



ON THE DEVELOPMENT STRATEGIES OF THE NEW ENERGY CAR INDUSTRY IN CHINA

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Abstract

New energy vehicles are being paid unprecedented attention by governments, manufacturers and consumers for their environmentally friendly features. However, the high attention has not turned into a large demand. Even with the support from the government, the sales of new energy vehicles remain far from acceptable. The disappointing performance of the new energy vehicles concerns the domestic automakers that desire to implement the new energy strategy. Starting from the consumers' decision, this paper gives an economic analysis of the influencing factors of purchasing the new energy cars. Given the temporarily unchangeable infrastructure and environment, this paper provides some product portfolio under the current resource. Finally, referring to the influencing factors once more, we give the domestic automakers some suggestions to play up strengths and avoid weaknesses.

1. INTRODUCTION

1.1. Major changes in the automobile manufacturing industry after the financial crisis

The automobile industry is usually one of the industries in the real economy that are shocked first in the economic recession. Influenced by the diminishing of market demand and the increasing difficulty of financing, American automobile industry has been suffering since the beginning of this century. Then, the oil price soared, leading to the demand of high oil consumption vehicles in decline, such as SUVs and pick-up trucks that are just the strengths of American automobile manufacturing industry. Until the last straw, the subprime crisis, broke the camel's back, American automobile industry was on the verge of death. A falling giant can shake the earth. Although someone may argue that surpassed by Toyota, the three giants, General Motor (GM), Ford and Chrysler, are not as powerful as they used to be, their influence on the global market is still striking.

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As a result of globalization, the crisis of American automobile industry soon spread to every corner of the world. The struggle of the three major automakers was clearly seen by everyone, reduction of output and even closing factories whose result, the great unemployment rate, was the very situation that the American government’s macro-control policy always desires to avoid. A glance across the Atlantic Ocean revealed a bleak European automobile market. In 2007, the quantity of European vehicle production ranked first in the world, while the year 2008 told a different story. The vehicle turnover of Western Europe in September declined 9% on year-on-year basis, followed by another 19.5% drop in October on year-on-year basis. The first 10 months witnessed the turnover falling 5.4%. Even the vibrant emerging market, Asia, caught a cold.

However, there is one thing warmly treated as the Savior of the whole automobile industry – the new energy car. After taunted about flying with private planes to the Congress to beg for salvation, in the second visit, the CEOs of three American automakers chose hybrid electrical vehicles (HEV) to show their sincerity and please the Congress. This prologue was followed by a series of revolution projects. In the report dealing with the crisis submitted by GM, the first item concerned raising the output of oil-saving vehicles developing energy-saving technology, optimizing portfolio and raising fuel economy. By 2012, more than half of the vehicle types will be elastic fuel and 15 types of HEV will be on market. Ford and Chrysler both announced the similar plan concerning raising fuel economy and developing new energy vehicle in their reports.

New energy policy became many governments’ favorite stimulus. In the 2010 federal fiscal budget submitted on 26th Feb. 2008, president Obama promised to allot 150 billion US dollars in the next decade to help American automakers produce energy-saving vehicles. The German government provided a 500-million-Euro fund to support automakers in developing HEV. In order to thank Korean government, Jeong Mong-gu, CEO of Hyundai KIA Automotive Group, who used to be condemned to embezzlement but granted amnesty by the government hoping Hyundai could lead Korean economy out of the recession, decided to help the government realize its goal to be one of the four biggest manufacturers of green vehicles in the world.

1.2. The comparison of the Chinese passenger car market before and after the financial crisis

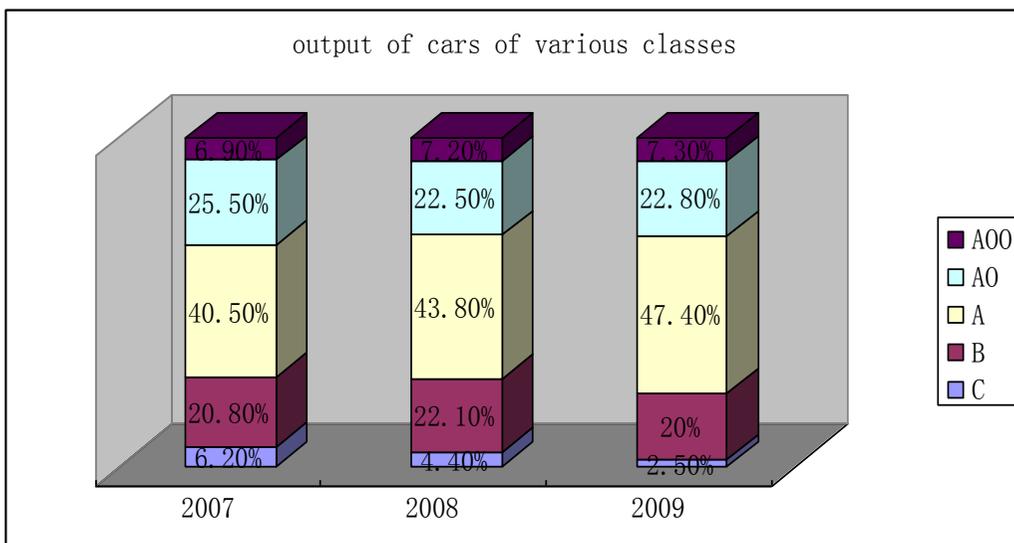


Figure 1: Output of various classes of cars
Source: China Association of Automobile Manufacturers

Let’s turn our eyes back to China to have a look at the changes which took place in our domestic automobile market during that period of time. The graph above indicates the output of cars of

various classes in China covering the years before and after 2008. According the international Volkswagen's classification of vehicle, A00 stands for the mini-car whose engine displacement is lower than 1 L; while A0 stands for the small car with displacement between 1 L and 1.3 L; A means the compact car from 1.3L to 1.6L in displacement; and B denotes the moderate car with displacement between 1.6 L and 2.4 L; C means the high class car from 2.3 L to 3 L. (Displacement is only one of the criteria. The other criterion, wheel base, is not specified here.) A glance at the column graph above reveals that the output percentage of the cars with displacement lower than 1.6 L grew slightly in 2008. This stemmed from that the financial crisis repressed the market of expensive car while released some market to the general compact car including A0 and A00 class car. However, they accounted for somewhere in the vicinity of 73% in these two years. Thank to the policy announced at the end of 2008 by Chinese government and some recovery trend, this percentage rose to 77.5%.

Although the general compact car does not equal to the new energy car, they both can be called environmentally friendly. Why do not we just use the data of the new energy car? That is because the new energy car is such a minority that it is impossible to compare it with the conventional car. Then other questions come to us, whether the trend showed in the graph indicates the potential market of the new energy car, especially when the new energy car is more expensive than the compact car and if our domestic automakers want to develop the new energy car, which strategies they should take. Our domestic automakers do have a lot of aspects to consider. The following part is dedicated to analyze the market enthusiasm for the new energy car and the domestic automakers' strategies.

2. THE DOMESTIC MARKETS

2.1. The influencing factors of the private car possessing

Speaking of the sales of cars in the market, we have to figure out the influencing factors of the private car possessing. By applying the econometrics, we will technically inspect our assumption and discover these factors. In order to avoid the systemic risk in 2008, the model we established is based on the data before 2007. The following data in the model come from the National Bureau of Statistics of China.

As we all know, consumers' income is the most significant factor. Firstly, let's assume that the dependent variable (Y), the private car possessing (10 thousand), has linear relation with the independent variable (X), consumers' income (Yuan).

According to the data above, we can draw a scatter diagram. The scatter diagram shows that Y may be the power function of X, but not an obvious linear relation. A better linear model might appear if we introduce another variable. Therefore, we try to explore some other contributing factors. When we decide to purchase a car, we must take the relative infrastructure into account, such as road condition and the access of gas stations etc. Thus, we introduce the highway mileage (10 thousand km) as our second explanatory variable (X_2). The revised model indicates that the possessing of private car is influenced both by consumers' income and highway mileage. Consumption level staying fixedly, every 10 thousand kilometers increase in the highway mileage will lead to a 44 thousand rise in private car possessing; highway mileage staying steady, consumers' income rising 1 Yuan will cause 2.3 thousand increase in private car possessing.

2.2. The consumers' decision

We have studied what elements consumers will take into account when they purchase the car. If we want to further study their purchasing behavior on a specific type of vehicle, the new energy car, we also have to pay attention to the substitution between the conventional car and the new energy car.

Toyota Prius was the first kind of HEV which realized mass production in the world. we select two other same class conventional cars for price comparison.

Table 1: Comparison of three brands

	Toyota Prius 1.5 Standard	Toyota New VIOS 1.5 GL-i	Honda Fit 1.5 L Luxury
Class	New energy	A0	A0
Length× width× height (mm)	4450×1725×1510	4285×1695×1450	3900×1695×1525
Displacement (L)	1.5	1.5	1.5
Max-velocity (km/h)	165	170	172
Transmission	Continuously variable transmission (CVT)	4-speed automatic	5-speed automatic
Comprehensive fuel consumption (L/100km)	4.7	5.6	5.1
Approximate price (RMB)	259800	112500	103800

Source: Types of Selling Automobiles in China in 2009

The price disparity is so obvious that the price of one HEV doubles the price of the same class conventional car. From the perspective of consumer equilibrium, the optimal portfolio of products is reached when the marginal rate of substitution (MRS) equals to the price rate.

According to his income, a consumer has his own budget line. The tangent point is the consumer equilibrium point.

$$MRS_{12}=P_1/P_2\approx 2$$

If he wants to buy an HEV, he has to sacrifice the possibility of buying two same class conventional cars. In terms of price, it is not acceptable for most consumers, while a more considerate consumer may compare the long-term interest by calculation.

Prius is 146400 Yuan more expensive than New VIOS. If we assume the No.93 petrol costs 6.5 Yuan/L, 146400 Yuan can be changed for 22507.69231 L gasoline. Since the comprehensive fuel consumption for New VIOS is 5.6 L/100km, this amount of fuel can cover 401923.0769 km. After this mileage, New VIOS costs 5.85 Yuan more per 100 km.

Regardless of the fluctuant oil price, the electricity bill, maintenance and battery lifetime, it is merely a vast oversimplification of the comparison. However, it unveils the price disadvantage of the new energy car.

The reason why the new energy car is eclipsed by the conventional car is that its externality has not been transformed to the advantage for consumers. When the behavior of an individual or a manufacturer influences the others' benefits, we name this influence externality. On the condition that the society benefits more than an individual dose, this externality is called external economy. Conversely, provided that individual's cost is smaller than that of the society, it is called external diseconomy. In this case, the new energy car emits less even no polluted gas to the atmosphere, so it does less harm to the environment than the conventional car. Although we are educated that environmental protection is every human being's responsibility, all rational people are not environmentalists. Clean air is like an undividable public product without rivalry and exclusiveness, so that many people want to be the free-rider who enjoys it while others pay for the cost to purify the polluted air.

2.3. Government's visible hand

Because of the externality, consumers' optimal decision deviates from the social optimization. It is the very time that the government steps in. Advancing to different phases, the government will have various strategies respectively.

2.3.1. The HEV phase

A hybrid electric vehicle (HEV) combines a conventional internal combustion engine (ICE) propulsion system with an electric propulsion system. HEV uses gasoline as its fuel and the driver has not to plug in to charge it. Driving at the same speed as the conventional vehicles, the driver almost cannot tell the difference between these two kinds of cars. All these resemblances destine that HEV is an ideal transitional product.

From the above analysis, we realize that a consumer's budget restrain line is decided by his income and the considerable high price of HEV becomes the major obstacle of promoting HEV. Subsidizing the purchasers of HEV, the government can internalize the external economy. It seems to be a good method to compensate its price disadvantage. At the executive meeting of State Council on 14th January 2009, "The Adjustment and Revitalization Programme of Automobile Industry and Steel Industry" was approved. In this programme, the most notable one was the vehicle purchase tax relief. According to the programme, from 20th January to 31st December 2009, the purchase tax on cars with displacement below 1.6 L would halve to 5% (It has risen to 7.5% this year). This tax relief not only showed the government's determination to revive the automobile industry, but also demonstrated its commitment to support small and compact cars. Similarly, tax preference and subsidy can also be applied in promoting the new energy car. Since HEV costs less in the long-run, it is unnecessary that the subsidy covers the whole price disparity. As long as the gap is narrowed down, together with some expectation of rising oil price, HEV will catch attention.

2.3.2. The plug-in HEV (PHEV) and battery electric vehicle (BEV) phase

A plug-in hybrid electric vehicle (PHEV), also known as a plug-in hybrid, is a hybrid vehicle with rechargeable batteries that can be restored to full charge by connecting a plug to an external electric power source. A PHEV shares the characteristics of both a conventional hybrid electric vehicle, having an electric motor and an internal combustion engine; and of an all-electric vehicle, also having a plug to connect to the electrical grid.

A battery electric vehicle (BEV) is a type of electric vehicle (EV) that uses chemical energy stored in rechargeable battery packs. BEV uses the electric motor and motor controller instead of ICE for propulsion.

Here, we need some review. After establishing the model of the influencing factors of the private car possessing, we discovered two contributing factors, the income and highway mileage. However, by far, our analysis has been focusing on the part of money, such as the price and income and has not yet mentioned which role the explanatory variable "mileage" plays in the development of the new energy car. When we introduced the variable X_2 , it was used as a representative of infrastructure, since the number of gas stations is too difficult to calculate as statistic. The convenience of driving is certainly a supporting facility to be reckoned with.

The most appealing difference between these two types of EV and HEV happens to lay on the supporting infrastructure. HEV consumes conventional fuel while PHEV and BEV need to be charged, which means that most of the parking lots need to be equipped with charging devices in this phase. Furthermore, since the ultimate goal of promoting new energy vehicle is environmental protection, our electricity supply has also to reduce the reliance on fossil fuel to avoid transferring the emission of polluted gas to the power plants. The construction of renewable energy or clean energy generating plants is a nationwide grand mission.

The governments of Japan and Germany have planned to establish charging stations in their capitals to support the development of PHEV and BEV. Although the development of China's

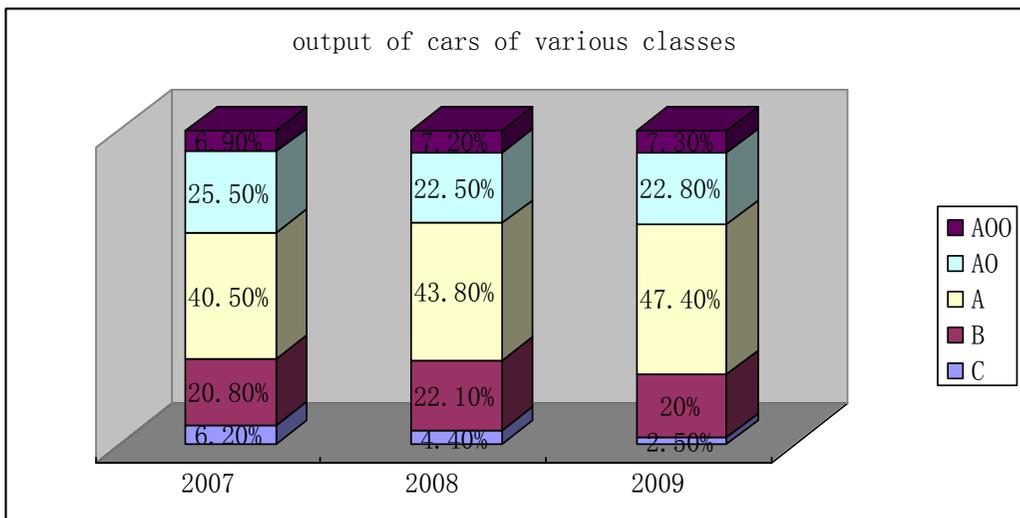
self-owned EV is still in the very beginning stage, other governments' behaviors have set the example for us in the next phase.

3. MANUFACTURERS' PORTFOLIO STRATEGY

Supported by the governments, the automakers are all doing their best to take a place in the field of future automobile market. Some press sensationalized it as a revolution of automobile industry. According to the definition in Oxford Advanced Learner's English-Chinese Dictionary, a "revolution" is a large change in conditions, ways of working, beliefs, etc. that affects large numbers of people (Horby, 2006). Let's highlight the phrase "large numbers of people". Have the cars we are driving or are going to buy changed into new energy cars? The majority of the answers are negative. Released in October 1997, Toyota Prius's sales volume was still 0.5 million by the middle of 2006 (Carson & Vaitheeswaran, 2008). It seems we are far from the generation of the new energy car.

Considering the selling performance of EV, automakers have to evaluate the product portfolio to promote the new energy car while make profits. Establishing a BCG Matrix, we explore the strengths and weaknesses of various types of cars.

In this matrix, four quadrants are divided by growth rate and market share with four symbols respectively. Since the output of the cars does not bear great disparity with its sales and market share, we reuse the column graph illustrated in Section 1 as our data source.



Data from the China Association of Automobile Manufactures

3.1. The cash cow

According to Chinese tradition, large objects represent high social status. It is unimaginable that a black-tie senior businessman is to drive a Chery QQ or a Volkswagen (VW) Polo. With reasonable price, the wealthier middle-class would rather choose spacious B class cars in the past. Before the financial crisis, the B class cars enjoyed a 6.25% growth rate in the output rate; whereas in 2009, its growth rate shrank to -9.50%. Anyway, in the first-tier cities, it remains very popular. Thus, we classify it as the cash cow which has high market share. Because heavy investments in advertising and plant expansion are no longer required, the automakers earn a positive cash flow. They can milk the cash cow to invest in other riskier businesses (Daft, 2000).

3.2. The star

China is no doubt a huge potential market. The reason why we use the word "potential" is because that our domestic demand generally remains weak compared with our status as the

largest explorer in the world. This fundamental reality of our nation determined the fact that the A class cars (including A0 and A00 classes) take the top spot in market share. The people in the second and third-tier cities cannot afford the expensive B class cars, not say the C class cars. Therefore, there is such an ironic situation that the cars with displacement lower than 1.3 L are running on the wide country roads while the cars with displacement higher than 1.6 L are stuck in the peak hour in cities. From the column graph, we see the output rate of the A class cars grew slightly, at the speed of 0.68%, one-tenth of the B class cars. Stunningly, the advantaged policy of automobile revitalization pushed its output rate to 77.5% in that bleak economic environment, with a 5.44% growth. With a large market share in a rapidly growing industry, the A class cars possess the attributes of the star. The star is important because it has additional growth potential, and profits should be plowed into this business as investment for future growth and profits. The star is visible and attractive and will generate profits and a positive cash flow even as the industry matures and market growth slows (Daft, 2000).

3.3. The dog

In the abovementioned analysis, we notice C class is the wealthy businessmen's exclusive auto style. As we all know, the output of high-class vehicles like Porsche does not manage to match that of the average-people-friendly vehicles and it does not need to because rarity makes them valuable. However, nowadays, they are becoming rarer and rarer. The output rate of C class cars dropped dramatically by 29.3% in 2008 and it got even worse in 2009, with an exponential slump to only 2.5%. Admittedly, the small market share and slow-growth make the C class car the dog. Conventionally, the dog is meant to be liquidated but it is not unprofitable in this case. For Chinese self-owned brands, their investment on C class cars should be very careful. The reason behind this is that it is an exclusive market and the majority of the consumers prefer the foreign prestigious brands, like Benz, BMW and Porsche.

3.4. The question mark

Now, let's go back to our minority, new energy cars, whose output is too small to be illustrated on the graph. If we classify the new energy car as the question mark, it must exist in a new, rapidly growing industry but has only a small market share. The poor performance of Toyota Prius has given us the hint of its extremely small market share; however, the rapid growth can only be predicted from the macro-policy and still undetectable from the market yet. That is why we call it the question mark. There are so many unpredictable situations which may help it rise to be a star or drag it to be liquidated.

In order to disperse the fog, we apply a SWOT model to analyze these situations.

3.4.1. Strengths

a. Less reliance on fossil fuel

Because of the limited petroleum resource, there is no doubt that the real oil price (removing the effect of inflation) will rise. The new energy car can reduce this kind of cost risk.

b. Battery technology

Battery technology is the core of the EV. According to "Nikkei Electronics News", following Sanyo, Sony and Panasonic, Beyond (BYD) is among the best in the field of the Lithium-ion battery and the nickel and metal hydride battery. It released Chinese first PHEV, F3DM, in December 2008, which is two years earlier than GM Chevrolet Volt and one year earlier than Toyota the third generation Prius PHEV. At the beginning of this year, its BEV, E6, has been approved to produce. BYD is absolutely the pioneer in Chinese new energy car.

c. Mass production advantage

As long as we manage to overcome the technical difficulties, in the mass production, China's labor cost advantage will embody in the price. As our analysis, the competitive price not only

can draw the consumers' attention from the conventional vehicle to the new energy car, but also is an unparalleled advantage compared with the foreign brands.

3.4.2. Weaknesses

a. Price

By far, the price disparity between the new energy car and the conventional car remains great.

b. Cruising range for one charge and charging time of BEV

Charging is the most troublesome part when driving the BEV. GM' Volt can run 110 km in the city condition and 144 km in the highway condition after one charge and without special equipment the recharging will last six to ten hours, which makes the long-distance intercity travel impossible.

c. Maximum speed of BEV

Admittedly, the maximum speed of BEV cannot match the conventional car with large displacement because most of the BEVs are a class.

3.4.3. Opportunities

a. Support from the government

In "The Adjustment and Revitalization Programme of Automobile Industry and Steel Industry", the government announced its support in the development of EV and the industrialization of the relevant crucial components by subsidization.

b. Lithium resource

Lithium is the core material of the battery. South America enjoys the largest storage of lithium resource but China is also one of the nations with abundant lithium resource.

c. Emission reduction of the greenhouse gas

No matter from the Kyoto Protocol or from the UN. Climate Change Conference in Copenhagen, the emission reduction is echoing around the world.

3.4.4. Threats

a. Foreign prestigious brands

Chinese products have been underestimated for a long time in the world. Although BYD has been head and shoulders above some famous automakers in the field of the new energy car, it is tough for us to overcome consumers' faith on the foreign prestigious brands. That is why our Department of Commerce broadcasted the advertisement "Made in China" all over the world.

b. Infrastructure for BEV

The construction of the infrastructure, like charging stations, has to start before the BEV becomes popular.

4. SUMMARY AND CONCLUSION

Starting from the econometric analysis, we discovered the linear relation between the consumers' income, mileage and the private car possessing. According to his income, a consumer draws a budget line to decide whether to buy a new energy car or a conventional car. The over-expensive new energy car seems to be less attractive to him. For the sake of the social interest, the government should subsidize the consumers to compensate the externality and initiate the construction of the relevant infrastructure to create convenience for the new energy car drivers.

Serving as the bridge between the automakers and consumers, the government tries to create an active market for the new energy car and supports the automakers' R&D. Although encouraged by the government, the automaker still has to consider whether it is the right time to release this technology to the market. Through the BCG Matrix, the automaker positions the new energy car among other kinds of conventional cars.

The market of the C class car is almost dominated by the foreign prestigious brands. Consequently, it should not be the focus of our domestic automakers. The B class car, as a cash cow, earns a positive cash flow which can be invested into the development of the A class car and the new energy car. However, the fact is that if our domestic automakers followed the development process of the foreign giants, we would just passively pick the left-over market under the shadow of the giants. Since most of our domestic automakers are new comers and do not suffer from the sunk cost of the plants and machines for the production of the B class cars, our overtaking strategy would better be give up the mature market and start from the rising market. If we are able to make full use of the competitive advantage, the star may also generate a considerable cash flow to incubate the question mark.

From the study of consumers' decision, we discovered one of the major influencing factors – the price. But the SWOT model told us that China has the unparalleled advantage in nature resource and mass production, which can lead to lower price than our foreign counterparts. But first of all, we should overcome the technical obstacle to reach the level of mass production. With the financial support from the government and the profit from the sales of the A class cars, the fund for the R&D of the new energy car will be sufficient. The problem lays on how to do the R&D. As we know, the Lithium-ion battery is the core of the R&D of the new energy car. Among the weaknesses we discovered, all of them stem from the battery, even the high price is because of it. Many foreign automakers attain the battery technology through M&A, like Daimler AG; others cooperate with battery manufacturers, like the Japanese automakers with Panasonic to name but a few. In terms of our self-owned brands, BYD has a very strong ability of battery R&D, whose batteries have been installed in many electronic gadgets, such as mp3. As for the other self-owned brands which are not capable enough to manufacture the Lithium-ion battery by themselves, the speed of R&D and the cost must be taken into account. Shortcut as oversea M&A is, it is too risky and costly and oversea M&A on the strategic technology cannot get rid of the interference of the government. Producing the Lithium-ion batteries for many foreign electronic product manufacturers, China possesses a large group of experienced battery companies. Exploiting domestic resource costs less and can get more support from the government but one thing must keep in mind: quality never give way to cost.

The development of Chinese new energy car industry is indeed confronted with many barriers, including internal weaknesses and external threats. Nevertheless, none of them are insurmountable. The developing technology will resolve the problems of the battery capacity and lower the cost. Thanks to our big government, China's infrastructure construction has always been efficient. However, the brand reputation cannot be established as quickly as the technology develops and it will be a nationwide campaign.

Though this study is focusing on the EV, the concept of the new energy car has an expanding boundary. There are some automakers dedicating themselves to the R&D of the hydrogen powered vehicles. The inevitable fact, however, is that it's tenfold cost than the conventional car is beyond the average people. Furthermore, producing liquid hydrogen is unbelievable expensive. Another kind of new energy car is the solar car. You may have seen it in the golf course but its low speed cannot qualify it racing on the highway. The technical breakthroughs in these two kinds of new energy car still remain vague.

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