 percent of the total number of electric vehicles.[8]

## **3.2 The situation of electric transportation in different regions**

China has formed six auto industry areas, respectively in the Yangtze River Delta cluster, Pearl River Delta cluster, Beijing-Tianjin-Hebei cluster, the middle triangle cluster, Chengdu-Chongqing western cluster, northeast cluster. In terms of industrial clusters, electric vehicle projects account for 30 percent of them and are increasing year by year. This is due to China's efforts to promote the application of electric vehicles in recent years, the scale of the new energy vehicle industry has gradually expanded.

### **3.3 The future development trend of electric transportation in the world and China**

With the severe energy situation and low carbon economy, the development of electric vehicles has become a general trend. Looking at the development technology routes of electric energy vehicles in the United States, Japan, the European Union and other developed countries, we can see that the development sequence of new energy vehicles is: HEV, BEV, FCEV. Hybrid electric vehicles focus on commercialization at present, battery electric vehicles are the focus on researching and development, and fuel cell electric vehicles are focus of long-term development that means it is still going to take some time to figure the mature technology of them out.

### **4. China's internal policies on electric transportation**

Firstly, “The Promulgation and Implementation of New Energy Vehicle Production Enterprises and Product Access Management Regulations” which was released on July 1, 2009 by the Ministry of Industry and Information Technology, fully shows that in order to promote the

development of the electric vehicle industry, our government will enhance the assessment of battery electric vehicles in the following aspects in the future: research and development, production, management, sales, etc. And through the implementation of relevant provisions to effectively eliminate some backward battery electric vehicle production enterprises, cultivate more high-quality production enterprises, so as to effectively avoid the "bad money to drive out good" phenomenon which means due to information asymmetry, high-quality sellers are not recognized and withdraw from the market, leaving only inferior sellers. It can also lead to effectively eliminate many adverse factors in the development of new energy vehicles [9].

Secondly, according to “The Parallel Management Measures of Average Fuel Consumption and New Energy Vehicle Credits of Passenger Car Enterprises”, The government's support for the development of new energy vehicles is clearly proposed here. The government will also pay enough subsidies to support this industry. This management Measure is undoubtedly the most attractive new energy vehicle industry policy in 2017, and will also have an impact on the establishment of China's future battery electric vehicle industry pattern to varying degrees. In the future, the proportion of oil-fueled automotive and battery electric vehicles will be changed in society.[10] The points policy mentioned in the Measures will be implemented from 2018. It is required that in the three years from 2018 to 2020, the proportion of the electric vehicles in total vehicles for electric vehicles manufacturers should reach 8%, 10% and 12% respectively. It is worth noting that the Measures also stipulate those points for electric vehicles can be carried forward and traded. If the number remains negative through carry-over and trading, the company will have to suspend the application of substandard new cars and the production of fuel-efficient models [11].

### **5. The problems of electric transportation today**

#### **5.1 Safety risks remain for electric cars**

Although electric cars have made progress, they still have quality problems and potential safety hazards. According to China National Energy Administration, from 2015 to 2018, a total of 24 fire accidents occurred in new energy vehicles in China, including 15 battery electric buses and 4 battery electric saloon vehicles. In the 24 cases, the problems are spontaneous combustion, collision and charging accidents. The causes of these accidents are mainly as follows:

##### **5.1. Improper use of batteries**

When the battery is soaked in liquid, WHO damaged its diaphragm, or damaged insulation layers, a short circuit may occur. This will cause overheating and fire. As the use time increases, the battery will gradually degrade, resulting in the change of its performances, increasing unsafe factors. In addition, some of the low-quality batteries are in concave-convex shapes and there are impurities,

pollution and other problems. They will lead to short circuit power battery in use even cause accident [12].

## **5.2. Battery materials do not meet standards**

At present, most electric vehicles in China use lithium batteries as the main raw material of power batteries. Due to the active and flammable chemical properties of lithium ions, collisions and extrusion in the actual use will lead to damage to the battery pack. This will expose the lithium ions in the battery to the air and cause a fire. In addition, due to the low degree of mechanization of battery pack installation and assembly in China, the quality of single battery or battery pack produced is not high. The quality of battery is changeable, and the phenomenon of battery leakage occurs from time to time. Once the electrolyte comes into contact with oxygen, it can quickly react and burn, igniting the battery pack and causing a fire accident.

## **6. The solutions to the problems of electric vehicles.**

Looking back at the accidents of electric vehicles, 58% of the EV accidents are caused by their batteries, and the fatality rate of combustion caused by battery accidents of electric vehicles is relatively high. The advance detection, early warning and disposal of battery faults are particularly important for driving safety. The solution to the problems of electric vehicles is through the popularization of The Big Data, like NIO company in China.

The static state of electric vehicles during charging and after charging is the main cause of fire accidents, and most vehicle combustion accidents occur in a state of charge. When electric vehicles fail, operating parameters such as voltage, temperature and insulation resistance generally have abnormal changes. Based on big data of battery failure, WHO need real-time continuous automatic collection and the status of battery, including total voltage, current, monomer battery monomer, insulation resistance temperature data collection, based on the intelligent early warning model, according to the analysis of large data and self-learning, WHO can infer the battery failure probability and failure happened in advance. The prediction and analysis of battery failure through big data is always a direct, effective and universal way, with high accuracy of 80%. The battery failure can be warned a week before it really goes down. In this way, people can have a great possibility to avoid these safety problems and thus protect their lives. In China, many Clouds are used in society nowadays.

## **7. Conclusion**

This paper mainly introduces the current development of electric vehicles in China and forecasts the future development trend. In this paper, three main types of electric vehicles are studied and analyzed. The advantages and disadvantages of each are explained. Compared with China's policies and development direction of electric vehicles in recent years, many problems in the development of electric vehicles has been listed. Some general solutions have been proposed, which indicates a bright future for electric vehicles.

## **References**

- [1] 'The advantages of battery electric vehicles' by Yang Wenlin 2020
- [2] 'The Paris Agreement' by UNFCCC 22/4/2016
- [3] 'Design and Experimental Study of Power System Test-bed for Pure Electric Vehicle' by Qin Dongchen, Li Jianjie, Wang Tingting, Cheng Lei 2018
- [4] 'Research on Torque Distribution of Four-wheel Drive Pure Electric Vehicle Based on M Script' by Wang Jin-qiao, Wang Xin-shu, Li Kui, Wu Jun, Du Da-bao 2021
- [5] 'Problems facing electric vehicle development in China' by Zhonghong National Research Institute (Beijing) Information Technology Research Institute 2020

- [6] 'Hydrogen Fuel Cells Fact Sheet' comes from California Hydrogen 2018
- [7] 'Advantages and disadvantages of hydrogen fuel cell vehicles compared with traditional lithium battery electric vehicles' by Zhang Kangkang, Tsinghua University 2020
- [8] 'In 2021, China's New Energy Vehicle Industry Market Status and Development Trend Analysis Policy Will Continue to Promote the Development of the Industry' by Ma Jun 2021
- [9] 'The Promulgation and Implementation of New Energy Vehicle Production Enterprises and product Access Management Regulations' by the Ministry of Industry and Information Technology 2009
- [10] 'In 2021, China's New Energy Vehicle Industry Market Status and Development Trend Analysis Policy Will Continue to Promote the Development of the Industry' by Ma Jun 2021
- [11] Central People's Government of the People's Republic of China 'The next 15 years of industrial development plan - new energy vehicle core technology aimed at the international advanced level' by Zhu Junbi 2018
- [12] 'The Safety Hazards of Electric Cars' by Zhonghong National Research Institute (Beijing) Information Technology Research Institute 2019