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Current Status of EV Technology in China Based on Expert Interview

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Abstract

Electric vehicles are developing quickly in China. Based on the expert interview, the current status, development trends, possible paths and related policy recommendations of the electric vehicle technology in China are discussed in this paper. It is found that there are some bottleneck problems for the electric vehicle development and some promotion policies should be taken in China.

Keywords: Electric vehicle; technology development; expert interview; China

1. Introduction

In a broad definition, electric vehicles include pure electric vehicles (EV), hybrid electric vehicles (HEV) and fuel cell electric vehicles (FCEV). They all are the low carbon electrification power train system transition from the conventional compression-ignition and spark-ignition internal combustion engine (ICE) to new generation vehicles in future. Developing EVs will help improve China's energy security and CO_2 emission reduction and reduce China's reliance on import of oil [1]. The LCA impacts for EV is dramatic: although energy use increases slightly compared to the original scenario, GHG emissions are reduced 73% when compared to conventional vehicle [2].

Governments and companies are rushing for the game of EV development globally. Currently, lots of OECD countries including US, Japan, Germany, France, UK, are providing substantial subsidies for automotive industry. Of them, EVs are the key benefited options.

China has established a policy framework to accelerate technology development and market transformation of EVs. The federal government has set the strategy to develop new energy vehicles and it has devised policies to support research and development, regulate the industry and encourage consumption. Some local governments have already started to carry out these policies.

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In this paper, the current status, development trends, possible paths and related policy recommendations of the electric vehicle technology in China are discussed based on the expert interview.

2. Methdology

2.1 Open questions to experts

Both academic and industry field experts are interviewed with open questions.

The experts include Doctor LIN Chengtao, assistant professor of Department of Automotive Engineering of Tsinghua University, Mr. YU Zhenhua, president of Prudent Energy Technology Co., Ltd located in Beijing and Prof. GAO Chao, president of China Tex Mechanical and Electrical Engineering Ltd located in Beijing. China Tex is one of most famous motor companies in China.

2.2 Questions asked

The questions listed as follows:

1) Technology status

- What is the current status of EV technology in China?
- Which global firms are leaders in the EV technology? To what extent do Chinese firms have capabilities in the technology, and how do these capabilities compare with those of technology leaders?

2) Capabilities in Chinese firms

- What is the nature of Chinese firms' capabilities? Are they focused on manufacturing, design or both?
- What is the role of international collaboration and/or technology transfer in developing these capabilities? What specific mechanisms have been used (e.g. licensing, joint ventures, takeovers)?
- To what extent are local linkages important for Chinese firms (e.g. with research institutes, design institutes, other firms in their supply chain)?
- Do Chinese firms have access to the most up to date 'vintage' of the technology? If not, is this seen as problematic?

3) Financial and policy frameworks

- To what extent have policies already been put in place to encourage the development and deployment of these technologies?
- What are the most promising national and international policy options that could make further progress in overcoming cost and other barriers in future?

3. Results and discussions

3.1 The overall situation of EV technology in China

Research and development of electric vehicles in China is at the same starting line as other countries basically, and the both gaps technology and industrialization level are small between China and other advanced countries.

At present China has listed a variety of HEV and pure EV in the national automotive product announcements. China has a small production capacity of EV and on the critical stage of shifting from demonstration application to industrial development.

China has made large progresses in the field of key components of EV including power battery, drive motor, electronic control and system integration technologies. The key parts of electric vehicle research and development system has been initially established.

3.2 EV industrialization in China

Although many domestic enterprises have introduced electric vehicles, but there is still a long distance from research to mass production line , requiring a lot of works of engineering research and development. But China is still very weak in this area of engineering and the government is needed to increase investment in this part.

Demonstration programs are needed to test some technology and start the market. Electric vehicle technology is the main bottleneck in battery technology due to that the current vehicle power battery's energy density is relatively low and more battery are assembled to improve the mileage EV need. What's more, the stability and life of the battery should be tested in the demo programs to discover and solve problems and improve battery performance through the practical application. And there is a market driven by demo demand, therefore the battery industry will accelerate the pace of technological progress.

EV industry is not a sudden overnight thing but a gradual process. Through demonstration operations and expanding the battery application scale, technology will be further enhanced, battery cost will be reduced and the relevant technical standards will be improved.

3.3 Vehicle battery situation in China

Battery, the power source for electric vehicles, is the key factor restricting the development of electric vehicles. There are six key performance indicators for battery: energy intensity, consistency, power intensity, cycle life, safety and cost. For competing of electric cars with the fueled car, the key aspect is to develop high energy intensity, power intensity, long life and efficient batteries.

For China, there still are obstacles in the electric vehicle batteries package manufacture. For example, development and manufacturing of polymer electrolyte membrane of lithium-ion battery are still in low level and cannot fully meet the domestic demand; development and manufacturing level of battery management system, including temperature control system, charge and discharge control system, security system, urgently need to improve. The above two aspects are restricting EV battery industry in China.

China is one of biggest lithium-ion battery countries and accounting for about 25% of global market share. Though China has a good industrial base, there are technology gaps between China's lithium-ion battery production technology and those of advanced international level (see Table I). In China some of the key technologies and materials (such as the membrane, a high purity lithium hexafluorophosphate for electrolyte) have not yet formed industrial production capacity, and some important battery performances (including energy density, life, consistency and safety) still lag behind the international advanced level.

TABLE I. Lithium batteries technology level with comparison to international level

Key chain	**Score (1-5)**	**Key barriers**
Material	2	The membrane and high purity lithium hexafluorophosphate for electrolyte and LFP has to be imported.
Battery design	3	Not optimal for life, consistency and safety.
Process control	3	The automatic level is not high.
Battery Management System	2	the precision of state determination and reliability of engineering application are lag behind international level

3.4 EV motor situation in China

High-performance EV has a high-level requirement on the motor system: a constant power output, high power density, wide speed range, fast torque response, high energy efficiency, maintaining reliability in different environments and low cost characteristics.

At present, the above such characters of energy efficiency, control accuracy and reliability for motors technology in China still lags behind the international advanced level, and further improvements are in need for product development and manufacturing process.

3.5 Technology gap and cooperation in EV motor field in China

There are not big gap between China and other countries for the stage of R&D, but the gaps are very big in the aspects of process control and materials treatment. Domestic companies are worried about the incoming of the foreign ones. There is not very deep degree of technology cooperation in domestic and foreign companies.

In future, China may get some technology benefit from those high tech foreign companies by giving them some market share.

Those foreign companies will occupy the high-price market but domestic companies still hold the market share of low-price EV motor.

4. Key findings and suggestions

4.1 Major bottleneck problems for EV development in China

For battery, beside high cost and immature infrastructure for EV currently, battery technology is the major aspect of EV in China and it has the bottleneck problems:

- Low energy density, low range, short life span.
- Big room occupying battery.
- Long time to charge.
- Non-scale production line, variety in battery qualities.

For motor and other part, the technology issues are not so big problems, but the gaps between domestic and foreign countries still exist like the battery technology categories.

4.2 EV development paths for China

Till today, China's auto industry has evolved from technology import, digestion and absorption into the development of independent R&D. For the emerging EVs industry, which path should the development of them takes is a hot issue.

At present, the likely development path includes independent R&D, technology transfer, digestion and absorption, and direct procurement of components (see Table II).

TABLE II. EV technology development path in China

Path No.	**1**	**2**	**3**
Detail	independent R&D	technology transfer, digestion and acquisition	direct procurement of components
Support	R&D department and S&T agency	Industry and enterprise	Companies partly
Advantage	long-term competiveness	Getting Intelligent Property quickly and dominating some market	Low initial input and production cost
Risk	Investment; Long time R&D	Key technology will be controlled by foreign companies	the industry will be handled by other countries

Among them, the path of independent R&D will help the enterprises to master core technologies and improve competitiveness from the long-term view, but large investment and long cycle issues are inevitable; the path of technology transfer, digestion and acquisition can also help to master some key technologies but those involved companies often maybe in the status of dependency on import but not digestion and acquisition; the path of direct procurement of components will cut off their long-term competitiveness though their cost can easily be covered.

In the opinion of experts, the above 3 paths can all happened due to the big land of China and the complex market including different types of vehicles (from high to low price, from city to rural area).

So all the companies (domestic and foreign, high-price and low-price) will get their own market share and benefit from the mega EV market in China based on the low carbon constraint world.

4.3 Barriers for EV related technology transfer in China

Not only the domestic companies requiring technology innovation but also the abroad companies owning advanced technology have been barriers for EV technology transfer to China:

1) Anxiety on market losing

In China, some companies think they are on the same start-line for the EV technology and battery improvement and cost reduction are the key two points. So technologies R&D by themselves are the key tasks to take to get the EV domestic market. If the technologies are only transferred with potential IP problem, the market losing will be real.

2) Disinterest of foreign countries

For those advanced EV countries, such as Japanese and American companies, all develop on themselves. They are advanced in R&D and are scaling up manufacturing capacity.

With no mature technology in producing materials, China purchases materials from overseas, e.g. Japan and plays the role of manufacturing batteries for mature applications, e.g. mobile phones, etc.

So there is no collaboration between China and Japan in R&D efforts so far.

4.4 Suggestions for EV technology transfer

1) Build the technology alliance platforms

With the support from the bilateral governments, to build lots of technology platform between Sino-UK, Sino-US, Sino-German, and Sino-Japan.

On these platforms, all sides can share the technology results and speed the EV commercialization on both sides.

2) Solve the intelligent properties issues

With the help of the professional lawyers, to sign efficient by equal IP contract. Technology transfer then can smoothly happen.

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