Comparing the Current Status and Development Trend of New Energy Vehicles in China and the United States.

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Abstract. The development of new energy vehicles is mainly based on the research on energy conservation. With the continuous progress of science and technology, new energy vehicles have been highly valued in the field of technology improvement. Especially in the current environment, with the increasing tension of oil resources and the increasingly prominent environmental problems, new energy vehicles, due to their high environmental friendliness and the cleanliness of power sources, have gradually come into people's view. It has aroused extensive concern of researchers in various countries. At present, new energy vehicles are in a period of promising development prospects, attracting the attention of countries all over the world, and many countries are competing to join this ranks. Based on the prediction of its future development direction, this paper focuses on the policy and development overview of new energy vehicles in China and the United States, analyzes and summarizes the current research status of new energy vehicles, and looks forward to their future development.

Keywords: New energy vehicles; Current policy; Development profile.

1. Introduction

According to some statistical data, there are more than 20 billion tons of harmful emissions in the world. Air pollution from fuel-led vehicles accounted for about 40% of total urban air pollution, and up to almost 90% in some cities [1].

The automotive industry is facing a severe challenge in today's world of energy crises and environmental problems. The birth of new energy vehicles (NEVs) has made up for the shortcomings in the development of low-voltage electric vehicles and completely reflects the focus of international attention on global environmental protection. To seize the market opportunity, many countries are scrambling to invest in research and development, almost regardless of the cost, using all available resources. The search for "green cars" with little or no environmental impact has become a basic national policy and a necessity for sustainable development [2]. The number of NEVs is growing rapidly in all markets and is estimated to continue to grow until 2023, as evidenced by the 1.9 million battery NEVs in use worldwide in 2017 [3].

NEVs are crucial to China's efforts to achieve its policy for sustainable development. It decreases air pollution in addition to the use of fossil fuels. The Chinese government has promised that by 2020, CO_2 emission per unit of GDP will be at to 45 percent lower than it was in 2005. At the moment, coal-fired energy generates 78.1% of total power. New and renewable energy sources only account for 9.4% of primary energy consumption. Non-fossil energy is predicted to generate 30% of the electricity produced and make up 11.4% of primary energy consumption by 2015. Lowering carbon emissions will result from the development of the NEV and improvements to the energy and electrical infrastructure [4]. NEV sales volume and annual growth rate both increased significantly in China between 2006 and 2013. 17.64 thousand NEVs were sold in 2013 after a sharp increase in sales since 2009 (see Fig. 1).

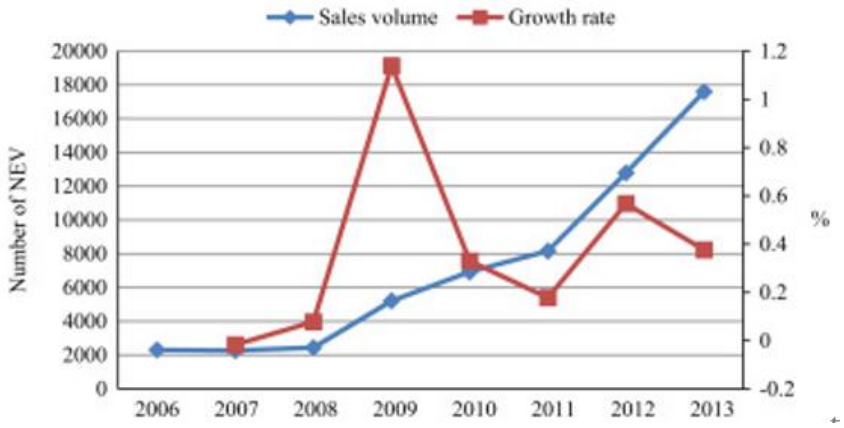

Fig 1. NEV sales volume and yearly growth rates in China throughout 2006 and 2013.

Grants from the Department of Energy totaling $2.4 billion were included in the 2009 US economic stimulus package to "accelerate the manufacture and deployment of the next generation of US batteries and electric cars." [5]. Furthermore, in the US, California and ten other states have adopted Zero-Emission Vehicle (ZEV) standards that require electric vehicles to account for a minimum percentage of passenger car sales. Similarly, twelve states in the Northeast and Mid-Atlantic regions of the US have committed to implementing a cap on CO_2 emissions from the transportation sector. Federal and state governments have also introduced rebates and tax credits to encourage consumer purchases of NEVs [6].

This study offers a thorough analysis and comparison of the present state of new energy vehicle (NEV) development in China and the United States, which may be used as a guide for NEV development in the future.

2. Chinese new energy vehicle descriptions

As China's automotive industry continues to develop, oil consumption is gradually increasing and the amount of oil extracted domestically is not sufficient to meet the country's product development.

In the Twelfth Five-Year Plan, it was proposed that the oil dependency should be kept within 61%, but data shows that in 2013, the oil dependency reached 58.1%. In addition, the development of the automotive industry has had a serious impact on the Chinese ecological environment, so China has stepped up its efforts to develop NEVs.

Electric vehicles have surpassed all other new energy vehicle types in popularity in China during the past five years. Sales of electric cars in China climbed significantly from 468,000 units in 2017 to 2,734,000 units in 2021, growing at a CAGR of 55.47%. Sales of EVs in China are anticipated to increase further, reaching 3.78 million units in 2022 (see Fig. 2).

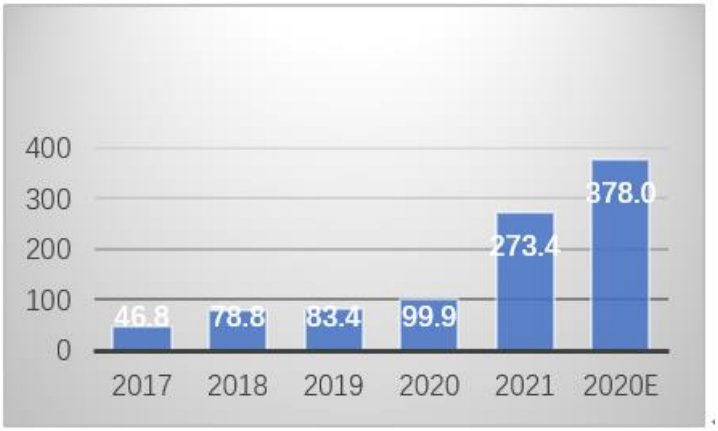

Fig 2. Sales forecast trend chart of China's electric vehicle market from 2017 to 2022. (Unit: Ten thousand).

Although the new energy vehicle industry has been fully developed with the support of the government, there are still certain gaps compared to foreign new energy vehicle industries, and many problems have not been fundamentally solved.

One of the biggest issues facing the worldwide NEV business is technology. One example is China. "Admission Management Rules for New Energy Auto Manufacturing Businesses and Products" was released by MIIT in June 2009. The Early Stages, Developmental Stages, and Maturity Stages of technological newcomer development are defined by this rule. This is dependent on the amount of industrialization, the accompanying systems and essential assembly technologies, the development of national and industry standards, and the technological maturity of the final NEV [4].

2.1. China's NEV development policy framework

2.1.1. Industrial policies

In order to regulate a certain sector, the government develops a set of legislative tools known as industrial policy. Industrial policy tenets will direct future industry growth. The three main industrial policies related to NEV are "The Guideline Catalogue for Industrial Restructuring," "Development Policy of the Automobile Industry," and "Options for Accelerating the Development of Energy Conservation and Environmental Protection Industries." Over a long period of time, these industrial policies provide the NEV with macroeconomic recommendations [4].

National policy on new energy electric vehicles: The current state support for the consumers of new fuel-efficient vehicles can be summarized in general in the form of monetary subsidies, tax relief and rights-of-way in the form of permits.

The policies would be implemented from February 12, 2018, with a transition period from February 12 to June 11. New energy trucks and special purpose vehicles would be subsidised at 0.4 times the previous corresponding standard, and the subsidy standard for fuel cell vehicles would not change. These subsidies would apply to new energy passenger cars, new energy buses, and new energy trucks that are licenced during the transition period. The central government will pre-allocate funds on a quarterly basis and liquidate them on an annual basis in addition to distributing the money for the subsidies to the manufacturers of new energy vehicles. The producer would make an application for the advance distribution of subsidy monies to the finance, science, and technology partition of the country where the company is registered at the end of each quarter after the sale of the goods. After organising the audit, the four ministries and commissions would pre-allocate the subsidy funds to the appropriate businesses. The subsidy funds would be distributed in accordance with the verification findings at the end of the year.

2.1.2. Development Plans

The "New Energy Vehicle Industry Development Plan (2021-2035)" was published by the General Office of the State Council on November 2, 2020. According to the plan, major improvements in key technologies, including drive motors, power batteries, and vehicle operating systems, will be made by 2025, increasing the market's competitiveness for new energy vehicles in China. Safety standards will also be substantially raised. 20% of all new vehicle sales will be made up of new energy cars, only a few specific places and use cases will see the commercialization of highly autonomous vehicles, and the convenience of charging and switching services will be much improved. 12.0 kWh/100 km will be the new pure electric passenger cars' average power usage.

2.2. Challenges

As an emerging industry, NEVs face several challenges in industrialization and social acceptance, although the Chinese government and efforts by the Chinese government and automakers [4].

2.2.1. Market factors

Relevant polls reveal that consumers are accepting of new energy vehicles the volume of the corresponding promotion changes depending on how well new energy vehicles are received. Additionally, there are notable distinctions, with residents in premier cities being more First-tier cities

have substantially greater levels of adoption of new energy vehicles than other county-level cities. The elements that influence this circumstance are examined in the paragraphs that follow. An investigation of the variables causing this is provided below [7].

Due to market circumstances, new energy vehicle development varies by location. However, because first-tier cities have more comprehensive charging infrastructure, lax new energy vehicle licensing requirements, and stronger after-sales support, new energy vehicle promotion is generally favourable [7].

A new energy car costs more than one that uses ordinary petrol. A new energy vehicle is more expensive than a conventional gasoline vehicle. When financial incentives are not present, new energy vehicles are frequently passed over since they are more expensive than conventional fuel cars for the same equipment.

2.2.2. Technological challenges

In the process of developing new energy vehicles in China, certain core components and key technologies are not yet systematically mastered and are usually based on traditional models, so the products do not have a high level of maturity.

2.3. Development Trend

Given the current environment, the three main development trends of new energy cars in the future will be pure electric vehicles, hybrid vehicles, and fuel cell vehicles. The technical foundation for new energy and energy-efficient cars is presently in place in China. Future development will primarily be focused on the formation of independent and autonomous intellectual property rights, a full R&D system, and the gradual shift from small-scale production to large-scale industrialisation [2].

3. Description of new energy vehicles in the USA

For much of its history, the US car market has been driven by demand for large displacement, space, and comfort. However, with the popularity of cars, the US government has gradually realized that the problems of energy consumption and pollution caused by road traffic cannot be ignored, and the US federal and some state governments have begun to focus on the development of electric vehicles to improve the international competitiveness of the US automotive industry. Support for electric vehicles in the US peaked during the Obama administration but support has fallen sharply since the Trump administration took office [8].

3.1. The legal foundation for NEV development in the USA

As a typical federal state, the US has a great level of autonomy when it comes to the creation of laws and policies across a variety of fields.

State governments have a great deal of autonomy when it comes to forming laws and policies in many different sectors, and they do so in accordance with their own unique natural and industrial resources as well as their own demands. As a result, policies differ greatly from one state to the next. This article primarily introduces the electric car policies at the federal and California levels because California is the leading state in the United States when it comes to the promotion of electric vehicles and has a very robust support system.

3.1.1. Industrial policies

Los Angeles, California, had a number of periods of photochemical haze from the 1940s through the 1970s that gravely endangered the city's environment and citizens' health. In order to address air pollution, the State of California has enacted strict vehicle emission and fuel economy regulations and prioritised the development of clean fuel technologies as well as low- and zero-emission cars. As a result, the California government supports the use of electric vehicles in a number of ways, including the implementation of zero-emission vehicle credit management regulations to encourage automakers,

financial subsidies to lower consumer purchase costs, transportation differentiation, and support for the development of charging stations to maximise their use. Zero-emission vehicle credits.

By requiring automakers to sell a certain percentage of zero-emission vehicles and permitting credit trading, the California Zero Emission Vehicle Act compels them to push zero-emission automobiles. First, some plug-in electric vehicles are treated as zero-emission vehicles, while others are not. BEVs and fuel cell vehicles (FCEVs) are transitional zero-emission vehicles (ZEVs) and have a lower credit value; PHEVs that meet the comprehensive tailpipe and fuel evaporation emission standards are ZEVs. The second requirement is that producers of conventional fuel vehicles must have zero-emission vehicle credits if their sales volume reaches a particular threshold (see Tab. 1).

Tab 1. California zero-emission vehicle credit calculation method and credit proportion requirements.

	ZEV		TV		
Single car points value	R<50 miles (approx. 80.5km)	R≥50 miles	R<10 miles (approx. 16.1km)	R>80 miles (approx. 128.7km)	R between 10 to 80 mph
	0	0.01 x R + 0.5. The upper limit of 4 points	0	1.1	0.01 x R+0.30
Points percentage	The percentage of credits will gradually increase from 2018 to 2025, and car manufacturers should achieve 4.5%, 7%, 9.5%, 12%, 14.5%, 17%, 19.5%, and 22% of annual sales of conventional vehicles respectively for zero-emission vehicle credits.				

·Purchase subsidy policy

The Clean Vehicle Rebate Project (CVRP) has been in operation in California since 2010. First, an electric car grant is provided at a predetermined cost based on the kind of vehicle. The subsidy is dependent on the kind of vehicle power and is provided on a first-come, first-served basis for electric cars up to 8,500 pounds in weight. The second is to put equality first by distributing different amounts of subsidies for different income groups and consumption objectives [8].

·Traffic policy

High occupancy vehicle lanes (HOV lanes), sometimes known as carpool lanes, are a traffic management strategy that discourages and promotes carpooling by limiting access to cars carrying more than two (or three, counting the driver) passengers.

·Charging policy

California offers businesses and consumer’s tax breaks and financial incentives to build and use charging infrastructure.

3.1.2. Development Plans

The US Department of Energy launched the "Blueprint for Electric Vehicle Adoption Program" in January 2013, a ten-year plan to boost the marketability and cost-effectiveness of electric cars. In order to participate in research and development, the U.S. Department of Energy established the "Recell" battery recycling center in 2019, as well as Oak Ridge National Laboratory, Algonquin Laboratory, and other research institutions and several industry chain enterprises. This was done by promoting closed-loop recycling to encourage the recycling of used battery materials in order to ensure the security of resource supply.

3.2. Challenges

3.2.1. Market factors

The 2030 aim of 50% new zero-emission vehicles is an extremely difficult number given the peculiarities of the US automotive business.

The objective of 50% of new vehicles by 2030 is a very difficult number that exceeds current forecasts by key agencies. Mid-size SUVs and trucks, which make up the majority of US sales, must be improved to reach this objective.

Mid-size SUVs and pickups, which make up a sizable portion of vehicle sales in the US, will need to be heavily electrified to meet this target.

According to certain data, in 2021 in the first half of the year, 270,000 new energy vehicles were sold in the US, representing a penetration rate of about 3%. This is significantly lower than the penetration rates of new energy vehicles in China and Europe, which are respectively about 10% and 16%, and even lower than the 6% global average.

According to the market, US buyers like SUVs, pickup trucks, and small, fuel-efficient vehicles. Around 70% of all households have 1-2 cars, with trade-ins being the most popular demand. With cheap petroleum, moving to an electric vehicle won't likely result in significant reductions in consumer costs. Instead, customers could have range anxiety, a lack of charging stations, and other typical issues with new energy cars. It is unlikely that the cost of purchasing a new electric vehicle would decrease significantly [9].

3.2.2. Technological challenges

The world's proven deposits of several heavy metals and rare earth elements, which are required for high-energy batteries, are comparatively tiny.

The Global Chrome Resource Survey Report reveals that chromium is largely distributed in the South African region, accounting for 83.3% of the total, which has led many to fear that the United States will transition from its current reliance on oil imports to a dependence on other imported materials. The vast majority of the world's proven reserves of chromium and rare piles of the earth are located outside of the United States. There are now 11 million tonnes of lithium deposits in the world, most of which are in South America. There aren't enough lithium reserves in the United States [10].

3.3. Development Trend

The US electric vehicle industry is expanding quickly and is projected to reach US$137.43 billion by 2028, representing a compound annual growth rate of 25.4%, up from US$28.24 billion in 2021. The global pandemic in 2020 had a significant impact on the sector, but it has since quickly recovered. This is large because consumers and automakers are switching from internal combustion engine (ICE) vehicles to electric vehicles as a result of the development of charging infrastructure and more affordable electric vehicle prices, which is driving up pressure on carbon emissions at both the domestic and international levels [11].

Several automakers that are not well-known in the electric vehicle business are swiftly emerging as major battery-electric vehicle manufacturers with a host of new models. Honda (Honda) disclosed this month that it intends to partner with Sony (Sony) to bring its Sony-Honda electric vehicle joint venture to the US market. The partners expect to supply their electric cars to the US and Japan by 2026. Sony Honda Mobility (SHM) intends to take pre-orders in 2025, concentrating predominantly on online sales. The company will manufacture the cars at Honda plants in North America and will offer Level 3 autonomous driving systems across the range.

4. Comparison and analysis

Comparatively speaking, the United States has an edge over China in terms of technological maturity, systematic research and development, the scope of infrastructure construction, and the

viability of management systems. China has advantages in scale management and is a rich source of raw materials for present or future batteries. To further support the idea of popularising electric vehicles in China, China should regulate the low-speed electric vehicle market as soon as feasible in addition to encouraging high-speed electric vehicles. China's new energy cars will gain popularity by learning from the United States about the significance of research and development in electric vehicle technology and standardised management, as well as by taking into consideration Chinese customers' affordability.

5. Conclusion

Despite a slow expansion and rising market sales, China is developing rapidly in the new energy vehicle and electric vehicle sectors. However, there is a pressing need to draw attention to the fact that China still lags far behind the United States in terms of research, development, and quality improvement of core electric vehicle technologies, that its policies for the sector are insufficiently comprehensive, and that the imperfection of related facilities and the low level of market acceptance have so far prevented the necessary advancement of electric vehicles.

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