

Comparison Of the Electric Vehicle Industry in China and The United States - In Terms of Sales Volume, Policies, And Technology

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Abstract. In today's global warming environment, countries are trying to reduce their carbon emissions. One of the most accepted and effective ways around the world is to develop the electric vehicle industry. China and the United States, as the two largest economies in the world, the development of the electric vehicle industry in the two countries can be a reference for the world, especially in the context of China's first electric vehicle sales. In the United States, as an automobile power, the electric vehicle industry is also developing rapidly, and gradually catching up with the pace of China. Therefore, by comparing the sales volume, technology and policies of the two countries, this study analyzes the similarities and differences between the industry in the two countries, aiming to find ways to develop the electric vehicle industry in the two countries and even the whole world, and jointly contribute to solving the global climate problem.

Keywords: Electric vehicle; industry comparison; China and the United States.

1. Introduction

As two huge economic entities in the world, China and the United States are often pointed out for comparison. At the same time, in the context of global warming, the efforts made by the two countries to protect the environment are often discussed by the world. Once, both countries were auto powers. In China, since 2009, it has sold more vehicles than any other country in the world, with over 26.275 million units sold in 2021 [1]. However, in the total sales, the sales of new energy vehicles also accounted for a part. China's growing electric vehicle market may change the current climate and economic situation in China and even the world [2]. The same situation is happening in the United States too. As a country that has a hundred years of car industry development, the sales volume in the U.S. is also a scary number. At the same time, the U.S. also start to develop its electric vehicle industry, trying to catch up with China and achieve its carbon neutrality goal as soon as possible.

By comparing the development states of the electric car sectors in China and the United States, it is possible to study several phenomena and trends of national economic competitiveness and global economic growth. In today's rapidly developing modern society, where countries are very concerned about the issue of re-energy power generation and invest a lot of money and time, comparing the development status of the two nations and analyzing their future trend becomes even more important. China and the United States, the two largest economies in the world, have maintained a leading position in the electric vehicle industry. PEVs are seen as one long-term solution by the Chinese government to the social and environmental issues brought on by rapid motorization [3]. According to the Eleventh Five-Year Plan (2006-2010), the government started promoting alternative energy cars in 2006. In 2009, they introduced the Ten Cities, Thousands of Cars Demonstration Program [4]. Since then, as shown by regular high-level official comments, significant policy implementations, significant governmental and industrial investments, and large buying incentives, the institutional climate for PEVs has improved. As a result, the PEV market in China expanded after 2013, despite initial poor market penetration. Since 2015, China has been the world's largest market for electric vehicles. In the United States, the electric vehicle industry is also in full swing. With the support and encouragement of the federal government, the United States has also given birth to world-renowned brands such as Tesla, and various states have established more and more charging infrastructure.

China and the United States together account for 75 percent of the world's electric vehicle market. The analysis of the electric vehicle market in these two countries can provide a reference for other countries. At the same time, it will provide opportunities for the two markets to learn from each other and contribute to the world's environment together. The article is targeted to analyze the difference in the electric vehicle industry between America and China from four aspects which are sales, technology, customer preference and policy comparison. And the main question that is answered in this article is What are the parallels and divergences between China and the United States, the two biggest PEV markets in the world? The data and policies in the article are from official government websites.

2. Electric Vehicle Sales in China and the United States

2.1. Domestic Electric Vehicle Sales in China and the United States

The overall number of new energy passenger vehicles in China's 31 provinces in 2022 was 5.2331 million, more than doubling from 2.9034 million in 2021 and representing a significant growth of 80.24%. They had 3,974,400 pure electric passenger vehicle insurance policies, which made up 75.95% of the total; 1.25 million plug-in hybrid electric vehicle policies, which made up 24.05 percent of the total; and 140 fuel cell passenger vehicles [5]. The penetration rate of new energy reached 25.6% as well. In comparison to the United States, new energy vehicle sales from 2018 to 2020 remained at around 350,000, and their penetration rate stayed around 2%. In 2021, however, sales of new energy vehicles surpassed 680,000 for the first time, and their penetration rate rose to 4.4% in 2022. The United States' annual sales of new energy vehicles and their penetration rate demonstrated consistent efforts and once more experienced substantial growth. In 2022, the sales volume of new energy vehicles in the United States reached 992,000, close to the million mark, an increase of nearly 52%, and the annual penetration rate of new energy vehicles was 6.9%, an increase of 2.7 percentage points from 2021.

2.2. Export Electric Vehicle Sales in China and the United States

When compared to the level of roughly 1 million units in 2018–2020 and the first breakthrough of 2 million units in 2021, China's vehicle exports in 2022 of 3,111,000 units, an increase of 54.4%, the growth in 2022 is certainly more noticeable. Among them, China's new energy vehicles do even better on the global market; in 2022, new energy vehicle exports reached 679,000 units, a rise of 1.2 times year over year, accounting for 21.8% of all automobile exports, demonstrating robust and positive growth [6]. There is an interesting phenomenon China also exports electric vehicles to the U.S. Less than 10% of all vehicles exported to the United States in 2018–2020 were new energy vehicles from China, which was a modest proportion of the total. 533 new energy vehicles from China were exported to the United States in 2019, making up 1.3% of all vehicles exported to the country. But beginning in 2021, exports of Chinese new energy vehicles to the United States significantly increased, reaching nearly 18,000 in 2021, and exports exceeded 21,000 in the first three quarters of 2022, accounting for more than 30% of all auto exports to the United States. However, the data of export electric vehicle sales in the United States can not be found on the official websites or papers because the U.S. government did not publish the data. This sends us a message that the United States is exporting very few electric vehicles.

3. Innovative Technology for Electric Vehicles

3.1. Innovative Technology in China

In contrast to the long-standing shortcomings in core technologies like fuel vehicle chassis, engines, and gearboxes, Chinese automakers have made great strides in the last ten years in terms of core technologies like "three electricity" for new energy vehicles, and some technological fields now rank

among the top in the world. Drive motor technology is essentially in sync with foreign levels when it comes to new energy vehicle parts, and the majority of them are close to the international advanced level. Motor control is at the forefront when it comes to key technologies for core components. In the era of new energy cars, the rate of technological integration and evolution in the areas of intelligent networking and autonomous driving is rapidly quickening, and it has elevated Chinese automobiles to a prominent position. For example, between 2005 and 2021, China's new energy vehicles have 904 patents in the "Method and Device for Directly Converting Chemical Energy into Electricity" section, the highest part of all patent types [7]. However, there is insufficient innovation in core technology areas. The key factor influencing the development of new energy vehicles is battery technology, which is the fundamental technology used to power electric vehicles. Even though China's present research efforts are concentrated on electric energy, batteries, and electric, battery technology still have flaws in terms of performance, service life, and capacity. Due to China's late entry into the creation of new energy vehicles, there is a significant technological gap with other industrialized nations, and there are still significant issues with battery life, battery power, charging ease, safety, and other areas [7].

3.2. Innovative Technology in the United States

The United States seems to have more innovative technologies than China. Here are 5 representative technologies. Most exciting are the cost and performance advantages of solid-state batteries, although lithium-ion batteries, which have driven the industry, may already be included. The fact that NASA is involved in their research and development shows the importance of developing these components in the future.

Even if it still allows for the use of the phrase "single-pedal driving," this is by no means the main factor making it important. This highlights a few elements that make electric vehicles useful as daily transportation in addition to being a hallmark of the modern electric vehicle. Driving an electric car is, first of all, simpler as a result once you become used to it. The second benefit of regenerative braking is that it allows the driver to save a modest amount of energy while driving, which might be exploited by automakers to build even more energy-efficient passenger vehicles in the future. "Single-Pedal Driving" might, however, create certain safety risks.

Without the electric motor, electric vehicles (EVs) would not be possible. The electric motor, which has several benefits over the conventional internal combustion engine (ICE), is at the core of every car of the future. Benefits include no emissions, quieter operation, and lower maintenance expenses. When it comes to vehicle performance, electric motors offer nearly instant acceleration and more torque, making them more responsive than their counterparts with internal combustion engines.

Without thermal management, electric vehicles would not be able to travel the distances they do now. The observation results of Kalaf et al. (2021) on driving electric vehicles in winter show that the efficiency of the battery will be significantly affected by temperature [8]. What's more, to achieve such efficiency, electric vehicles will need to adapt to different climates around the world, which involves how companies can share their electric vehicle services globally.

An all-electric vehicle's battery functions as the central nervous system thanks to the electronics designed for such purposes, which have been developed over many years of development. Switches provide the energy for an EV, transmitting immediate messages to allow for speedy reactions between components.

4. Policies of Electric Vehicles

4.1. Policies of China

China's new energy vehicle policies can be classified into two groups: those that support the sector and those that encourage sales. The policies for the industry come first. The government provided direction on the growth of the industry in the official document Notice of The General Office of the State Council on issuing the growth plan for the New Energy Automobile Industry (2021-2035),

which was proclaimed in 2020. Just four of the most significant are listed below. The first and most crucial point is enhancing technical innovation potential. There are two primary points for the innovation part, to be more precise. Improve the degree of safety technology, such as battery management, charging connection, and structural design, as well as the overall performance of new energy cars by strengthening the development of vehicle integration technology. Additionally, strengthen the fundamental industrial capacity, which comprises the ability to conduct advanced basic processes, fundamental core components, fundamental key materials, and fundamental key technology research and development. The country will improve oversight and inspection of the maintenance of access conditions for businesses and support the survival of the fittest by deepening the industrial management reform, which is the second step. Giving full play to market forces, encourage rival businesses to merge and reorganize in order to become bigger and more powerful, and further enhance industrial concentration. Thirdly, improve the development of skilled workers. The future success of an industry is sometimes determined by top personnel. In order to satisfy the demands of the integrated development of new energy vehicles and allied sectors, the government will quickly establish a talent training system. It will also prepare a list of skills that are in short supply in the sector, in order to increase the talent in the electric vehicle industry. Strengthening intellectual property rights protection is the fourth point. The government will fully implement the national intellectual property strategy, support researchers in the development of valuable core intellectual property in the area of new energy vehicles, strictly enforce the intellectual property protection system, and step-up law enforcement against intellectual property infringements [9].

The government must encourage sales of electric vehicles through a number of preferential programs before they become a popular choice among consumers. It may be argued that the year 2014 serves as an excellent example of this demand-pull phenomenon since electric vehicle sales growth picked up that year [10] after major incentives were established and made available to both fleet customers and private consumers. The purchase of new energy cars has been excluded from vehicle purchase tax since September 2014, and the policy was twice further extended in 2017 and once in 2020 and 2022. The total amount of tax exemptions provided by the aforementioned regulations will surpass 200 billion yuan by the end of 2022 [11]. Additionally, a national incentive for the development of charging infrastructure for electric vehicles was announced in November 2014, prompting local governments to become more active in the building of charging facilities to ensure security for the rapidly increasing sales of electric vehicles [12]. Moreover, Subsidizing consumers who purchase electric automobiles is one of the most effective strategies for boosting sales of electric vehicles. The subsidy varied from 35,000 to 60,000 when the policy was first launched in 2013. Subsidies have largely boosted sales of electric cars. However, this policy ended at the end of 2022.

4.2. Policies of the United States

The United States develops incentive policies based on sales volume and industry, just like China does. According to recent rules, the United States' policies for electric vehicles are more concerned with early-stage manufacturing than they are with sales volume. Starting with the regulations that support the sector, the American government has long supported the use of hydrogen energy, power batteries, and automobiles. Consider the Advanced Technology Vehicles Manufacturing direct loan program (ATVM), which was established by the U.S. Department of Energy following the financial crisis. Up to this point, the project has collected a loan balance of 16 billion US dollars, of which 8 billion have been invested directly in the manufacturing sector, including Tesla, Ford, Nissan, and other companies [13]. The goal is to assist in the production of cutting-edge automobiles and parts in the United States. Additionally, the U.S. government proposed investing \$17.40 billion on March 31, 2021, to promote the growth of the domestic electric vehicle market, primarily to strengthen the domestic industrial chain.

In 2022, the United States also started providing tax credits for new energy cars, with a number of requirements. These regulations, however, have requirements. Included in them are an extra \$4,500 tax credit for new energy vehicle manufacturers that join the United Auto Workers union, a \$500 tax

credit for manufacturers of American-made batteries, and another rule known as the section 30D credit amount. The IRA modifies the formulas used to determine the credit amount. The section 30D credit amount was previously based on the vehicle's battery capacity before the section 30D changes. Up to a maximum credit of \$7,500 per vehicle, the base amount is \$2,917 for a battery with a capacity of at least 5-kilowatt hours [14]. Examining these policies; the United States likely adopted them to boost both the sale and the production of electric vehicles. Batteries must be made locally since there are requirements for automakers and consumers to receive subsidies or tax breaks, for instance. Therefore, these policies also support domestic industry.

5. Conclusion

Overall, the paper mainly compares the electric vehicle industry of the two countries in terms of sales volume and technology. The first is the comparison and reason analysis of sales volume. At present, no matter the domestic sales or export sales, the number of China far exceeds the number in the United States. It seems like the United States still needs a long time to run after China. There are some reasons for this. Firstly, the policies in China and the United States have some differences. The fact that many purchase subsidies in the US take the form of tax credits makes it more challenging for consumers to deduct them from their income. The Chinese government offers speedy rebates to PEV makers as subsidies, directly lowering prices for consumers. Therefore, Chinese customers are more accessible and willing to promote electric vehicle sales. However, due to the regime of the United States, their policies are not very sustainable. For instance, when Biden took office, the government was just beginning to formulate policies on subsidies. Therefore, the policy implementation time is far behind that of China. Secondly, the national conditions of the two countries are different. The United States, which has the name Nations on Wheels, indicates that cars are necessities for every family. Due to the huge area of the country, most Americans travel by car. Thus, they need some stable vehicles. However, electric cars always have to charge after a long journey, and it takes longer time than traditional cars. Therefore, most Americans prefer fossil cars. However, in China, due to the convenient metro and high-speed railways, they always drive for short distances. Electric vehicles seem more suitable for them. From the point of view of science and technology, the author believes that the United States has more scientific and technological achievements than China. First of all, from the policy perspective, the policy formulated by the United States is more inclined to promote the technological development of the industry, while China is more inclined to promote sales. Secondly, the United States has nearly a hundred years of automobile development history, and mature fuel vehicle technology can be easily applied to new energy vehicles. China's industry started late, so it is not as good as the United States. In conclusion, the study aims to help the two countries learn from each other, draw on each other's strengths, and jointly contribute to the global environment because the increasingly serious climate problem has become a global problem. Although the U.S. makes many efforts to improve its electric vehicle sales, it still will not develop as well as China since its policies are not mature. However, improving innovative technology is still the main goal in the future for these two countries.

References

- [1] CAAM. A brief analysis of the economic operation of the automobile industry in 2021 [EB/OL]. (2022-01-12) [2023-08-07]. <http://en.caam.org.cn/Index/show/catid/44/id/1833.html>
- [2] Wang Yunshi, Teter J, Sperling D. China's soaring vehicle population: even greater than forecasted. *Energy Policy*, 2011, 39(6): 3296-3306.
- [3] Hao Han, Ou Xunmin, Du Jiuyu, et al. China's electric vehicle subsidy scheme: Rationale and impacts. *Energy Policy*, 2014, 73: 722-732.
- [4] Xu Lei, Su Jun. From government to market and from producer to consumer: Transition of policy mix towards clean mobility in China. *Energy Policy*, 2016, 96: 328-340.

- [5] Zhen Xueqin. China's new energy vehicle sales in 2022. *Automobile crossbar*, 2023(3): 104-107.
- [6] Finance and Economics. The evolution of the pattern of electric vehicles in China, the United States and Europe in 2022: the new energy era under the comprehensive competition of sales volume, growth rate and penetration rate [EB/OL]. (2023-01-23) [2023-08-07]. <https://finance.sina.com.cn/tech/roll/2023-01-30/doc-imycxwqu7029778.shtml>
- [7] Wang Jin, Zhang Yarui, & Chen Sisi. The status quo, problems and countermeasures of China's new energy vehicle technology innovation. *Enterprise technology and development*. Enterprise technology and development, 2022(7): 20-22.
- [8] Kalaf O, Solyali D, Asmael M, et al. Experimental and simulation study of liquid coolant battery thermal management system for electric vehicles: A review. *International Journal of Energy Research*, 2021, 45(5): 6495-6517.
- [9] General Office of the State Council. Notice of The General Office of the State Council on issuing the Development Plan for the New energy automobile Industry (2021-2035) [EB/OL]. (2020-10-20) [2023-08-08]. https://www.gov.cn/zhengce/content/2020-11/02/content_5556716.htm
- [10] Li Zhi, Fan Hang, Dong Shuyan. Electric Vehicle Sales Forecasting Model Considering Green Premium: A Chinese Market-based Perspective. arXiv preprint arXiv:2302.13893, 2023.
- [11] The Xinhua News Agency. The Ministry of Finance and other three departments issued a document exempting the purchase tax of new energy vehicles [EB/OL]. (2014-08-06) [2023-08-08]. https://www.gov.cn/xinwen/2014-08/06/content_2731129.htm
- [12] Ministry of Finance Website. Notice on the construction of new energy vehicle charging facilities [EB/OL]. (2014-11-26) [2023-08-09]. https://www.gov.cn/xinwen/2014-11/26/content_2783831.htm
- [13] Loan Program Office. ADVANCED TRANSPORTATION FINANCING [EB/OL]. (2007) [2023-08-09]. <https://www.energy.gov/lpo/advanced-transportation-financing>
- [14] Internal Revenue Service. Section 30D New Clean Vehicle Credit [EB/OL]. (2023-04-17) [2023-08-09]. <https://www.federalregister.gov/documents/2023/04/17/2023-06822/section-30d-new-clean-vehicle-credit>