

AN EXAMINATION OF THE EVOLVING PATTERNS AND THE STRATEGIC DIRECTION OF RENEWABLE ENERGY TECHNOLOGY ADVANCEMENTS

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Abstract: The rapid development of the world's automobile industry has brought great speed and convenience to people's daily travel. At the same time, it has also caused corresponding energy crisis and environmental pollution to some extent. In order to promote the long-term and healthy development of the industry, some important international automobile companies have strengthened research on new energy vehicles. Based on this, this article explains the evolution and characteristics of the world's automotive power technology, analyzes the relevant new energy vehicle development policies promulgated by our country, and provides necessary reference.

Keywords: New energy; Power technology; Development trends; Policy orientation

1 INTRODUCTION

As an important pillar industry for the development of the national economy, the automobile industry has been listed as a key area for a new round of industrial and technological revolution under the sustainable development concept of "low carbon, environmental protection, and energy conservation" and has begun to Developing towards intelligence, electrification and globalization. At this stage, in the context of the continuous development of the automotive industry, relevant powertrain companies will be based on the research and development and application of hybrid technology to achieve corporate transformation, upgrading and development. Moreover, according to my country's current policy analysis on the introduction of new energy vehicles, within a long period of time, the technical departments of previous fuel vehicle companies will continue to strengthen the thermal efficiency of engines and the research and development of special hybrid engines[1-2].

2 ANALYSIS OF THE EVOLUTION AND CHARACTERISTICS OF AUTOMOBILE POWER SYSTEMS

The development of automobile power systems has roughly gone through four periods. The initial automobile power system was provided by steam power; as early as the mid-eighteenth century, Mr. Watt invented the steam engine, and then by the end of the nineteenth century, Daimler and Diesel invented the steam engine. The internal combustion engine changed the power system of automobiles from steam power to fuel power[3]. In the early 20th century, electric vehicles became popular in the United States. The automobile power system developed from scratch, from huge to streamlined, and its development tended to be more comfortable and convenient.

The second stage of automobile development is a stage of energy conservation, high efficiency, and environmental protection. Its structural performance is that the gasoline engine has been optimized from the carburetor to multi-point injection, using direct injection in the cylinder, and gradually developed into a mechanism using mixed injection, and has transformed from purely mechanical to electronic control, continuously comprehensively optimize performance, and continuously improve its economy, to the current period of development to control pollutant excretion[4].

The third phase of the automobile power system, the hybrid power stage, is to upgrade and improve the traditional power system to achieve energy saving and emission reduction, and optimize its economical performance.

The fourth period of automobile power system is the pursuit of green, simple and intelligent stage, using pure electric power system[5]. At present, the power system of the automotive industry is in the transition from the third stage to the fourth stage. Most automobile factories and power system assembly companies in various countries regard hybrid power and new energy power as their key research and development directions, investing a lot of money, time, and technology in research and development. Preferential policies for the automobile industry in various countries favor green, simple, and smart cars.

Table 1 Documents issued by relevant Chinese institutions

Policy Implementation Time	Policy Projects	Policy Changes
August 11, 2016	"New Energy Vehicle Carbon Quota Management Method"	1. Deepened the definition of carbon quotas for new energy vehicles 2. Proposed the preliminary management concept of carbon quotas (managers, applicable objects, quota calculation, trading and settlement, etc.)

1st solicitation of opinions on September 22, 2016	"Interim Methods for the Parallel Management of Company Average Fuel Consumption and New Energy Vehicle Points"	1. Deepened the calculation method of two point indicators (NEV, CAFC points) 2. Deepened the management method of two point indicators
1st solicitation of comments on June 13, 2017	"Method for Parallel Management of Average Fuel Consumption and New Energy Vehicle Points of Passenger Car Companies"	1. Strengthened technical standards for new energy vehicles 2. Changed the points value of pure electric vehicles (linked to the actual mileage of pure electric vehicles) 3. The time range of each link in points management has been changed.
Officially released on September 22, 2017	"Interim Methods for the Parallel Management of Company Average Fuel Consumption and New Energy Vehicle Points"	1. Officially implemented on April 1, 2018, the original 2018 new energy points proportion standard will be cancelled. 2. The company threshold for the points proportion standard has been established, and the annual output of fuel vehicles has been increased from 50,000 to 30,000. 3. New energy vehicle points are not allowed to be carried forward, but only the new energy vehicle points from 2019 can be carried forward in equal amounts for one year.

3 DEVELOPMENT POLICIES FOR NEW ENERGY POWER TECHNOLOGY

In order to promote the development of the new energy automobile industry, promote automobile emission reduction and energy conservation, reduce air pollution, and promote the strategic transformation of energy in my country's transportation sector, with the review and approval of the State Council, relevant Chinese organizations have launched a nationwide promotion of new energy Car work[6]. In recent years, with the development of society, in order to further accelerate the development process of new energy vehicles in our country, government departments have successively promulgated the "New Energy Vehicle Promotion Subsidy Standards", "Double Points Management Method", and "Management Regulations for Investment in the Automobile Industry" A series of preferential policies such as this fully reflect the importance my country attaches to new energy vehicles and demonstrates its determination to support the industrial development of new energy vehicles[7].

3.1 Parallel Management Method of Average Fuel Consumption of Passenger Car Companies and New Energy Vehicle Points

In recent years, Chinese government departments have introduced parallel management methods for passenger car companies' fuel consumption and new energy vehicle points (Table 1). It can be seen from Table 1 that: my country has correspondingly relaxed the average fuel consumption standards for small car companies. For the small passenger car industry with an annual output of less than 2,000 units, it has relaxed the points compliance standards for average fuel consumption; at the same time, it has also relaxed the standard for new energy vehicles[8]. Corresponding threshold requirements have been set for the proportion of automobiles. For passenger car companies with an annual output of less than 30,000 units, a new energy vehicle point proportion standard has been formulated; for companies with an annual output of 30,000 or more units, the points proportion standard in 2019 is 10%, and the points proportion standard in 2020 is 12%; the proportion standards for new energy vehicles in 2021 and in the future will be specifically announced by relevant information and industrial institutions; implement a parallel management method of points so that positive points can be based on 80% Or 90% of the proportion will be carried forward to subsequent annual applications, and the negative points offset will be reset to zero.

3.2 New Energy Vehicle Promotion and Application Subsidy Program and Its Product Technical Standards

First, standards for pure electric vehicles. In recent years, our country's government departments have made strict regulations on subsidy programs for pure electric vehicles. Among them, the standards for cruising range are more stringent, focusing on automotive products that support long cruising range[9]; the density of battery energy is strictly set, and a correlation coefficient is formed; the energy consumption standards for automobiles are more stringent, and a correlation coefficient is formed; newly added batteries, A maximum limit is set for electricity subsidies, and the maximum limit for unit battery and electricity subsidies should be $\leq 1,200$ yuan/kWh. As shown in Table 2.

The formula for calculating the subsidy for bicycles and passenger cars is as follows: Bicycle subsidy amount = mileage subsidy index * battery system energy density adjustment coefficient * vehicle energy consumption adjustment coefficient (Table 3 for specific subsidy coefficients). Changes in the threshold requirements for power consumption subsidy per 100 kilometers is shown as Table 4.

Table 2 Specific requirements for pure electric cruising range

Pure Electric Driving Mileage (Km)	Subsidy Amount In 2018 (Yuan)	Subsidy Amount In 2017 (Yuan)
$100 \leq R < 150$	0	20000
$150 \leq R < 200$	15000	36000
$200 \leq R < 250$	24000	

$250 \leq R < 300$	34000	
$300 \leq R < 400$	45000	44000
$400 \leq R$	50000	

Table 3 Relevant requirements for vehicle energy consumption

Electricity Consumption Per 100 Kilometers Is Better Than The Threshold Standard	Subsidy Coefficient In 2018
$0\% \leq r < 5\%$	0.5
$5\% \leq r < 25\%$	1
$25\% \leq r$	1.1

Table 4 Subsidy threshold standards for electricity consumption per 100 kilometers

2017 Subsidy Standard For Electricity Consumption Gate Per 100 Kilometers	2018 Subsidy Standard For Electricity Consumption Per 100 Kilometers	Subsidy Threshold Standard For Electricity Consumption Per 100 Kilometers
$m \leq 1000$		
1000	$< Y \leq 0.014 \times m + 0.5$	$Y \leq 0.012 \times m + 2.5$
$m \leq 1600$	$Y \leq 0.005 \times m + 13.7$	$Y \leq 0.0126 \times m + 0.45$
$1600 < m$		$Y \leq 0.0108 \times m + 2.25$

Second, standards related to plug-in hybrid electric vehicles. In recent years, the Chinese government has made strict regulations on the subsidy program for plug-in hybrid electric vehicles. The main reasons are to lower the basic subsidy amount and to make vehicle energy consumption standards more stringent. The calculation formula is as follows: bicycle subsidy amount = mileage subsidy index * vehicle energy consumption adjustment coefficient. Specific requirements for pure electric cruising range can be found in Table 5.

Table 5 Specific requirements for pure electric cruising range

Pure Electric Driving Mileage (Km)	Subsidy Amount In 2018 (Yuan)	Subsidy Amount In 2017 (Yuan)
$50 \leq R$	22000	24000

Third, detailed requirements for vehicle energy consumption. At this stage, my country has introduced new regulations on vehicle energy consumption standards, which mainly reflect the following two aspects:

- ① When $50 < R < 80$, the fuel consumption in state B must meet the following standards, see Table 6:
- ② When $R = 80$, the power consumption per 100 kilometers in state A must meet the relevant threshold conditions for pure electric passenger vehicles in my country (the tightening coefficient is ignored).

3.3 Soliciting Opinions on Management Requirements for Investment in the Automobile Industry

In addition to clarifying the scope of investment in the automobile industry, my country's relevant management regulations also release a message that focuses on supporting the transformation of previous automobile companies and encouraging them to develop and manufacture new energy vehicles. Among them, the relevant policies include the content of "correctly guiding the investment direction of social capital and controlling the disorderly development of automobile companies." An updated and more reasonable plan has been made for the overall layout of the new energy vehicle industry, supporting existing fuel vehicle companies to expand the proportion of investment in assets, continuously optimizing the product structure, and developing new energy vehicles. See Table 7 for the classification of investment project types in the automobile industry.

Table 6 Subsidy coefficient for state B fuel consumption

Comparison of limits corresponding to B-state fuel consumption and current conventional combustion consumption in national standards	Subsidy coefficient in 2017	Subsidy coefficient in 2018
$65\% \leq r < 70\%$	1	0
$60\% \leq r < 65\%$		0.5
$B < 60\%$		1

Table 7 Classification of automobile industry investment projects

investment projects	Fuel vehicle investment project	Traditional fuel vehicle Ordinary hybrid car Plug-in hybrid project
	Pure electric vehicle investment project	pure electric vehicle Extended range pure electric vehicle fuel cell vehicle

Parts investment project	car engine body assembly The fuel cell Special-purpose cars and trailers managed by parts
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First, investment direction. The previous production capacity distribution structure of fuel vehicles has been improved. New production capacity investment projects must be established in provinces where the utilization rate of automobile production capacity in the past two years has been higher than the domestic average. Support enterprises to invest in the form of equity, such as mergers, reorganizations and strategic cooperation, and promote enterprises to jointly develop new products and coordinate production to increase the concentration of the automobile industry. Encourage my country's state-owned automobile companies and private car companies to carry out mixed ownership reform activities to achieve the goal of "complementing their advantages and combining powerful forces", and then build a world-class group automobile enterprise. Encourage important enterprises in my country's automobile industry to strengthen the cooperation and practice of "production, academia, research and application", pool advantageous resources, and then build an automobile industry alliance.

Second, prohibited investment projects. The exclusion conditions for fuel vehicle investment projects in my country are as follows: ① Independently newly established fuel vehicle companies. ② Existing vehicle manufacturers are building fuel vehicle production levels across commercial vehicle and passenger vehicle categories. ③ Existing fuel vehicle companies that are not included in my country's regional development plan will all move to other provinces. ④ Changes in the equity of fuel vehicle zombie companies.

Third, investment projects in auto parts. About the engine project. For new automobile engines and new engine investment projects in my country, the power per liter of gasoline engines to be produced must be higher than 70 kilowatts, while the power per liter of diesel engines must be higher than 50 kilowatts, and the engines must meet my country's relevant vehicle emission standards.

4 IMPORTANT NEW ENERGY VEHICLE TYPES CURRENTLY SALES AND APPLICATIONS

The models of new energy vehicles currently on sale in major automobile industries can be roughly divided into three categories, namely pure electric, gasoline-electric hybrid (non-plug-in), and plug-in hybrid. Among them, the production and sales of non-plug-in new energy vehicles are generally concentrated in several joint ventures such as Honda, Toyota and Hyundai. Representative examples include Toyota's "Planetary Gear Dual Motor Power Mode" and Honda's "Single Motor Assisted IMA Mode". In terms of motor and engine integration, there is also Hyundai/Nissan's single-motor dual-clutch combined drive (P2 solution) mode, which is a mode in which the engine and motor are combined by a clutch.

The engines of the above-mentioned PHEVs all use the Atkinson cycle, and the thermal efficiency can reach 38.5%-40%, which is about 220g/kWh lower than the fuel consumption. Although our country's state-owned automobile companies have successfully developed Atkinson cycle engines, However, there is still a long way to go compared to developed countries in terms of thermal efficiency. Most of the main pure electric passenger cars launched are WM Motor, NIO, Yundu, Singularity, Qiantu, Xinte, Zhengdao, etc. They all adhere to the concepts of "intelligent interconnection" and "new energy" in car manufacturing. The "pure electric technology" at the root of the improvement cannot provide good impetus. At the same time, suppliers relying on the above technologies are also partners of traditional automobile companies such as CATL.

5 CONCLUSION

In short, with the development of society and the rapid changes in science and technology, my country's automobile industry will be restricted by environmental factors, energy factors, and technical factors in its forward development. In order to promote the sustainable development of the automobile industry, relevant automobile companies must actively develop, Promote and apply new energy vehicles. The ultimate development goal of the company is pure electric vehicles, and pure electric technology must rely on previous fuel vehicle companies. In the future, hybrid vehicles will have broad market development space. Therefore, in the past, fuel vehicle companies should continue to improve the thermal efficiency of engines, or strengthen the research and development of hybrid-specific engines.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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