

Domestic and Foreign New Energy Vehicle Development Technology Path

Libin Zhang^a, Haodong Yao^b

China Automotive Research institute (Tianjin) Automotive Engineering Research Institute Co., LTD., Tianjin 300300, China

^azhanglibin@catarc.ac.cn, ^byaohaodong@catrac.ac.cn

Abstract

With the aggravation of global environmental pollution, fossil energy depletion and other problems, all countries in the world attach great importance to the development of new energy vehicles which are environment friendly and low oil depending, and keep increasing their R&D investment in the field of new energy vehicles, promoting the rapid development of the global new energy vehicle industry. In order to better grasp the leading countries' new energy vehicle popularity, clarify the technical path of global new energy automotive industry trends, this paper has collected the new energy vehicles "sales market data of five developed countries" data at auto-industry and analysed the current status and tendency of new energy vehicle industry under the condition of different policy environments.

Keywords

New Energy Vehicles; Technology Path; Comparison at Home and Abroad.

1. Research Background

In recent years, with the accelerating of economic globalization and technological progress, a new round of technological and industrial revolution is booming, causing automotive industry integrated with advanced technologies in the fields of communication, energy and transportation deeply. As the best carrier for intelligent networking technology, new energy vehicles has become an important direction and trend for the world's auto-industry. According to EV Volumes, global sales of new energy vehicles in 2021 totaled 6.89 million units, up to 110% growth year-on-year. The transformation from traditional fuel vehicles to new energy vehicles is not only the development of technology, but also a kind of reform and innovation of the time[1]. For China, the development of new energy vehicle industry is not only the path China must take to become a developed country at auto-industry, but also the key points for the breakthrough of a new round of economic growth and an important way to achieve transportation and energy transformation.

In the current global trend of carbon reduction and environmental protection, the development of new energy vehicles is a key strategic measure to cope with climate change and promote the green and sustainable development of the industry. In the aspect of development of new energy vehicle industry, China not only has a certain first-mover advantage, but also creatively combine creative new energy vehicle industry's development with promoting instrial competitiveness, ensuring energy security, improving air quality, coping with climate change and other factors, bringing us great advantages in the competition of global new energy vehicle market. According to Chinese auto industry association statistics, In 2021, the sales of new energy vehicles in The Chinese market reached a new high of 3.521 million units, with a year-on-year growth of 157.5%. In addition, as the world's largest new

energy vehicle market, China's global sales of new energy vehicles in 2021 is as high as 51%, up about 9 percentage points compared with 2020.

At present in China, Japan, South Korea, the United States, Europe, represented by the auto industry of developed countries and regions are increasing investment in new energy vehicle industry, promoting the fast development of new energy vehicle industry within the area and the transformation and upgrading of the global auto industry in the same time. However, when facing different kinds of new energy automotive technology path, all the countries have made different choices affected by its own resources, culture and industry foundation.

China has been the largest auto market in the world with its' largest auto production and sales scale for years. Although with the significant progress that has been made in key technical field, China's overall technical level of auto-industry has significantly improved compared with advanced countries, China is still not a developed country at auto-industry due to its' late start and weak industrial foundation, and there is still a gap between China and other traditional auto-industry developed countries in many aspects. As the technological innovation system has been initially formed but still needs to be improved and support of vehicle technology process is also needed for economic development, social progress and industrial transformation, China has to innovate and develop vehicle technology to realize technological change and industrial reconstruction.

2. Technical Route Comparison of New Energy Vehicles at Home and Abroad

New energy vehicles generally refer to vehicles that use energy supply and conversion device other than conventional vehicle fuel (gasoline, diesel, etc.) as power source, or vehicles that use conventional vehicle fuel but with of new vehicle power devices in the meantime, the new energy vehicles discussed in this paper include: Micro hybrid electric vehicle (48V), mild hybrid electric vehicle (MHEV), hybrid electric vehicle (HEV), plug-in hybrid electric vehicle (PHEV), battery electric vehicle (BEV) and fuel cell vehicle (FCV).

On the whole, among the countries with developed auto industry in the world, Japan started the research and development of new energy vehicles as early as the 1960s and has been continuously investing in the field of new energy vehicles in the past decades, thus the new energy vehicle market has a high new energy penetration rate (as shown in Figure 1). In 2021, the penetration rate of new energy vehicles in Japan is as high as 33.51%. By contrast, as one of the leading countries that developed and used new energy vehicles earlier in the world, the United States has established a perfect policy system and good market environment. But because of the influence of domestic policy guidance around 2017, the attention and support for developing new energy vehicles is decreased obviously which has affected the development of the nation's new energy automotive industry. The development process of new energy vehicle industry in China, South Korea and Germany is similar: In the early 1920s, the market penetration rate of new energy vehicle in the three countries are relatively low. After five years of development, the output and market penetration rate of new energy vehicle in China, South Korea and Germany are all rising rapidly. In 2021, the output of new energy vehicles in China, South Korea and Germany increased by 1861.56%, 520.76% and 12117.79% respectively compared with 2015, and the market penetration rate of new energy vehicles increased by 13.82, 12.90 and 36.86 percentage points respectively, indicating rapid industrial development.

From the perspective of new energy vehicle types: China focuses on the development of battery electric vehicles (BEV). Statistics from Marklines show that BEVs has always occupied a high market share in China's new energy vehicle market from 2011 to 2021, with the market share ranging from 56.02 to 80.73%. Most of the remaining market share is occupied by HEVs and PHEVs models. Besides In 2021, the market shares of HEVs and PHEVs are similar, which is 13.36% and 15.62% respectively. Japan's new energy vehicle market is dominated by medium hybrid vehicles(HEV), and since 2021 the number of mild hybrid electric vehicles (MHEV) begin to increase. Before 2020, new energy vehicle types in Japan are dominated by HEV, and more than 95% of new energy vehicles in the market are HEVs. But in 2021, the annual sales of MHEV in Japan surge, with the annual sales

of less than 1,000 units in 2011 raising to 554,500 units same period in 2021, mild hybrid electric vehicles' market share up to 37.22%. In the United States and South Korea, hybrid electric vehicle (HEV) is the main driving force, while mild hybrid electric vehicle (MHEV), plug-in hybrid electric vehicle (PHEV) and battery electric (BEV) are gradually increasing. In 2011, the majority of new energy vehicles in the United States and South Korea are HEV vehicles. After nearly ten years of development, the number of BEVs in the two countries have increased. The sales volume of new energy vehicles in BEV has increased to more than 30% and sales volume of BEV in South Korea has increased significantly from less than 500 in 2012 to 79,177 in 2021, with an annual growth rate of 73.77%. Germany presents a parallel development trend of battery electric (BEV), mild hybrid electric vehicle (MHEV) and plug-in hybrid electric vehicle (PHEV). In 2021, a total of 1,084,329 new energy vehicles were sold in Germany, including 340,470 BEVs, 342,486 MHEVs and 321,710 PHEVs. The market share of new energy vehicles is 31.40%, 31.59% and 29.67% respectively. There is little difference in recognition of different types of new energy vehicles in the German market.

Under the background of increasingly prominent energy security issues, different countries choose slightly different development paths of new energy vehicle technology according to their actual conditions and national conditions:

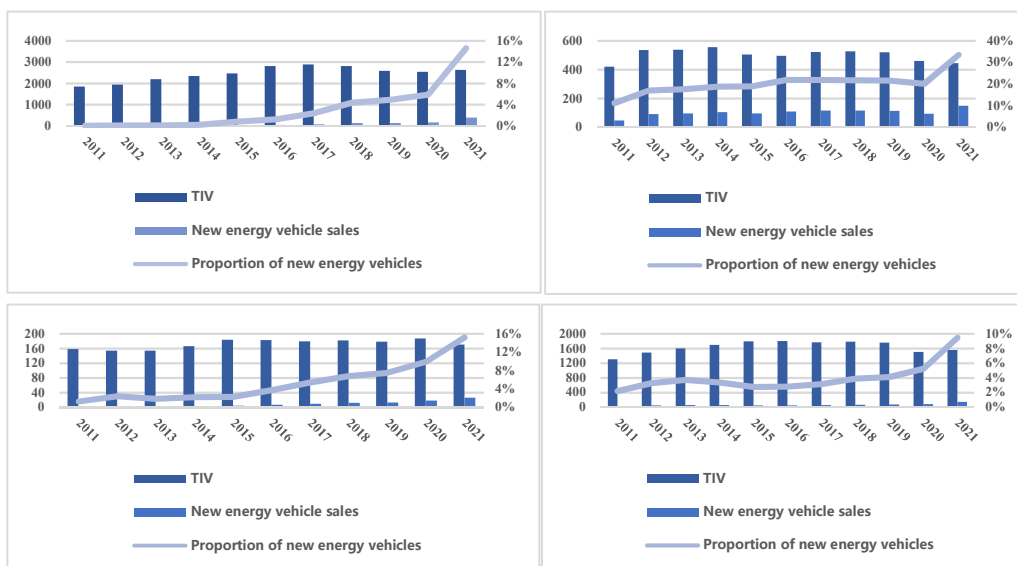
China's new energy vehicle industry has characteristics of policy-driven development, rapidly increased market size and preliminary formation of public technology platforms and industrial alliances[2]. Having the advantage of rich coal reserves, China's proved recoverable reserves rank third in the world and are widely exploited for thermal power generation, which can meet the charging demand of a large number of electric vehicles. At the same time, China has also mastered advanced ultra-high voltage, extra-high voltage long-distance power transmission technology, and built the scale of the world's leading developed power supply network. Having a good ability to build and improve the charging service capacity, our nation can strongly support the promotion and application of new energy vehicles throughout the country. In addition, the combination of lacking oil resources, long-term dependence on imports, as well as the late start of the science and technology of internal combustion engine, gearbox and material lagging behind developed countries, resulting in battery electric vehicles become the best option for the development of new energy vehicles in China. In the field of developing new energy vehicles, both at home and abroad are on the same starting line. China also has comprehensive advantages such as first-mover advantage, complete industrial chain and great market. As the country and enterprises pay more attention to high-quality development, brand effect and technological innovation, China will face great pressure in the global competition of new energy vehicle market in the future, but the opportunity to continue to maintain a leading position is also great.

For Japan, the investment in new energy vehicles has gradually increased, and the "New Generation of vehicles strategy" for the future has been formulated. On the premise of this strategy, the Ministry of Economy Trade and Industry, the Ministry of Land Infrastructure and Transport and other relevant departments of the Japanese government have formulated a series of support policies to vigorously promote the sales of new energy vehicles, the construction of infrastructure and the construction of new energy vehicle society[3]. On the one hand, the domestic famous global vehicle production companies such as Toyota, Honda that has always been in the pursuit of superior fuel economy for the vehicle, continuous studies and explorations in terms of internal combustion engine's fuel consumption were invested. While hitting a plateau in reducing fuel economy on the traditional internal combustion engine, Japanese companies chose a hybrid technology development route and accumulate a great number of inventions and patents in the field of hybrid system. On the other hand, because of Japan's domestic energy self-sufficiency is extremely low, in a period it would be difficult for government to promote a wide range of installing and transforming charging equipment, causing Oil-electric hybrid has become the key direction of Japan's automobile industry in the next decade instead of plug-in hybrid electric vehicle and battery electric vehicle when Japanese government making <<Next generation automobile strategy>> in 2010.

Since 2014, the South Korean government has started to implement the green vehicle plan, and has determined the promotion plan of new energy vehicles with the development of battery electric vehicles, hybrid electric vehicles and hydrogen energy vehicles as the core. However, despite the nation's aggressive promotion strategy of plug-in hybrid and battery electric vehicles, South Korea is similar to Japan in terms of energy problem and cannot handle charging and powering supply problems well, which leads to a slow increase in the penetration rate of battery electric vehicles and plug-in hybrid electric vehicles.

Research and development of new energy vehicle technology and policy support in the United States has been in the international leading level, during the Clinton and bush administration, the United States has successively introduced " Partnership for a new generation vehicle (PNGV)", "energy policy act", "high-tech vehicle manufacturing incentive plan (ATVMIP)" and other policies to promote the development of new energy vehicles. During Obama's administration, government procurement, demonstration operation, legislative norms, retrograding subsidies, tax deduction and continuous improvement of points policy were adopted to support the development of new energy vehicle industry focusing on plug-in hybrid electric vehicles. In recent years, with the rapid rise of Tesla, the penetration rate of battery electric vehicles in the USA's new energy vehicle market has been steadily increased.

As the origin of the world's automobile, Germany has a very developed automobile industry, including strong manufacturing technology, mature vehicle market, world's leading vehicle technology and professional vehicle talents. But limited by geographical position and environmental resources, Germany is facing the problems of lacking fossil energy and improting raw materials extensively. As a result, vigorously developing renewable energy, Germany has developed a savings grid in combination with emerging energy and actively guided domestic consumers' consumption concept of energy conservation, emission reduction and low carbon, reducing the difficulties of domestic new energy vehicle marketing. hybrid electric vehicle, plug-in hybrid electric vehicle, battery electric vehicle have also accumulated a similar number of consumers through virtue of their own respective advantages with similar market share of new energy vehicles. In recent years, the surge in sales of New energy vehicles in Germany mainly benefits from the excellent performance of plug-in hybrid electric vehicles. With the preservation of both internal combustion engine and battery, plug-in hybrid electric vehicles are generally considered as a transition product to electrification for traditional vehicle. FCA CEO Mike Manley has publicly said that hybrids are the best way for automakers to meet EU emissions targets for now, but after 2025, battery electric vehicles will become mainstream[4].



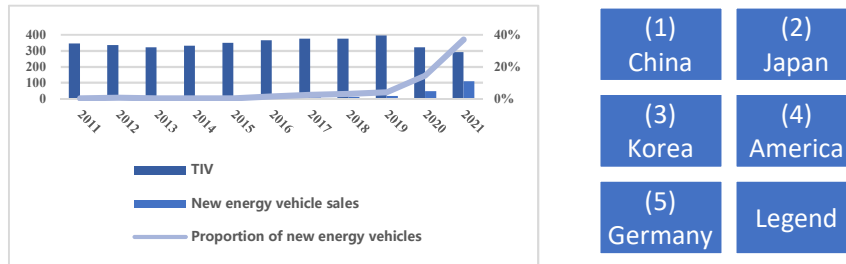


Figure 1. Sales and market share of new energy vehicles in leading countries (unit: 10,000 units)

3. Conclusion

Globally, in the auto market of the countries with developed auto industry, The market penetration of new energy vehicles, including Micro hybrid electric vehicle (48V), mild hybrid electric vehicle (MHEV), hybrid electric vehicle (HEV), plug-in hybrid electric vehicle (PHEV), battery electric vehicle (BEV) and fuel cell vehicle (FCV), has increased significantly in recent years.

Affected by their own resources, location, culture and other factors, the routes of new energy vehicles developed by various countries are different: China focuses on the development of battery electric vehicles (BEV);New energy vehicles in the United States, Japan and South Korea are dominated by hybrid electric vehicle (HEV). German market is relatively diversified, and the development of battery electric (BEV), medium hybrid (MHEV) and strong hybrid (PHEV), is relatively balanced.

Although all countries in the world are actively breaking new energy vehicle technology, there is still a long way to go in the technology research and development of new energy vehicles. Having a clear understanding of the new energy industry, strengthening the in-depth analysis of battery technology and improving the battery range is the only route we must take. As the biggest new energy vehicle market around the world, China has the most obvious sales advantages of battery electric vehicles, resulting in battery electric vehicles to become the mainstream for the development trend of the world's new energy vehicles when fuel cell vehicle promotion is mainly in the United States, Japan, South Korea and other places. However, driven by the market, more enterprises will be attracted to develop battery electric vehicles and cultivate more powerful enterprises, which will further temper the globalization level and R&D level of Chinese auto enterprises, becoming an important opportunity for China's auto-industry to achieve overtaking on curves.

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