

# Development Status and Trend of New Energy Vehicles in China

-- Consumer Data Analysis Based on Internet

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**Abstract:** Under the background of energy conservation and emission reduction advocated by the state, the sales volume of new energy vehicles increased rapidly and reached new highs in 2021. However, many domestic new energy vehicles still face the problems of serious homogenization and low market share. In view of this situation, we mine and capture the data of online consumers and potential consumers, analyze consumers' preferences in combination with the knowledge learned, take Shenzhen BYD Co., Ltd. as an example, analyze its competitive environment, and finally put forward feasible suggestions.

**Keywords:** Energy saving and emission reduction, New energy vehicle, BYD.

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## 1. Introduction

China's new energy vehicles are now in a highly developed stage. According to the analysis of the data of China Automobile Industry Association, in June 2021, China's production of new energy vehicles reached 248000 units, a year-on-year increase of 1.3 times. With more mature production methods and scientific and technological innovation of relevant production lines, the output increased steadily. In addition, in June 2021, the sales volume of new energy vehicles in China reached 256000, a year-on-year increase of 1.4 times. The sales volume of new energy has set a new historical record and reached a new high, and the market share of new energy vehicles has been expanding. People's recognition of new energy vehicles is increasing, and new energy vehicles are in a state of sustainable development. In the first half of 2021, the cumulative production and sales of new energy vehicles in China were 1215000 and 1206000 respectively, an increase of 134.9% and 139.3% respectively, far exceeding the output of traditional gasoline vehicles. The proportion of new energy vehicles in the field of automobile sales is increasing, and it has become the largest hot spot of automobiles in the first half of the year.

Old automobile enterprises are making efforts to transform. BYD, SAIC GM and other enterprises have borrowed the original technology and brand advantages and fully combined with the needs of today's Chinese market to launch new energy vehicle series such as Wuling Hongguang mini, Han, Qin and so on. New brand enterprises are also unwilling to show weakness. Through the research and development of science and technology, they are in line with the fast-paced life and aesthetic concept of young people, and produce brands such as Xiaopeng automobile and Weilai automobile, so as to win public praise and occupy the market. The publicity of different automobile enterprises for their new energy vehicle products can be seen in major shopping malls, and major brands are trying to occupy a favorable market position [1]. The increasing number of automobile

manufacturing enterprises and the influx of a large number of enterprises can only prove the heat of today's new energy vehicle market. However, many automobile enterprises have exploited the loopholes of legal subsidies to develop various "old man le" new energy vehicles, which do not meet the relevant safety requirements and specifications. The development direction of automobile enterprises is also different, each has its own advantages and disadvantages, and consumers have rich choices, but it is becoming more and more difficult. It has become a big problem for consumers to choose a new energy vehicle of an old brand enterprise with good brand effect and service guarantee, or a new brand vehicle with full sense of science and technology and full sense of youth [2].

BYD Co., Ltd. (hereinafter referred to as "BYD") was established in February 1995 and headquartered in Shenzhen, Guangdong Province. The company has more than 220000 employees and its business spans four major industries: automobile, rail transit, new energy and electronics. It is listed in Hong Kong and Shenzhen, with a business income and market value of more than 100 billion yuan. BYD is committed to promoting the sustainable development of human society with technological innovation and helping to achieve the goal of "carbon peaking and carbon neutralization". In 2015, BYD won the first award for new energy industry in the 70 years since the founding of the United Nations - "United Nations Special Energy Award". In 2016, BYD won the large enterprise award of "Zayed Future Energy Award". In 2017, BYD won the title of "The Most Admired Chinese Company" of Fortune magazine in 2017, ranking fifth and ranking first in the automotive industry. In 2020, BYD became one of the top 100 most valuable Chinese brands in 2020brandz, and won the champion of the most valuable Chinese brand in the automotive industry for six consecutive years [3].

Taking BYD Co., Ltd. in Shenzhen, China as the research object, this paper explores the influencing factors of consumers' purchase of new energy vehicles through the

collection and analysis of network big data, and analyzes how Chinese automobile enterprises can better meet the needs of consumers and continuously expand themselves in combination with BYD's own advantages and disadvantages, opportunities and difficulties. At the same time, new energy vehicles are a high-tech industry and an important field to explore and enrich the socialist market economy. By exploring the development of new energy vehicles, it is conducive to further promote the concept of energy conservation and emission reduction, as well as to summarize the experience of other emerging high-tech industries and provide reference significance.

## 2. Network Status Analysis

In order to understand the spread and development status of new energy vehicles in China, we use big data mining to obtain network data about new energy vehicles. Making full use of these data can help automobile enterprises understand consumer needs, plan the future development direction of products, formulate targeted marketing strategies and improve their competitiveness.

### 2.1. Network Focus Trend Analysis

When analyzing the popularity and popularity of new energy-saving vehicles in China, we used Baidu Index to conduct a pre survey. Baidu is a large search engine and video platform in Chinese mainland. Its Baidu index is a data sharing platform based on massive Internet user behavior data. Through the analysis of Baidu Index, we can study the trend of keyword attention, gain insight into the changes of Internet users' needs and monitor the hot spots of media attention. In Baidu Index, we use "new energy vehicles" as the keyword for query and analysis. After screening and eliminating the bad content, we select the data from November 10, 2020 to November 10, 2021 for analysis, and draw the relevant conclusions as follows.

The keyword search trend of Baidu Index of new energy vehicles shows that the attention of Internet users and consumers to new energy vehicles is in a tortuous upward stage, but the node volatility increases in some times. Publicity should be increased to maintain exposure and make consumers more exposed to new energy vehicles. The overall daily mean (4359) of the keyword search index of new energy vehicles is greater than the mobile daily mean (3471). The data prove that the heat of new energy vehicles has been increasing in recent years [4].

From the demand map of related words and the search index map of related words, we can get the following conclusions: "top ten ranking of new energy vehicles", "new energy", "ranking of new energy vehicles", "price list of new energy vehicles" and other words have strong correlation with keywords. This phenomenon shows that netizens are usually associated with these words when searching for "new energy vehicles". Netizens and consumers want to know more about various brands of new energy vehicles in terms of performance and price. At present, there are brand effects and Title Effects in the new energy vehicle industry. Among the relevant needs of subdivided search keywords, there are other new energy vehicle brands such as "Nezha new energy vehicle", which shows that they are the main competitors of BYD to a certain extent. At the same time, there are also keywords such as "regret death after buying an electric car" and other negative expressions of consumers in the hot words on the list, indicating that there is still a large room for the

product to rise.

### 2.2. Geographical Distribution

The regional distribution index shows that the search index of Guangdong, Jiangsu, Shandong, Zhejiang, Henan and Shanghai ranks in the forefront. When divided by cities, Shanghai, Beijing, Hangzhou, Shenzhen, Chongqing and Chengdu ranked first in the search index. This shows that consumers of new energy vehicles are mainly located in East China and radiate to north, central and South China. This shows the insufficient publicity of the concept of new energy vehicles. Consumers and potential consumers of new energy vehicles are still concentrated in the north, Shanghai, Guangzhou and Shenzhen. Potential consumers in second and third tier cities may give up choosing new energy vehicles because of insufficient understanding.

### 2.3. Crowd Portrait

From the crowd portrait, we can see that there are more men than women among the consumers of new energy vehicles, but the difference between the two is not much. The group aged 20-39 accounts for the main part, and the proportion of consumers under 19 and over 50 is no more than 10%. By further analyzing the TGI index, that is, the index reflecting the strength or weakness of the target group within the specific research scope, such as geographical region, demographic field, media audience, product consumers, etc., we can conclude that for Internet users under the age of 19, consumers of new energy vehicles belong to the vulnerable group. This is because Chinese law clearly stipulates that minors are prohibited from driving. For netizens aged 30-39, consumers of new energy vehicles belong to the middle and strong group, and the TGI index reaches more than 90. We can learn that older potential buyers may give up the purchase option of new energy vehicles because of conservative ideas and insufficient understanding, which is also a manifestation of insufficient marketing efforts of new energy vehicles [5].

## 3. Text Mining Based on Consumer Forum Data

Sharing their shopping experience and consumption experience to the social platform has become a common behavior habit of contemporary consumers. A considerable proportion of consumers will leave their own evaluation of the goods on the network after purchasing and using the goods. These comments not only include consumers' attitude towards the actual goods, but also consumers' most direct feeling about the use of the goods. These valuable information are often randomly distributed in the text data of major website platforms. It is too time-consuming to extract and analyze through manual operation. Therefore, natural language processing technology and the use of machine learning methods to deal with unstructured or semi-structured text data have become a hot spot in the era of big data.

With the rapid development of e-commerce, more and more people understand product information through e-commerce websites. Therefore, we will mine the key information under the text data by capturing the comment data of new energy vehicles on the forum, using text word segmentation processing, word frequency analysis, semantic network analysis, etc., so as to judge the tendency of the text comment data and mine and analyze the hidden information. Accurately and effectively analyze consumers' concerns, likes

and dissatisfaction with new energy vehicles from Internet review data, so as to make a preliminary evaluation on the appearance, interior decoration, price and power of new energy vehicles, so as to optimize the questionnaire and improve the field survey scheme.

### 3.1. Capture of Comment Data

The research data used in the survey are from the owner comments of Pacific Auto network. The data crawling is completed by octopus software. After setting the process steps, run the program and grab it to the forum for evaluation. For the captured data, we uniformly collect five fields: user name, purchase location, comprehensive score, advantages and disadvantages, and store them in the form of Excel.

### 3.2. Data Preprocessing

In the process of data crawling, there are a large number of incomplete, inconsistent and abnormal data in the massive original data, which seriously affects the execution efficiency of data mining modeling, and may even lead to the deviation of analysis results. For the comment data of online e-commerce platform, due to the random and diverse writing and expression of users on the network, and the phenomenon that some businesses hire water soldiers to comment, it is particularly important to clean the original data.

On the basis of previous studies, there are many text de duplication algorithms, most of which measure the similarity of two texts first, usually including Jaccard distance, Cosine distance, European distance and so on. Among the massive text de duplication algorithms, the most famous is simHash algorithm, which is a set of algorithms proposed by Google and applied to the actual web page. However, this kind of algorithm still has serious defects, such as judging two sentences with only one word difference and very similar words as non repetition, and judging two sentences with opposite semantics as repetition. According to the characteristics of comments, we preprocessed the data to retain the comprehensive evaluation of consumers as far as possible.

### 3.3. Keyword Extraction and Word Frequency Analysis

Before analyzing the text data, we need to divide the collected comment data into individual words. Unlike English, which realizes word segmentation with natural writing interval, the difficulty of Chinese word segmentation is that there is no obvious interval or division between words when writing Chinese. This part uses the Jieba Library of Python software to complete the Chinese word segmentation of commodity comment data. The Chinese word segmentation package provides functions such as word segmentation, part of speech tagging, unlisted identity recognition, keyword extraction and so on. The basic implementation principle and steps are as follows:

(1) Efficient word graph scanning based on trie tree structure. Generate a directed acyclic graph (DAG) composed of all possible words of Chinese characters in the sentence. (2) use dynamic programming to find the maximum probability path and find the maximum segmentation combination based on word frequency. (3) New word discovery. In Jieba word segmentation, the positions B, M, E and S of the word in the word are taken as the hidden state, and the word is the observation state. The dictionary file is used to store the representation probability matrix, initial probability vector

and transition probability matrix between the words respectively. This is a standard decoding problem, and the Viterbi algorithm is used to solve the maximum possible hidden state according to the probability.

After segmenting the text data according to the operation steps, extract high-frequency words and draw a word cloud. In the figure, the higher the word frequency, the larger the word size. Through observation, we find that consumers pay more attention to the appearance, space, interior and power of new energy vehicles. Further analysis shows that the appearance, interior, power and endurance of vehicles are the main driving forces for consumers to buy. In addition, we can also find that consumers are dissatisfied with the products. For example, some consumers think that the car smell is serious and the noise is large. In the face of these common problems, we need to optimize the products.

## 4. Analysis on Competitive Environment of BYD New Energy Vehicles

### 4.1. Macro Environment Analysis Based on PESTEL Model

As a macro environment analysis model, PESTEL analysis model is mainly used to analyze the macro environment state, analyze the changes in the industry development under the macro environment, and study the factors that help and hinder the industry development, so as to find a more development direction and development path.

#### 4.1.1. Political Factors

The subsidy standard for new energy vehicles issued by the central finance encourages consumers to buy more new energy vehicles, promotes the development of new energy vehicles, and is used to promote the relevant deployment requirements of the state to strengthen energy conservation and emission reduction. "Policy driven" has become a major driving force for China to promote the development of new energy. In order to achieve China's "double carbon" goal of carbon peak and carbon neutralization, the development of new energy vehicle market will become an inevitable trend. Provinces also vigorously promote the development of energy-saving vehicles and new energy vehicles market in different ways and corresponding to the call of the state, so as to achieve the goal of energy conservation and emission reduction. Take Guangdong Province as an example. In the notice on several policies and measures to promote urban consumption issued on November 9, Guangdong Province proposed to gradually relax the licensing indicators of cars in Guangzhou and Shenzhen, further promote the market development of new energy cars and promote the sales of new energy cars. By 2022, the incremental indicator of configuring energy-saving cars in Guangzhou will increase to 80000. We are committed to improving the layout of relevant automobile sales outlets, guiding them to sink into the county and other third and fourth tier cities, and encouraging the development of new energy vehicle sales. As early as 2016, Shenzhen promulgated the financial support policy of Shenzhen for the promotion and application of new energy vehicles in 2016, which defined the Subsidy Methods of new energy vehicles in Shenzhen, including purchase subsidy, one-time charging subsidy, charging facility construction subsidy and power battery recovery subsidy. Comprehensively promote the development of new energy

vehicle market from production, sales, use and recycling.

#### **4.1.2. Economic Factors**

Compared with traditional fuel vehicles, new energy vehicles are cheaper to use. Both natural gas and today's pure electric vehicles can save costs more effectively under the same distance, which has also become the reason why consumers are more inclined to choose new energy vehicles. Lower price, more cost-effective for practical car owners. This transformation is first reflected in the online car Hailing transformation of local taxis and major platforms. The lower cost brings more objective income to the transportation service industry. In addition, local subsidy policies have successfully promoted the development of new energy vehicles and successfully entered a favorable position in the automobile sales industry. In addition to small private cars, the cost savings of large trucks and buses are more prominent. Local governments have responded to the call, and buses have switched to new energy buses. SF logistics company has also switched some large transport vehicles to new energy transport vehicles, which has achieved the development goal of promoting energy conservation and emission reduction while reducing costs and increasing profitability.

#### **4.1.3. Sociocultural Factors**

China's vigorous publicity of the environmental protection concept of "green water and green mountains are golden mountains and silver mountains" has continuously strengthened the Chinese people's awareness of environmental protection. For the relevant policies of the corresponding countries, people's attitudes towards environmental pollution are constantly changing. With the affirmation of the concept of environmental protection and energy conservation of new energy vehicles, the above social and cultural factors are affecting consumers' choice of new energy vehicles and reducing their choice of fuel vehicles. Under the continuous influence of social culture, people realize that environmental protection is everyone's social responsibility, which makes consumers more willing to grasp the key words such as green and environmental protection, and also willing to pay for environmental protection products, which promotes the development of new energy vehicle market.

#### **4.1.4. Technical Factors**

The development of new energy related technologies in China is particularly prominent in the preparation of lithium batteries. According to the output of fuel cells of new energy vehicles and the installed number of lithium batteries, the output of lithium batteries in China continues to be stable and the number of lithium batteries used continues to rise. Major manufacturers increase investment in R & D and innovation of different types of new lithium batteries, ensuring that the core power source technology of new energy vehicles is no longer limited and at the world advanced level. In addition, the number of infrastructure construction of charging piles, the supply station of new energy vehicles, is also increasing, which provides corresponding convenience for the charging of electric vehicles. In combination with the popularization of technology and other factors, the construction rate of charging piles is also increasing, so as to adapt to the growth of the number of new energy vehicles and prevent the embarrassing situation of more vehicles but insufficient charging spaces. This deficiency will greatly reduce consumers' enthusiasm for purchasing new energy vehicles.

#### **4.1.5. Environmental**

New energy vehicles mainly solve the problem of environmental pollution, alleviate the greenhouse effect, reduce carbon dioxide emissions, and promote the development of energy conservation and emission reduction. Electric energy is more conducive to generation than gasoline, diesel and other resources. Wind power generation, hydropower and other technologies are also developing. As a green and clean energy, electric energy is undoubtedly more conducive to the sustainable development of the environment and solves the two major problems of resources and climate. In addition, from the perspective of the market environment, not only China, the United States, Britain and other world powers are trying to promote the development of new energy vehicles to promote the goal of reducing carbon emissions. As a world power, China should shoulder our responsibilities.

#### **4.1.6. Legal Factors**

In 2017, China promulgated the regulations on the administration of access to new energy vehicle manufacturers and products, which defined the access threshold of new energy vehicle enterprises, parameters and indicators of new energy vehicle related technologies, special testing indicators of new energy vehicles, etc., so as to improve the relevant basic industry norms and ensure the relevant quality of products produced by new energy vehicle enterprises, To ensure the legitimate rights and interests of consumers. Now, the state also focuses on the safety and legal issues related to new energy vehicles, puts forward guiding solutions to corresponding problems in time when problems arise, severely crack down on cheating subsidies to buy new energy vehicles, truly develop the new energy vehicle industry and refuse to produce new energy "waste".

## **4.2. Micro Environment Analysis Based on Porter's Five Forces Model**

Porter's five forces model gathers a large number of different factors into a simple model to analyze the basic competitive situation of an industry. The five forces model identifies five main sources of competition, namely, the bargaining power of suppliers and buyers, the threat of potential entrants, the threat of substitutes, and finally, competition among companies in the same industry. In a sense, competitive strategy stems from the deep understanding of the competition law that determines the industrial attraction. In any industry, whether domestic or international, whether producing products or providing services, the law of competition will be reflected in these five competitive forces. Therefore, Porter's five forces model is a strategic analysis tool often used by enterprises in formulating competitive strategy.

### **4.2.1. Competitiveness of Existing Competitors in the Same Industry**

At present, the competition of existing competitors in the same industry is more serious. The existing enterprise competition is often reflected in price, advertising, product quality, product introduction and after-sales service. There are many competitors with equal strength and wide participation. There are many competitors in the automotive industry, such as Chang'an, Geely, GAC motor, Wuling Hongguang, etc., as well as foreign countries such as Tesla, Toyota, Mercedes Benz, Audi, etc. In China's new energy vehicle market, foreign well-known automobile brands account for a large proportion, among which BMW, Mercedes Benz and Toyota

are more trusted and welcomed by consumers and become the first choice of most consumers. BYD's popularity, market share and consumer trust are not as good as those of foreign well-known brands. Among domestic brands, BYD does not have an advantage. Chang'an and Geely have strong competitiveness and are not as competitive as Wuling Hongguang in terms of price. It cannot become the first choice for consumers in domestic new energy vehicles. Therefore, BYD has great competitive pressure in the domestic new energy vehicle market. Homogenization of products and services, low user transformation cost. From the perspective of providing products, the models of new energy vehicles manufactured by new energy vehicle manufacturers are similar, and the models that can stand out may be rare. In this case, all automobile brands hope to innovate in products and services, create their own brand characteristics and establish their own user loyalty. However, from the market point of view, most of them are homogeneous service policies, which is difficult to create their own competitiveness and enterprise popularity.

#### **4.2.2. Entry Threat of Potential Competitors**

Once potential competitors enter the industry, they will not only bring new production capacity and new resources, but also hope to win a place in the existing market divided by enterprises, which may compete with existing enterprises in raw materials and market share, and eventually reduce the profitability of existing enterprises in the industry. The entry threshold of new energy vehicle industry is high. Through the survey, we found that although the Internet has brought some changes to the industry, the sales of new energy vehicles are mainly offline stores, and automobile manufacturing is still inseparable from the support of factories and assembly lines. Obstacles still exist and pose little threat to existing enterprises.

#### **4.2.3. Threat of Substitutes**

Due to the particularity of the new energy vehicle industry, it is more likely to be replaced by traditional vehicles. It may be that the style is not satisfied, the price is unacceptable, or even the salesperson's introduction is not satisfied, which can become the reason for its replacement.

From the changes in the growth rate of substitute sales, it is not difficult to find that the growth rate of new energy vehicle industry is slowing down and gradually maintained in a stable environment. Today, the market share of substitutes is also declining, which is also related to consumer demand. After the upsurge of new energy vehicles, more and more consumers still tend to buy traditional vehicles due to short mileage and difficult charging. Traditional cars have regained the favor of consumers with their comfort and convenience.

#### **4.2.4. Bargaining Power of Suppliers**

Suppliers mainly affect the profitability and product competitiveness of existing enterprises in the industry through their ability to improve the price of input factors and reduce the quality of unit value. The strength of suppliers mainly depends on what input factors they provide to buyers. Since BYD has its own factory, the supplier is stable and controllable, but it also brings problems such as lack of innovation.

#### **4.2.5. Bargaining Power of Buyers**

Buyers mainly affect the profitability of existing enterprises in the industry through their ability to lower prices and require higher product or service quality. Since BYD mostly takes the retail Road, the number of buyers actually

does not pose a threat, and its bargaining power is weak in this regard. What buyers buy is basically a standardized product, and it is economically feasible to buy products from multiple sellers at the same time. On this issue, the bargaining power is also weak, because the models of each brand have intellectual property protection. Unauthorized production by other manufacturers is an infringement and needs to bear legal liability.

## **5. Countermeasures and Suggestions**

By comprehensively analyzing the above online consumer data, PESTEL model and Porter's five forces model, we put forward the following countermeasures and suggestions for BYD.

### **5.1. Cooperate with the Government to Strengthen Infrastructure Construction**

In theory, the one-time charging of new energy vehicles can reach 400 kilometers, but in the actual journey, it is often only about 200 kilometers. The demand for power and charging pile of new energy vehicles far exceeds its supply, and even there is a situation that it takes 5 or 6 hours to queue up for one-time charging. BYD should invest more funds in supporting infrastructure construction, operate the operation links after the purchase of new energy vehicles, and reduce the worries of consumers when purchasing new energy vehicles.

### **5.2. Focus on Customer Needs and Market Segmentation, and Create Differentiated Products**

BYD's traditional cars now have a variety of models, such as buses, SUVs and cars. The diversification of models is conducive to covering a wider market. Therefore, BYD should use its strong R & D capability and integrated factory to develop and promote multi model new energy vehicles. Pay attention to the main consumer groups and ages of different models. For example, female consumers prefer small cars or compact cars, and family consumers prefer SUVs. Further optimize the appearance, interior and internal space of new energy vehicles for different consumer groups. Pay attention to the problems generally raised by consumers, such as heavy odor and loud noise, optimize the product performance, and create differentiated products to make them more meet the needs of consumers.

### **5.3. Reduce Production Cost and Change Price Strategy**

BYD can give further play to its own advantages, constantly make breakthroughs in R & D, improve the commonality of parts between traditional vehicles and new energy vehicles, scale production, reduce the production price of new energy vehicles, sink the market and expand the share of medium and low-end markets. BYD can also sell naked cars and develop new energy battery leasing business to further reduce consumers' purchase costs. Because the power battery needs to be rented, it can also avoid the embarrassment of long queuing time and increase customer stickiness.

### **5.4. Broaden Sales Channels and Innovate Marketing Mode**

With the popularity of the Internet, BYD should pay more

attention to online sales channels, improve the product content of online sales, such as the appearance, configuration, interior, battery and other information of new energy vehicles, provide timely and effective customer service services, establish O2O business model, online operation and offline sales. At the same time, it can cooperate with multiple e-commerce platforms to establish a complete online sales model. The marketing model can also make full use of the Internet, not only through advertising, but also through the soft text push of Wechat, Microblog and other social platforms to promote the concept of energy conservation and emission reduction, introduce new energy vehicles, help potential consumers know more about new energy vehicles, and achieve the ultimate goal of improving sales.

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