

A Comparative Study of the Development Trends and Competitive landscape of the Electric Vehicle Market in China and the United States

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Abstract. This paper will perform a comparison of the Electric Vehicle (EV) markets in China and the United States, focusing on the patterns of development and the competitive environment. It examines issues such as legislation updates, infrastructure investments, market expansion, and the strategies of leading car makers. China has shown electric vehicle adoption through aggressive public investments in charging infrastructure, large subsidies, and strong support for its local manufacturers like BYD and NIO, via their centralized government-led strategy. Without a doubt, it is China that holds the key to the current worldwide electric vehicle market. In contrast, the U.S. proposes a decentralized structure, with a mixture of federal tax encouragement, state-level programs, and private-sector advances as illustrated by Tesla's leadership in electric vehicle technology. Despite the considerable federal funding for charging infrastructure, the U.S. still trails China, as far as both EV sales and the scale of infrastructure, are concerned. This paper showcases the electric vehicle technological development patterns observed in both countries with their impacts on the energy transition globally.

Keywords: Electric vehicle, technology, market, policy.

1. Introduction

The global transition to introducing NEVs, especially EVs, into the global automotive industry can be seen in societies with problems of climate change, urban air pollution, and energy security. Among the key players of this shift are China and the USA, with different automotive market histories and ways of approaching the EV development process. Letting them unveil their ways provides us with the principles of green-oriented development and the near future of the industry.

Policies proposed to maintain China's position as the world's biggest automobile market include incentives for NEV adoption through government funding, investment in infrastructure, and research support [1]. As of now, approximately two-thirds of the global share of electric vehicles comes from the nation, as China's contribution for the year 2023 was observed to be substantial: 60% [2]. Both rural areas and metropolitan areas drive the demand.

While US innovation companies like Tesla turned the tide and changed people's ideas on EVs, in the US, more Electric Vehicles are driven for public transportation than personal use. US environmental policies such as tax credits and green regulation resulted in the EV boom, but the supply was not enough to respond to the increasing demand in China. This is attributed to disparities in infrastructural development as well as the difference in people's tastes and preferences as consumers. The American car industry draws attention through high standards of performance as well as through the development of the most advanced technologies like for instance, self-driving vehicles.

This paper aims to look at the developing trends and competitive methods by the second largest power of China and the strongest power of the US, to find out the social, economic, and political impetus that are the key drivers to their different rates, scale, and pace of EV development. This will lead to the examination of market segmentation, the actors, and the government participants that consequently ascertain the impact these two countries have on the global EV market and the outlook of eco-mobility.

2. Analysis of China-US Electric Vehicle Market Development Trends

2.1. Policy Environment

The hybrid policy of the US federal and state governments has initiated several efforts to amplify the clean energy agenda and reduce greenhouse gas emissions, which have, in turn, impacted positively on the EV situation. The recent 2022 Inflation Reduction Act at the federal level has significantly bolstered the EV market by providing an EV consumer tax credit of up to \$7,500 [3]. The aim of these is to drive purchases, especially of locally produced EVs, which makes them the driving force of market growth. Apart from the federal tax credits, the EPA has also enforced strict emissions norms, which beseech automobile manufacturers to come up with models that are more fuel-efficient, including EVs. On the other hand, the federal government has also been involved in the strengthening of the charging infrastructure through the provision of grants such as the Bipartisan Infrastructure Act, which included \$7.5 billion to construct a nationwide network consisting of 500,000 stations meant for charging electric vehicles.

On the other hand, the state policies may differ significantly. California has led other states in this aspect by providing state tax credits setting up zero-emission vehicle (ZEV) regulations and reviewing to phase out gasoline cars by 2035. The Advanced Clean Cars Act of the California state, together with the same regulations of other states, has played a significant part in the increase of electric vehicle sales, promoting innovation in clean technologies, and attracting investments.

China has a strong intervention-oriented policy system, which emphasizes the importance of this sector and helps to accelerate the adoption of electric vehicles, thus becoming the biggest market in the world for them. The NEVs scheme, which the central government has developed, makes manufacturers eligible for a large amount of subsidies, and consumers also can earn cash rebates of up to \$1,000 [4]. These, together with the tax breaks and policies that favor electric vehicle registration, are significant in reducing the initial cost of buying an electric vehicle in China. Besides the two, the Chinese government has also set ambitious fuel efficiency standards and NEV adoption goals of slightly above 40% of total car sales by 2030. Furthermore, China has significantly invested in infrastructure to make achieving this target possible, with the installation of 5 million electric vehicle (EV) charging points, of which the majority were enabled through public-private partnerships (PPP), expected to be completed by the end of 2023 [5].

In the same way, the allocation procedure of the Chinese government is directed towards financing domestic EV manufacturers through its research and development programs and granting of exclusive trade privileges. The ability in this respect has helped manufacturers such as BYD and NIO to rule the local market while expanding their operations across borders.

Comparison: While the USA and China provide financial and regulatory support for the expansion of electric vehicle use, China does this more focused and interventionist, with the government directly involved in setting the market with subsidies, mandates, and infrastructure investments. On the contrary, the policy setting in the US is nationally more partitioned, with federal policies being augmented through initiatives on the state level. The USA strategy brings about the consumer tax credit and private sector innovation, whereas China's approach is developing rapidly and through carmakers creating supportive infrastructure. In comparison, both strategies are helping the automotive sector to grow exponentially, and the presence of major state involvement of the Chinese has placed it ahead in terms of market share of electric vehicles and infrastructure development as compared to the USA.

2.2. Infrastructure

China and the United States diverge in their strategies for the development of electric vehicle (EV) infrastructure, China being the leader in both the magnitude and the degree of innovation involved. After 2023, China's goal is to install more than 5 million public and private charging points, with a particular understanding of DC fast chargers to stimulate long-distance traveling. The Chinese government has played the most important role in this regard, being the main driving force in the

cooperation with state-owned enterprises and private companies to ensure coverage in each nook and corner of the urban and rural areas. More importantly, China has been the first to introduce battery swapping stations, which enable drivers to have the batteries replaced by fully charged ones in no time, and that contributes to the process of the further expansion of EVs in the country. In contrast, the US has a meager EV charging network, with only 160,000 public charging stations available. The infrastructure development in the US is now being led by private players like Tesla, ChargePoint, and Electrify America, along with the recent federal initiative and the Bipartisan Infrastructure Law, which sets a target of installing 500,000 public charging stations throughout the country by 2030. Unlike the US, which relies much on the private sector, China has made a breakthrough by using the government-led strategy and has far surpassed the US in the number of EVs produced and sold and the size of the EV market.

2.3. Technological Innovation

Though both countries have achieved a lot in this sector related to electric vehicle (EV) technologies, the specific areas in which each one has reached a breakthrough point are, however, different. In addition, the fact that China is now a leader in this field, with manufacturers such as CATL, which produces cost-effective, high-energy-density lithium-ion batteries, gives the country a further advantage [6]. The second was the battery-swap technology that NIO designed for those who own electric vehicles. US players, including Tesla, which is on top of the industry, feature their products as high-performance, typical of technological innovations such as the 4680-battery cell, which has advantages like density in energy, the charge speed, and the car's mileage.

With regards to the technology of drive systems, what BYD has done is apply efficient and economical machines for the common masses, while Tesla concentrates on the creation of designs of high-performance motors, which are regarded as the fastest car in the world, which is a production model, with its "Plaid" powertrain called electric efficiency [7]. There are intelligent and autonomous driving technologies emerging so fast that even the two countries I am mentioning have already noticed it.

China's model looks for highly developed V2X (vehicle-to-everything) communication combined with Intelligent Transport Systems (ITS) for smart rich cities, while in the US, this position goes to the development of technologies for autonomous driving, where the leader is Tesla Inc. with its Autopilot and Full Self-Driving software, which rely on the latest AIs and sensors integration [8].

2.4. Market Demand

EV sale figures in China and the U.S. indicate the circumstances in their respective countries and consumers' preferences. In China, the main factor contributing to the explosion in demand is the government's aggressive policies, such as subsidies, preferential tax rates, and regulatory incentives, which have put this country at the forefront of global EV sales. It accounted for approximately 60% of all EV sales worldwide in 2023. Chinese customers, particularly in cities, are fond of affordable and compact EVs that can be produced by domestic brands (such as BYD and NIO) thanks to restrictions on cars powered by gasoline and the evolving awareness of ecological issues. Meanwhile, the demand for EVs in the U.S. is progressing gradually, and consumers are focusing on such attributes as spaciousness, long-distance range, and high performance, which are to a larger extent driven by suburbanization and the long-distance driving culture. With Tesla building its brand around tech-savvy and high-end consumers, this is meaningfully shaping U.S. demand. Though the adoption is mainly in California and other selected states, the like of the Inflation Reduction Act president of the United States on a federal level intends to increase demand. The price of EVs is also relatively high, and the pace of the construction of charging stations in rural parts is slow, which remains a concern. In the end, China is focusing on price and government automation while the U.S. wants to dictate the market and is innovative.

3. Analysis of the Competitive Landscape of the Chinese and US Electric Vehicle Markets

3.1. Competitive Strategy

The different parameters of Chinese and U.S. corporations determine the way these companies organize their strategies, with the result that the competition in the electric vehicle (EV) market could be characterized by the nature of the different markets and the different systems of market arrangement.

In China, many initiators from local brands that stand out with their increased global performance are very active. Top brands in this category are BYD, NIO, Xpeng, and Li Auto – they all place accentuation on the cheapness, mass production, and technology integration. In China, efficient mass market production supported by government subsidies and investment in infrastructure is the strength behind the declining price of mass production and, to an extent, through favorable trade policies. The Chinese producers underscore the battery efficiency, which could include innovations like CATL's lithium-ion batteries or other types of vehicle batteries (such as those used by Baidu's battery technicians). Besides, they develop the full cycle of EVs, including the swap board and expanding charging stations at different points. Besides, Chinese automakers have started looking abroad as they use their low prices to stir Western brands in the Chinese market and abroad.

Collaborations with technology companies such as Huawei and Baidu, as well as highly recognized brands like Changan and Geely, confirm China's strength, especially in smart car and autonomous driving technology. These companies gain from advanced technologies as well.

Though the sector in the United States is an oligopoly only with one manufacturer – Tesla – companies like General Motors and Ford are still competing equally by modifying a wide array of electric vehicles in their product ranges. The Tesla model revolves around high-end services, cutting-edge battery technologies developed by its own and other manufacturers, and the in-house production of cars' batteries and self-driving systems, along with their self-driving bikes. The main novelty with Tesla lies in the incorporation of a self-driving vehicle, especially with the automaker's addition of Autopilot and Full Self-Driving, which must be compared with the traditional U.S. market, which has a new level of self-driving cars. Instead, the legacy automakers, Ford and General Motors, prefer a hybrid approach of mixing the trust the brands enjoy on the market with making electric vehicles, such as the Ford Mustang Mach-E and the General Motors electric Silverado and Hummer.

In the US market, the segment of EVs considered premium is also gaining share. Brands occupying a position there include the ones that add luxury, driving performance, and technology facets to their EVs to closely contact eco-aware tech lovers.

3.2. Market Structure

Electric vehicles (EVs) in China and the US have different government policies, consumer preferences, and competitive dynamics resulting in different market structures. The EV market in China is fragmentary and boasts many domestic brands, for example, BYD, NIO, Xpeng, and Li Auto. Without government backing, this process would be slow and difficult, but with strong support from the government, it is possible, through the use of subsidies, tax incentives, and investment in charging stations. These regulations have made a start to the quantity production and widespread consumption of electric vehicles, which in turn has helped China to emerge as the world's top producer of electric cars. In 2023, the majority of global electric vehicle consumption replicates the trend of urban cities and small-town consumers, more concerned about prices and practicality. Local car manufacturers produce affordable compact EVs, which makes EVs available for everyone. Though, with the emphasis on affordability as well as battery technology innovations like NIO's battery-swapping technology, and improvement in its infrastructure, China managed to decrease the commercialization time to make it more competitive. China saw foreign enterprises like Tesla getting their hands dirty by localizing production, which took China's population size base advantage and proved beneficial for them.

In the US, Tesla, as the market leader, has created this image that the electric vehicle is now about performance, long-range, and innovative features such as self-driving capacity. The traditional automakers, spotlighting General Motors (GM) and Ford, grow their production of electric models like the Ford Mustang Mach-E and the GM Hummer EV. Nevertheless, the United States' market has less impact by the way of government interventions with growth being dependent on State policy facilitations, Federal Tax credits, and consumer interest than in the case of the Chinese market. The US incentive base is also more strongly tilted toward larger, high-performance EVs used for long-distance travel and common in suburbs, showing the US geography and driving conditions.

Comparison: China's EV market is characterized by high competitiveness and heavy public administration with many local firms pursuing enterprises in this sector that have the support of subsidy policies to enhance production and innovation. However, on the U.S. side, a different picture is seen where the market is concentrated and Tesla is the market leader for the current and future markets while traditional automakers continue to gradually increase their EV presence. While the US is smarter in EV's high-end models and technological integrations such as automation, China aims at the contrary: getting prices low and making it easy so that as many people as possible make use of them. Even if both markets are rapidly optimizing and increasing their market share, China gives ahead with the support of the government and attention to infrastructure which brings about speedy development of its EV industry as compared to the US.

4. Conclusion

The main differences in the electric vehicle (EV) markets in China and the United States are the specific government interventions, market structures, and consumer demands, which will conclude with. The Chinese player is motivated by stringent government policies that breed a competitive environment dominated by local automakers like BYD and Nio, with cost-conscious customers and rapid infrastructure development. Alternatively, the US market is more distributed and has Tesla and other manufacturers converting to EVs, while Toyota is more performance-oriented and niche, favoring less government intervention.

The model also suggests that the two countries would benefit from increasing the effectiveness of their respective infrastructure and policy frameworks to facilitate the switch to greener energy sources. In China, further investment in charging infrastructure, especially in rural regions, and the continuous innovation in battery technology should help to sustain its rightful place at the forefront of the green car revolution. The United States can most likely boost EV adoption by enlarging federal aid, strengthening the necessary charging infrastructure, and fostering the creation of more affordable models so that the sale would cover a broader market segment. In turn, both countries should partner with tech companies to achieve the development of self-driving technologies as well as a smart mobility environment.

Down the road, the worldwide EV market will probably see tight competition, with both the U.S. and China trying to preserve their front rank. China enjoys the strength to hold a global bulk EV market due to its advantage in cost and choice of export markets. The US, however, is much behind the pack regarding mass adoption, though it is probably the one that would lead first in advanced technologies like autonomous driving and battery innovation. This is all while the two markets are enlarging, the global automotive industry will see more speed toward sustainability, and electric vehicles will be at the center of the well-deserved future of transportation.

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