



Research on the development of new energy automobile industry based on the SWOT-PEST model from the dual carbon perspective

BY

Chen Qinglin

School of Economics and Management, Southwest Petroleum University



Article History

Received: 15/03/2023

Accepted: 21/03/2023

Published: 22/03/2023

Vol – 2 Issue – 3

PP: -32-38

Abstract

In the context of global carbon emission reduction, countries around the world have conducted multi-directional discussions and studies on the issues of economic development and environmental protection. In order to implement the two goals of "carbon peak" and "carbon neutrality", China has begun to develop green economy in an all-round way. Transportation, as the key object of the development of green economy, energy conservation, and emission reduction, has attracted wide attention internationally. The automobile industry has gradually entered the ranks of low-carbon transformation, and thus the new energy automobile industry has ushered in rapid development. In this era, the automobile industry, which was originally in a disadvantageous position, has gradually turned to the manufacturing and innovation of new energy vehicles. And in the international automobile industry to form an objective fierce market competition mode. This paper uses SWOT-PEST model to analyze the advantages, disadvantages, opportunities, and challenges of developing new energy automobile industry from four aspects: politics, economy, technology, and society. To sum up, the problems existing in developing Chinese new energy automobile industry and the possible future trends, and to provide suggestions for the development of Chinese new energy automobile industry.

Keywords: SWOT PEST model; Double carbon; New energy vehicles; Industrial development

1. Introduction

China's industrial carbon emission structure shows a "three-world" situation, with the power sector leading, followed by industry, and transportation being the third largest source of carbon emission and one of the important sources of greenhouse effect 1. According to the statistics of the International Energy Agency (IEA), in 2020, the transport sector will account for 26% of the total global carbon emissions 2. According to the statistics of the carbon emission industry, in 2020, under the impact of the global epidemic, carbon emissions will be reduced by 5.9%, reaching 32.079 billion tons. China, as the world's largest carbon emitter, has a carbon emission of 9.97 billion tons, which will reach 10.59 billion tons in 2021. The total carbon emission of China's transport sector is about 1.1 billion tons, of which road transport accounts for 86.76%, water transport 6.47%, railway 0.68% and aviation 6.09% 3. Statistics show that in 2022, the number of motor vehicles in China reached 417 million, including 319 million automobiles. Carbon emissions from transportation accounted for about 10% of the country's total carbon emissions, which has great room for emission

reduction. Today, the "oil and electricity switching" of transportation energy is accelerating. In 2022, the production and sales of new energy vehicles in China will increase by 96.9 percent and 93.4 percent, respectively, year-on-year, showing huge potential for energy optimization market.

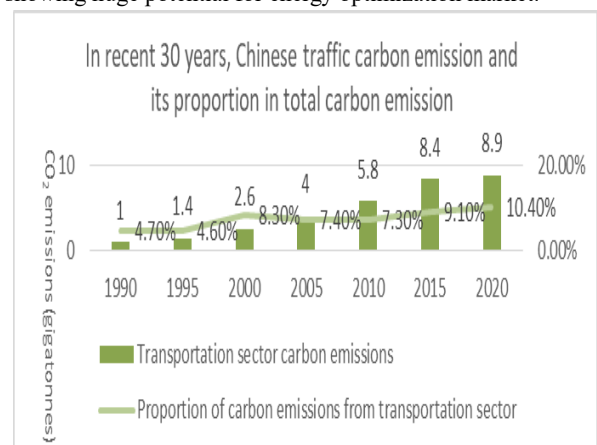


Figure 1-1 Traffic carbon emission and its proportion in total carbon emission in recent 30 years

Data source: Office for National Statistics



In order to alleviate the problem of environmental pollution, countries began to restrict the use of fuel vehicles, in order to alleviate the shortage of oil resources, a large number of fuel vehicles will emit harmful gases and cause greenhouse effect. Automobile energy transformation began to be included in the hot topic of research in various countries, and new energy vehicles came into being. The emergence and development of new energy vehicles is an important symbol of green energy, indicating that the automotive field is undergoing a rare overall change since its birth. Vigorously developing new energy vehicles can not only promote the greening of energy and reduce CO₂ emissions but also have far-reaching significance for regulating the national energy consumption structure and maintaining the ecological environment of the earth.

2. SWOT-PEST analysis of new energy automobile industry in our country

SWOT PEST is a model that analyzes the factors influencing the development of the industry through the macro and microenvironment and then determines its advantages and disadvantages as well as the opportunities and challenges it faces 4. SWOT model is used to analyze the internal strengths, weaknesses, external opportunities, and threats faced by the development of the new energy automobile industry, and then PEST model is used to analyze the external factors of opportunities and threats from the political, economic, social and technological aspects of the new energy automobile industry in detail 5.

2.1. Advantage Analysis

2.1.1 Political advantage

The Chinese government has promulgated many policies conducive to the development of new energy automobile industry, actively promoting market behavior standards and industrial structures. The new energy automobile industry in our country has entered a stage of rapid development under the support of national policies and has been among the top ranks of the international automobile market.

In 1991, the Ministry of Science and Technology of our country included "research on the key technology of electric vehicle" into the national science and technology project, and the development of the new energy automobile industry of our country was gradually on track. In 2001, the state implemented the "863" program, and new energy vehicles were officially listed as major national scientific and technological innovation projects. In 2005, The State Council issued the Outline of the National Plan for Medium and Long-term Scientific and Technological Development, which included the research and development of core technologies of new energy vehicles into key areas for priority development 6. In 2007, the Ministry of Industry and Information Technology issued the "New Energy Vehicle Production Access Management Rules", which unified the concept of new energy vehicles at the national level for the first time. In the "New energy vehicle Production Access Management Rules", the related industry chain manufacturing of new energy vehicles is required to have the specified qualification, and the low-end

enterprises entering the new energy vehicle market are strictly checked. It plays a positive role in improving the R&D capability of key technologies of new energy vehicles 7. The period from 2009 to 2016 is an important stage for the rapid growth of China's new energy automobile industry 8. The Central Committee of the CPC Central Committee and The State Council formulated the Plan for the Adjustment and Revitalization of the Automobile Industry, making the new-energy automobile industry one of the seven strategic emerging industries and more comprehensively deploying the development of the new-energy automobile industry. In 2017 and 2018, the Ministry of Finance reduced the capacity of medium and low-end new energy vehicles by adjusting the subsidy policy for new energy vehicles, and paid attention to the high subsidy for high-end new energy vehicles, so that high-end new energy vehicle enterprises have enough funds to develop the overall performance of new energy vehicles. And relevant policies in the past two years have given support to the new-energy automobile industry. For example, the Ministry of Finance issued the 2022 Fiscal Subsidy Policy for the promotion and application of New Energy Vehicles on December 31, 2021, the National Development and Reform Commission issued the Implementation Plan for promoting Green Consumption on January 21, 2022, and the Ministry of Transport issued the 14th Five-Year Development Plan for Green Transportation on January 21, 2022. In the international situation and all the policies issued by our country show that in order to actively respond to the energy crisis and environmental governance, the national government to promote the development of the new energy vehicle industry has vigorously promoted the good policies to promote the protection of consumer rights and interests.

2.1.2. Economic advantages

Imedia Research recently released the "Global and China New energy vehicle Industry Consumption Trend Monitoring and Case Study Report 2022-2023", which shows that the market scale of China's new energy vehicle will increase year by year from 2017 to 2021, and it is estimated that the market scale of China's new energy vehicle will reach 11.5 billion yuan in 2023. In the Chinese market, there are abundant alternative models of new energy vehicles, many attractive products, strong and supportive demand, and the high growth of market size is expected to continue. In 2022, China's new energy vehicle market completed a total of 6.887 million retail sales, a year-on-year growth of 130.4%. By the end of 2022, the number of new energy vehicles in China reached 13.1 million 9. In terms of penetration, China's new energy vehicles rose from 7 percent in 2020 to 25.6 percent in 2022, accounting for more than a quarter of the auto market. The huge growth in new energy vehicle sales comes against the backdrop of a shrinking auto market, which means that new energy vehicles are replacing traditional fuel vehicles at an accelerating pace in the Chinese market.

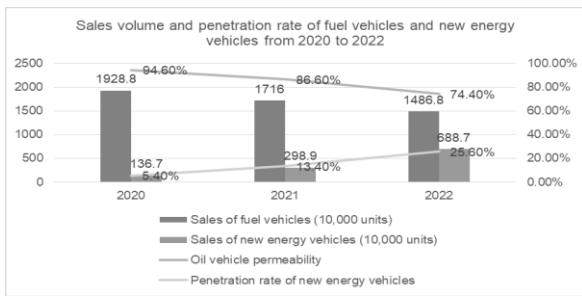


Figure 2-1 Sales volume and penetration rate of fuel vehicles and new energy vehicles from 2020 to 2022 Data source: Office for National Statistics

China's GDP reached 121.02 trillion yuan in 2022, up 5.8 percent year-on-year from 2021, according to the National Bureau of Statistics. In addition, China's per capita disposable income continued to rise from 2013 to 2022, reaching 35,000 yuan in 2021 with a year-on-year growth of 9.1%, and 36,883 yuan in 2022 with a year-on-year growth of 5.0%. The expanding economic scale has promoted the development of Chinese industry and also benefited the development of new energy automobile industry. Due to the impact of the novel coronavirus epidemic, the growth rate of per capita disposable income of residents has slowed down, but the per capita disposable income of residents continues to rise, and the purchasing power level of consumers also increases. Therefore, the purchasing ability and willingness of bulk commodities such as new energy vehicles will increase, providing a good economic environment for the development of the new energy automobile industry.

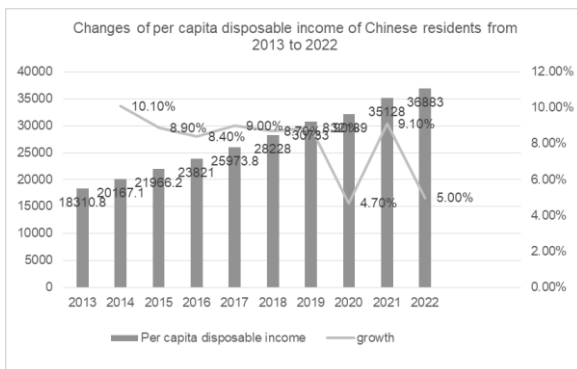


Figure 2-2 Changes of per capita disposable income of Chinese residents from 2013 to 2022 Data source: Office for National Statistics

2.1.3 Social advantages

In 2022, three Chinese new energy vehicle companies ranked among the top 10 in the world in terms of sales volume, and nearly 700,000 new energy vehicles were exported to other countries. In the world's top 10 power battery-installed enterprises, six enterprises are from China, which also shows the strong brand competitiveness of China's independent brand new energy vehicle industry, making the market size of China's new energy vehicle industry ahead of the world. In addition, consumers' awareness of environmental protection is gradually increasing, and more hardware facilities can be built and realized, which makes the prospect of new energy vehicles optimistic by many people.

2.1.4 Technical advantages

In 2015, China issued the "Made in China 2025" technology roadmap, which points out in the sixth field (energy conservation and new energy vehicles) that it will continue to support the development of new energy vehicles, master core technologies, form a zero-to complete innovation system and promote China's new energy automobile industry to be in line with the international advanced level 10. According to the plan, 1,000 green demonstration factories and 100 green demonstration parks will be built by 2020, while the comprehensive performance of new-energy vehicle products and the performance of key components will be further improved. In 2020, as a stage of technological improvement, the industrialization of new-type lithium-ion batteries will be realized, and intelligent track control of power batteries will be realized. Product performance and quality will be greatly improved, and cost will be significantly reduced 11. In 2022, China's key technologies for new energy vehicles will lead the world in terms of the energy density of single-power batteries in mass production and the peak power density of driving motors. By 2025, while establishing the green manufacturing system, the comprehensive performance of new energy vehicle products will reach the international advanced level, and the lightweight technology will be further improved. 2025 as the industry development stage, new power battery technology needs to make significant progress. When the industry reaches its mature stage by 2030, power battery technology will achieve remarkable results in system integration efficiency, temperature adaptation, fast charging, and battery life.

2.2 Contrarian analysis

2.2.1 Political opposition

The state has given great encouragement and support to the new energy automobile industry politically, but it has not achieved the effect of truly stimulating the market to a certain extent. First, the development of enterprises is more dependent on the policies of local governments, which means that the national level has formulated corresponding supportive policies. If the local government fails to implement them in time, enterprises and consumers to a certain extent do not enjoy the encouragement and support of the state. Secondly, the means of publicity should be strengthened. Diversified ways and methods of publicity should be adopted to enable consumers to know the corresponding preferential policies in time. Third, enterprises do not communicate much with government agencies on the basis of environmental protection construction. Active contact with local governments will get corresponding policy support, which will increase the development of new energy automobile industry.

2.2.2 Economic disadvantage

The domestic economic situation has been affected to a certain extent by the impact of the novel coronavirus epidemic. Now the epidemic is under control and the corresponding policies have been relaxed, which has enabled industrial production to recover, but it will take some time to achieve a significant effect. At present, the development of

new energy vehicles is unbalanced in regions. Compared with cities with high penetration rate, the market consumption of new energy vehicles in rural areas still needs to be improved, showing unbalanced development. It is difficult to open the new energy vehicle market in areas with low penetration rate. At the same time, many uncertainties will still affect the economic situation.

2.2.3 Social disadvantage

The domestic automobile market is mainly dominated by fuel vehicles. Although new energy vehicles are gradually entering people's vision, they have been accustomed to the travel mode of fuel vehicles in people's cognition, and the number of motor vehicles has reached 417 million. The owners of original fuel vehicles do not necessarily turn to new energy vehicles when the fuel vehicles have not reached the retirement age. New energy vehicles enter the market, causing people's high attention, but the excessive sensitivity to its safety performance, once a new energy vehicle safety accident into people's vision will make people back. Third, people do not have a strong sense of environmental protection, and will not choose new energy vehicles for environmental protection.

2.2.4 Technical disadvantage

According to the power type, the current domestic new energy vehicles can be divided into three types: pure electric vehicle (BEV), fuel cell electric vehicle (FCEV), hybrid electric vehicle (HEV).

Pure electric vehicle (BEV). Battery pack and driving motor are taken as the main structure of pure electric vehicles and the only power source. Pure electric vehicles realize completely zero emission during driving¹². Compared with the technical performance of pure electric vehicles in western countries, our pure electric vehicle industry still has a gap in battery performance, and its endurance and safety reliability need to be further improved. Meanwhile, domestic pure electric vehicles still need to rely on imports of many parts, such as vehicle controller chip. Compared with western developed countries with advanced technology in the manufacturing level of pure electric vehicles, the manufacturing cost of pure electric vehicles in our country is high.

Fuel cell electric vehicle (FCEV). Fuel cells are mainly hydrogen fuel cells, which provide kinetic energy for electric vehicles by converting fuel chemical energy of hydrogen fuel cells into electric energy, so as to realize driving and other functions of electric vehicles. On the fuel cell electric vehicle industry, our country has the main technology which is comparable with the western developed country and has established a perfect research and development system in our country. But in the core technology, there is still a clear gap in the fuel cell electric vehicle industry.

Hybrid electric vehicle (HEV). Hybrid electric vehicles usually refer to petrol-electric hybrid vehicles, which have two power systems: an engine and an electric drive. As the main type of new energy vehicles in our country, hybrid electric vehicles have been put into use on a large scale, and have achieved certain energy-saving emission reduction

results. But the industrial chain of parts of our country needs to be further established and perfected.

2.3 Opportunity Analysis

2.3.1 Political opportunities

In 2021, the 14th Five-Year Plan for national economic and social development was voted through at the Fourth session of the 13th National People's Congress. In order to vigorously promote China's social and economic development and build a strong domestic market, the development of new energy automobile industry has also been attached great importance by the central government⁴. In recent years, driven by national policy support, market guidance, technological progress, user experience improvement, and other factors, China's new energy vehicle market has sustained explosive growth. On March 4, 2023, the opening session of the 14th session of the National Committee of the Chinese People's Political Consultative Conference was held in the Great Hall of the People. Wang Junjin focused on rural new energy vehicle consumption and other topics, and brought the "Proposal on promoting rural new energy vehicle consumption". Under the guidance of the new policy, the new energy automobile industry will move forward steadily in the new development direction.

2.3.2 Economic opportunities

Now that the COVID-19 epidemic has gradually retired from the stage of history, developed economies have begun to recover gradually, while emerging markets are also growing, and the global economy is showing a momentum of sustained growth. China has also entered the middle and later stages of industrialization. During this period, the national economy has been further promoted, people's food, clothing, housing, and transportation have been fully guaranteed, and the constantly improving happiness index makes people willing to pay for a more comfortable life consumption. In the domestic economic situation is good, are conducive to the steady development of the new energy automobile industry.

2.3.3 Social opportunities

Green transition is an opportunity for China's economic development and structural upgrading. China will reach its carbon peak by 2023, and the development of green transition will push forward quickly. The promulgation of relevant domestic preferential policies has stimulated consumers' willingness to buy new energy vehicles. The new energy transportation system has also been established in public transportation and freight logistics. The sound charging system will also promote the rapid development of the new energy vehicle industry.

2.3.4 Technical Opportunities

Chinese economic development is faced with the new technological revolution represented by information technology. In the new technological revolution, the digital process is constantly promoting the development of digital economy industry, not only improving our traditional industry but also playing a positive role in economic structure. In 2020, China Society of Automotive Engineering issued the "Energy Saving and New Energy Vehicle Technology Development

Roadmap 2.0" to further study and confirm the development direction of global automotive technology "low-carbon, information and intelligent" 13. The technology roadmap sets out several targets for China's auto industry to meet by 2035. First, the country's auto industry carbon peak will be achieved before the national commitment to peak carbon emissions. Second, build new energy vehicles into mainstream products of the automobile industry 13. Third, large-scale application of the core technology of China solution intelligent connected vehicle. Fourth, promote independent innovation of key core technologies to form a corresponding and efficient industrial chain. Fifth, establish and improve the smart travel system to achieve ecological transportation. Sixth, the technology innovation system is basically mature and has the original innovation ability to lead the world 1314.

2.4 Threat Analysis

2.4.1 Political threat

The policy of recycling and utilization of power batteries in new energy vehicles is relatively late. At present, there are more than 10,000 nearby power battery recycling service outlets, but more comprehensive service outlets need to be established to fully realize the recycling of power batteries because the improper disposal of discarded old batteries is still a non-negligible threat to the environment.

2.4.2 Economic Threat

China's economy is gradually leading the world. In order to maintain their own rights and interests as a major country, it is inevitable that some countries will not carry out a trade war against China in an attempt to curb China's economic development. In addition, after three years of suffering from the novel coronavirus epidemic, China's economic situation is still in a relatively complex process. Although the impact of the epidemic is gradually decreasing, the surprise of unknown health events cannot be ignored.

2.4.3 Social threat

The domestic automobile market is mainly dominated by fuel vehicles, and the market recognition degree of new energy vehicles is far less than that of fuel vehicles. Due to the lack of in-depth understanding of new energy vehicles, compared with fuel vehicles, reliable and mature, new energy vehicles in people's impression are in short endurance and poor power, leading to the constraint of the development of new energy vehicles.

2.4.4 Technical Threats

Compared with the mature new energy vehicle technology of western developed countries, our new energy vehicle needs to be further developed and perfected, and there is still a gap in the core technology. At present, the industry chain of new energy automobile battery is still insufficient in research and development in the aspects of energy density, safety, and reliability of battery. In addition, the game between major countries intensified, some countries in order to contain the rapid development of Chinese economy, in core technology, core parts to the implementation of the "neck" measures to Chinese industry and try to pull up the economic gap, which

makes our new energy automobile industry in the key technology in the passive situation.

3. Strategic suggestions for the construction of new energy automobile industry

3.1 Weak innovation ability of core technology

Our new energy automobile industry still lacks in core innovation capability, and the complete integration technology of pure electric vehicle, plug-in hybrid electric vehicle (including extend-program), and fuel cell vehicle needs to be strengthened, as well as the basic industrial capabilities of power battery and management system, driving motor and power electronics, networking and intellectualization technology need to be enhanced 15. In vehicle integration technology, we need to develop high-performance vehicle platform for new energy vehicles and improve safety technical levels such as battery management and structural design to improve the comprehensive performance of new energy vehicles 16. In terms of industrial basic capacity, the technology supply system of key components should be built to improve R&D capabilities of basic key technologies, advanced basic processes, basic core components, and key basic materials 17. The concrete can be reflected in the following three aspects: First, the battery technology to strengthen the breakthrough of technical difficulties; Second, we will accelerate the integration of core technologies such as big data and cloud computing in vehicle-machine networking technologies. Third, improve the basic technology engineering of new energy vehicles, such as the application of key materials such as high-performance aluminum magnesium alloy 18.

3.2 The quality assurance system needs to be improved

According to the data "Analysis of China's New Energy Vehicle Users' Purchasing Factors in 2022" released by IIMedia Data Center, when Chinese consumers consider buying new energy vehicles, they mainly care about vehicle safety, followed by charging time, and then the maximum driving capacity of new energy vehicles.

It can be seen that consumers pay the most attention to automobile safety performance, so the new energy automobile industry must do the following two aspects in quality assurance: The first is to promote the quality of brand construction, improve the product quality of new energy vehicles, improve the high temperature and collision resistance of batteries and the safety of the car structure in the research and development, in addition, to fully simulate various accidents in the sample car test, to strengthen the overall safety performance of new energy vehicles; The second aspect is strict internal supervision of production safety, perfect responsibility system.

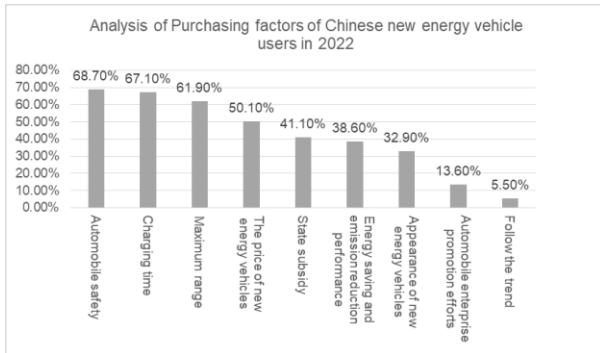


Figure 3-1 Analysis of Purchasing factors of Chinese new energy vehicle users in 2022 Data source: IIMedia Data Center

3.3 Infrastructure construction is still lagging behind

The construction of infrastructure for new energy automobile industry is still in a structural situation with the rapid development of new energy automobile industry. By the end of 2022, 5.21 million charging piles and 1,973 power changing stations have been built in China 19. However, by the end of 2022, the number of new energy vehicles in China has reached 13.1 million 20. According to the above data, the existing charging piles are far from enough to provide owners of new energy vehicles. In addition, there are great differences in the regional distribution of charging piles, leading to the low utilization rate of many charging piles. Therefore, in view of the problems such as insufficient and unreasonable distribution of charging piles, the construction of supporting infrastructure for new energy vehicles should be accelerated, and the distribution of facilities should be rationally and scientifically distributed in urban and rural planning and power grid planning, so as to improve the utilization rate of charging piles and the charging convenience of users.

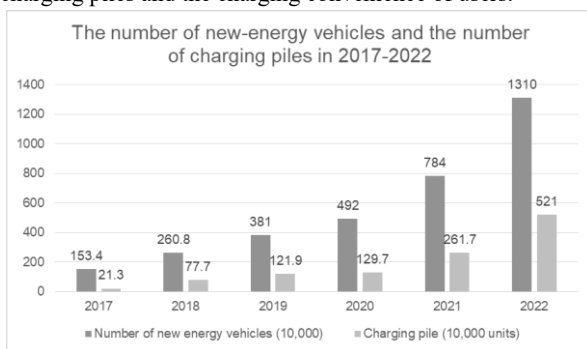


Figure 3-2 The number of new-energy vehicles and the number of charging piles in 2017-2022 Data source: Office for National Statistics

3.4 Industrial ecology is not yet sound

Generally, the power batteries of new energy vehicles need to be scrapped and replaced when they have reached their service life. However, due to the low utilization value and high disposal cost of used automobile batteries, the problem of used automobile batteries has not been effectively solved 21. With the increase in the total quantity of new energy vehicles in our country, a large number of used batteries will be produced. How to rationally deal with the new energy

vehicles used power batteries is the urgent problem. To promote the development of the new energy automobile industry, the following points should be achieved: first, actively promote the development of the battery value chain, improve the recycling system of waste battery recycling and utilization, cascade utilization and recycling, encourage joint construction and sharing of recycling channels, and strengthen the supervision of the whole life cycle; Second, based on the sustainable development of new energy vehicles, optimize the industrial layout of recycling and utilization, promote the efficient extraction of valuable elements of scrapped power batteries, and promote the development of industrial resources, high value and green 22.

4. Summary and outlook

The earth is a home for human beings to live and survive together. Protecting the beautiful earth is in line with the development needs of modern people and relates to the happy life of future generations. In response to the twenty spirit, the new development concept of innovation, coordination, green, open and sharing, the problem of harmonious development between man and nature, the strategy of "carbon peak" and "carbon neutrality" are actively promoted, and the industrial energy transformation is promoted. The new energy automobile industry, as the direction of future development, has become the benchmark of high-quality development of the world automobile industry. In the future development of new energy vehicles, adhere to the principles of market-led, innovation-driven, coordinated promotion and open development, and further, carry out the energy transition to the end. China's new-energy automobile industry has many advantages over the world, but it still needs to steadily tackle key problems in core technologies, continue to support the construction and improvement of core parts platform through government policies, strive to enhance international competitiveness, enhance Chinese residents' recognition and acceptance of new-energy vehicles, alleviate energy crisis, and benefit the world.

Reference literature

1. Li Mengqi. Research on Road congestion State Evaluation and Macro Basic Map based on Floating car data [D]. Beijing Jiaotong University, 2016.
2. Lu Chao, Yang Shiyi. Path analysis of low-carbon development of Urban Transportation [J]. People's Forum, 2022, No.742(15):69-71.
3. Li Xiaoyi, Tan Xiaoyu, Wu Rui, Xu Honglei, Zhong Zhihua, Li Yue, Zheng Chaohui, Wang Renjie, Qiao Yingjun. Research on the path of carbon peaking and carbon neutrality in Transportation [J]. Engineering Science, 2021, 23(06):15-21.
4. Yang Linzhi, Yao Huifang. Reverse logistics analysis of packaging based on SWOT PEST model [J]. Logistics Engineering and Management, 2023, 45(01):20-22+28.
5. Zhang Yuanyuan, Yao Yixia. Research on Nantong Home Textile Logistics System based on PEST SWOT perspective [J]. Logistics

- Technology,2021,40(03):119-121+135.
6. Tong Mengjun, Guan Huacheng. Research on Energy Balancing Multi-path Routing Algorithm Based on Ant Colony Algorithm [J]. Chinese Journal of Sensors and Actuators,2013,26(03):425-434.
 7. Wang Yingjiao. Government environmental policies on the development of new energy automobile supply chain function mechanism research [D]. Beijing jiaotong university, 2020. The DOI: 10.26944 /, dc nki. Gbfju. 2020.000741.
 8. parada. China's new energy automobile industry policy research [D]. Nanjing normal university, 2019. The DOI: 10.27245 /, dc nki. Gnjsu. 2019.000508.
 9. There are 417 million motor vehicles in China and more than 500 million drivers [J]. Road Traffic Management,2023, No.461(01):5.
 10. Li Zhihao. CFD Simulation of Blowers for Hydrogen Gas Leakage in Fuel Cell Vehicles [D]. Taiyuan university of technology, 2020. DOI: 10.27352 /, dc nki. Gylgu. 2020.001494.
 11. Liu Jinbao. Preparation of carbon-based multi-element composite and Its Application in Energy Storage Devices [D]. Shanghai University of Applied Technology,2016.
 12. Jiang Haibin. Research on Control Strategy and Controller of Pure Electric Vehicle [D]. Shanghai Jiao Tong University,2010.
 13. Zhang Wei. New energy car battery technology development bottleneck analysis and countermeasure research [J]. Metal functional materials, 2021, 28 (01): 78-84. The DOI: 10.13228 /j.b oyuan. Issn1005-8192.202000122.
 14. "Energy Saving and New Energy Vehicle Technology Roadmap 2.0" was released, putting forward six goals for China's automobile development towards 2035 [J]. Commercial Automobiles,2020,No.359(11):5.
 15. Jin Shicheng. Research on Engine Optimization of Extended Range Electric Vehicle Based on Atkinson Cycle [D]. Northeast forestry university, 2022. DOI: 10.27009 /, dc nki. Gdblu. 2022.000565.
 16. New Energy Automobile Industry Development Plan (2021-2035) (Abstract)[N]. New energy vehicles, 2020-11-09 (010). The DOI: 10.28896 / n.c nki. NXXQC. 2020.000285.
 17. Yumei Yang. Research on the Influence Factors of China's New Energy Vehicle Exports to the US under the Background of China-US Trade Friction[J]. Manufacturing and Service Operations Management,2022,3(3).
 18. China Government Net. Under the State Council general office on the notice issued by the new energy automobile industry development planning [EB/OL]. <http://www.mofcom.gov.cn/article/b/g/202011/20201103017539.shtml>.2020
 19. Wang Yajing. Beautiful China's "green" thick [N]. China's discipline inspection report, 2023-02-06 (005). The DOI: 10.28423 / n.c nki. NJJC. 2023.000290.
 20. Wang Meixin. Electric car lithium-ion battery charged state and health state estimation research [D]. China mining university, 2022. The DOI: 10.27623 /, dc nki. Gzkyu. 2022.001228.
 21. Xu Yan. Current situation and trend of development of the new energy vehicles [J]. Journal of practical technology, 2020, (24): 13-15. DOI: 10.16638 / j.carol carroll nki. 1671-7988.2020.24.005.
 22. Cheng Yanjin. Based on new energy vehicle power battery recycling blockchain alliance decision-making research [D]. Shanghai second industrial university, 2022. The DOI: 10.27916 /, dc nki. Ghdeg. 2022.000022.