

# *A Review of Research on the Future Development of Electric Vehicles and Traditional Fuel-powered Vehicles*

Yihang Wang<sup>1,a,\*</sup>

<sup>1</sup>*School of Mechanical-electronic and Vehicle Engineering, Chongqing Jiaotong University, China*  
*a. wasai4639@gmail.com*

*\*corresponding author*

**Abstract:** As the global number of traditional fuel-powered vehicles continues to rise, the development of electric vehicles (EVs) has become increasingly significant in addressing the severe environmental pollution associated with conventional internal combustion engines. This paper presents a comparative analysis of the characteristics of electric vehicles and traditional fuel-powered vehicles, with a focus on key technological aspects such as battery replacement systems for EVs and the current advantages of fuel-powered vehicles. Furthermore, the paper examines the challenges related to the driving range of electric vehicles, as well as the environmental impact of fuel-based transportation. Drawing on these analyses, market equilibrium strategies are proposed for the future development of both electric and fuel vehicle models. Considering the respective advantages and limitations—such as the battery life constraints of EVs and the environmental pollution from fuel vehicles—this paper outlines a roadmap for the coexistence and progression of both technologies. The findings suggest that while fuel-powered vehicles may continue to play a role, electric vehicles are poised to dominate the civilian automotive market in the future.

**Keywords:** EVs, Traditional fuel-powered vehicles, Battery replacement model, Future market.

## **1. Introduction**

In the 21st century, countries around the world are vigorously promoting the transformation of the automotive industry towards electric vehicles. Various countries have introduced different policies to restrict the development of fuel-powered vehicles and promote the development of electric vehicles. The development of electric vehicles is the only way for every country to become an automotive power. Daimler AG, studied the market trends and consumer acceptance of electric vehicles, proposed a strategy for electrification transformation, and emphasized that electric vehicles will occupy a larger market share in the next decade[1]. Tesla, Inc., through its research and development team, explored the impact of advances in battery technology on the performance of electric vehicles, especially innovations in range and charging speed. Professor Li of the Department of Automotive Engineering at Tsinghua University, studied the technical route selection of electric vehicles, analyzed the advantages and disadvantages of electric vehicles, hydrogen fuel cell vehicles and hybrid vehicles, and proposed a development strategy suitable for China's national conditions[2]. China Automotive Technology Research Center, published a study on the industrial policy of electric vehicles, exploring how national policies affect the market promotion and technological innovation

of electric vehicles[3]. The International Energy Agency (IEA), released a report on the development of the global electric vehicle market, analyzing the policies and market dynamics of different countries in promoting the popularization of electric vehicles[4]. The research team of the Massachusetts Institute of Technology (MIT) studied the environmental impact of electric vehicles and evaluated the impact of different power sources on carbon emissions during the life cycle of electric vehicles.

As countries implement policies for the transformation of automobiles, various automakers have responded highly to these policies and are actively transforming and upgrading. For instance, Maserati has announced its decision to exclusively manufacture pure electric and hybrid models after 2019; Jaguar has also declared that it will solely produce all-electric vehicles starting from 2025. However, blindly pursuing electric vehicles or traditional fuel-powered vehicles is not the optimal development plan, and currently, there is little research on the future development balance between electric vehicles and traditional fuel-powered vehicles. Future development needs to achieve a better balance between electric vehicles and traditional fuel-powered vehicles, and relative adjustments need to be made to the daily life needs and consumption levels of people in various countries. This article will use China as an example to explain the future development of electric vehicles and traditional fuel-powered vehicles.

## 2. Electric vehicles

### 2.1. Advantages of Electric Vehicles

**Energy Advantages:** In today's world, the global greenhouse effect is becoming more and more serious. The world is increasingly in need of cleaner and greener lifestyles, with transportation being an indispensable part of daily life. As a result, electric vehicles have emerged as a solution to this growing demand. The root cause of this shift towards electric vehicles lies in environmental resource issues. The clean fuel and zero-emission characteristics of EVs can contribute to environmental protection, which makes the replacement of traditional non-renewable fuel energy by new energy an irreversible trend. Most countries have already carried out a large degree of electric vehicle transformation. Taking China as an example, electric vehicle sales in the country have ranked first in the world for nine consecutive years since 2015. In 2022, it is projected that electric vehicles will account for more than 54% of new car sales in Norway, thus becoming the mainstream choice in the market. These countries have played a leading role in effectively addressing environmental pollution issues, resulting in significant reductions in carbon dioxide, nitrogen oxides, and other inhalable particulate pollutants emissions.

**Development Trend Support:** Taking China as an example, the country has implemented policy support to facilitate the transformation of the automobile industry through the "Electric Vehicle Industry Development Plan", "Action Plan for Large-Scale Transportation Equipment Renewal", and "Guiding Opinions on Further Building a High-Quality Charging Infrastructure System"[5]. BYD is particularly noteworthy for its announcement to cease production of traditional fuel-powered vehicles in 2022 and shift its focus entirely to pure electric drive and hybrid plug-in vehicles. This marks a significant transformation for the company, making it the first traditional automobile manufacturer in the world to discontinue production of fuel vehicles. BYD has successfully transitioned to electric vehicles and has even surpassed Tesla in leading the way in electrification transformation. By July 2024, the sales volume of electric vehicles had reached an impressive 311,804 units, securing BYD's position as the top-selling electric vehicle manufacturer globally. The favorable policy environment has greatly facilitated the rapid advancement of electric vehicle companies like BYD, resulting in remarkable achievements within a short period of time.

**Market Advantages:** While the country is vigorously promoting the transformation of traditional automobile companies to new energy, people's awareness of environmental resource protection is also constantly improving [6]. With the price reduction of electric vehicles and the increase in people's income and consumption levels, more and more people tend to choose electric vehicles. Since 2015, China's electric vehicle sales have ranked first in the world for eight consecutive years[7]. Some local policies promote the purchase of electric vehicles by offering reduced purchase taxes and providing more preferential policies for license plate selection. For instance, the Gansu Provincial Taxation Bureau has issued a document stating that electric vehicles acquired between January 1, 2024 and December 31, 2025 will be exempt from vehicle purchase tax, of which each new energy passenger car tax exemption amount does not exceed 30,000 yuan. Furthermore, for electric vehicles acquired between January 1, 2026 and December 31, 2027, the vehicle purchase tax will be halved. The tax reduction amount for each new energy passenger car shall not exceed 15,000 yuan[8]. While being cost-effective, it can also bring convenience to people's travel and reduce the cost of living without reducing the quality of life. These advantages provide sales advantages for the development of electric vehicles, provide financial support for the technical research and development and subsequent maintenance of electric vehicles, promote the development of electric vehicle companies, and pave the way for the development of electric vehicles.

## 2.2. Disadvantages of EV

**Security Disadvantages:** At present, the research and development of electric vehicles has not yet achieved complete independence. Key components such as chips and intelligent precision radars rely on imports, and the independent research and development rate is low. Currently, more than 90% of automotive chips come from foreign countries. Once foreign supply stops, it will seriously hinder the development of electric vehicles[7]

While electric vehicles use cleaner energy, they also bring certain safety risks. Most electric vehicles use renewable energy sources such as natural gas, high-energy batteries, methanol, and hydrogen. When the temperature is too high, they are prone to flammability and explosion. In the early stages of electric vehicle introduction to the market, there were numerous incidents of electric vehicles catching fire. Currently, lithium batteries are the most widely utilized power source for electric vehicles nationwide[9]. It has the characteristics of long service life and high energy density, but still has certain safety issues. Under continuous high-temperature conditions, electric vehicle batteries will experience accelerated aging, leading to reduced battery energy and increased risk of failure, which in turn can lead to thermal runaway of power batteries. In addition, with the country's series of subsidy policies for electric vehicle companies, some companies have ignored or underestimated the safety testing of electric vehicles in order to take advantage of the policies and increase output to obtain more subsidies, and put some unsafe defective products on the market, seriously affecting the safety of electric vehicles and threatening the lives of passengers[10].

**Disadvantages of Charging:** As electric vehicles have not yet been popularized nationwide, the infrastructure for electric vehicles in some provinces and cities is still relatively inadequate, which is evident in the limited number of charging stations and parking facilities for charging. Although the total number of charging facilities has reached 10.604 million by July 2024, the current ratio of charging facilities is only 1:3, which is still a long way from the national planned target of 1:1[11].

Due to climate reasons, electric vehicles are mostly popular in the southern region. In the northern region, due to the cold and snowy weather in winter, the charging of new energy batteries will be greatly reduced. During daily commuting and storage, a higher amount of energy is consumed compared to other environments, leading to the need for more frequent charging. However, it is important to note that the current charging efficiency stands at approximately 80%. The charging time of different vehicles varies depending on the charging method and battery capacity. On average, it

takes 6-8 hours to fully charge using a general charging pile and 1-2 hours using a fast-charging pile[12]. However, the majority of fast-charging stations are situated in public commercial parking lots, with a low rate of adoption. There are often problems such as long queues or slow charging speeds due to the small number of fast charging piles. For the majority of households, electric vehicles require daily charging, whereas traditional fuel-powered vehicles only need regular refueling with a fast refueling speed. In comparison, electric vehicles are relatively inconvenient, which hinders the development of electric vehicles.

### **3. Traditional-fuel Vehicles**

#### **3.1. Advantages of Traditional Fuel-powered Vehicles**

**Charging Advantage:** Conventional fuel vehicles have a greater driving range compared to electric vehicles. Depending on the fuel tank capacity and combustion efficiency of different models, most fuel vehicles can travel hundreds or thousands of kilometers on a tank of fuel. In addition, fuel vehicles have been in existence for a significant period of time, and the infrastructure supporting them, such as gas stations is relatively complete and widely distributed. There is no need to consider the fuel supply problem in remote rural areas or daily urban commuting. In addition, the efficiency of energy replenishment is relatively high. During off-peak hours, it typically takes just around 3 minutes to refuel without having to wait in line. This offers great convenience for drivers, eliminating the need to endure long waits of 6-8 hours as often experienced with electric vehicles. In areas where the shortcomings of electric vehicles have not been resolved, traditional fuel-powered vehicles appear to be more acceptable to the public.

**Advantages of Applicable Scenarios:** The wide distribution of fuel tanks and gas stations of fuel vehicles makes their application range extremely wide, and traditional fuel-powered vehicles are more reliable when traveling long distances or going to remote areas. Fuel-powered vehicles have a wide range of applications across various climatic conditions and can perform well in harsh environments. They can fulfill roles that current electric vehicles are unable to match, particularly in emergency situations or when emergency rescue is needed by drivers. In severe weather such as heavy rain, gas stations can maintain normal operation and provide protection for fuel vehicles; in snowstorms, fuel vehicles can rely on mature and stable technology, and reliable mechanical devices such as engines to maintain normal vehicle operation and lead drivers out of danger. In addition, fuel vehicles have a relatively simple maintenance process, which is easier to maintain than the complex electronic systems of electric vehicles.

#### **3.2. Disadvantages**

As the third largest country in the world, China has abundant non-renewable fossil fuel resources such as oil, coal, and natural gas. With the rapid development and popularization of China's automobile industry, China's traditional fuel vehicle ownership has ranked first in the world. Although such a large number of traditional fuel-powered vehicles have brought convenience to the public's travel, it has also brought serious environmental pollution problems.

The harmful substances contained in the exhaust gas of traditional fuel-powered vehicles are mainly carbon monoxide, hydrocarbons and nitrogen oxides[13]. The carbon dioxide produced when a car burns fuel is the main gas that causes the greenhouse effect. The large number of cars has accelerated the pace of global warming. Among them, carbon monoxide pollutants emitted by small cars account for 68% of the total carbon monoxide emissions of all vehicles, hydrocarbon pollutants emitted by small cars account for 74% of the total hydrocarbon pollutants emitted by all vehicles, and nitrogen oxides emitted by these vehicles account for 77% of the total nitrogen oxides emitted by all vehicles. It is particularly important to solve the environmental problems caused by cars.

## **4. Future Development Balance between EVs and Traditional Fuel-powered Vehicles**

### **4.1. Future Development Direction of EVs**

China ranks first in the world in the promotion of electric vehicle market, but it has always been "choked" by foreign countries in terms of technology research and development. The reason is that China currently has limited capital investment in the research and development of electric vehicles. The comprehensive government investment and other sources of investment are too far behind those of major automobile countries such as Germany, Japan, and the United States, resulting in a large gap in core technology with automobile powers. In the future, investment in research and development costs should be increased, key technologies should be overcome, and the development level of electric vehicles should be improved. At present, the biggest problem of electric vehicles is the charging. The charging speed needs to be gradually overcome in terms of technology, but new technologies can be used to make up for the charging - implementing the battery swap model. The battery swap model is a "car-battery separation" sales model[14]. In this model, when electric vehicles are sold, the battery is not included in the sale. Instead, a specialized energy company manages and leases the battery. The car owner obtains the right to use the battery by leasing, realizing the separation of the value of the car and the battery, thereby reducing the cost of car purchase for consumers. When energy is needed, the battery can be replaced at a battery swap station, which can greatly shorten the time required. Generally, it only takes about 3 minutes, which is close to the time it takes for a fuel car to refuel at a gas station. It can greatly solve the problem of charging for electric vehicles.

However, the battery swap model also has certain disadvantages[15]. For example, the construction cost of battery swap stations and facilities is high: the construction of a battery swap station costs about RMB 10 million, but an unmanned sales model can be adopted to save labor costs. However, the investment's payback period is relatively long and requires government support. Additionally, there is a lack of unified power battery standards in China due to the various types of electric vehicle models available. As a result, different vehicles require different power batteries, making it difficult to perform battery swaps with specific batteries. The construction of specific battery swap stations will lead to problems such as their distribution being not widespread and uneven. If the battery specifications are to be standardized, it will require coordination with numerous electric vehicle companies, which poses significant challenges. Additionally, there are safety concerns associated with this process. The energy density of power batteries is extremely high, and battery swap stations must store many batteries, presenting a major safety hazard. If battery swap stations are constructed in densely populated areas, they will pose a serious safety risk to nearby residents. Conversely, if they are built in remote areas, it will compromise the accessibility and convenience of these stations, which goes against the intended purpose of their construction. In the future, electric vehicles should focus on solving the endurance problem and improving the convenience for people to use electric vehicles, so as to better promote the development of electric vehicles and take over the responsibility of traditional fuel-powered vehicles.

### **4.2. Future Development Direction of Fuel-powered Vehicles**

Traditional fuel-powered vehicles should be retained in future development due to their wide applicability. However, they have a great impact on environmental pollution, and measures should be taken to reduce environmental pollution. For example, optimizing the exhaust device involves updating the exhaust system, upgrading the ignition device, and fuel injection equipment to promote complete combustion of automobile exhaust gas and reduce gas emissions. Additionally, improving fuel quality includes rectifying non-standard fuel, optimizing fuel composition ratio to promote



complete combustion, and reduce pollution emissions[16]. Introducing policy support such as encouraging scrapping of old or high-emission vehicles, increasing prices for fuel vehicles, limiting types and quality of produced fuel vehicles can facilitate electric vehicles taking over the civilian vehicle market.

### 4.3. Comprehensive Future Development Direction

In general, the future should focus on solving the endurance problem of electric vehicles and the high pollution problem of traditional fuel-powered vehicles. Electric vehicles should be vigorously developed to reduce environmental pollution and keep pace with the development of the times, but at the same time, traditional fuel-powered vehicles should not be abandoned; rather, their advantages should be retained while removing any unnecessary elements. This approach will optimize the future automobile market structure, allowing traditional fuel-powered vehicles to maintain a presence in the high-end market segment. Enterprises that retain traditional fuel-powered vehicles should only focus on supplying the high-end market, as well as serving the disaster relief industry and racing industry. The number and production of fuel vehicles should be significantly reduced. Policies should be implemented to promote the popularization of electric vehicles so that they occupy most of the market share in order to optimize the civilian automobile market structure. By striking a reasonable balance between electric vehicles and traditional fuel-powered vehicles, we can make full use of their respective advantages while avoiding their disadvantages.

## 5. Conclusion

In general, based on the low-carbon and environmentally friendly characteristics of electric vehicles, electric vehicles will completely replace traditional fuel-powered vehicles in the future. However, electric vehicles still have some limitations and cannot fully replace the advantages of traditional fuel-powered vehicles. This article explains the characteristics of electric vehicles and traditional fuel-powered vehicles, makes certain plans for their future development, promotes their respective advantages, avoids their respective disadvantages, and promotes electric vehicles to replace most traditional fuel-powered vehicles. This article exclusively addresses the primary advantages and pressing issues pertaining to electric vehicles and traditional fuel-powered vehicles. However, it does not delve into certain influential factors that also impact their development, nor does it provide extensive distinctions and explanations regarding various types of electric vehicles or batteries. In future research, a more detailed explanation of specific methods for promoting the development of electric vehicles can be provided based on improvement strategies employed for traditional fuel-powered vehicles.

## Acknowledgment

First of all, I would like to express my utmost respect and gratitude to my supervisor, whose meticulous guidance and patient instruction have not only facilitated my continuous academic progress but also deepened my understanding of the core principles within my field of study. Secondly, I would also like to thank my alma mater and college. The school provides a conducive learning environment and offers resources that enable us to fully dedicate ourselves to our academic pursuits.. The teachers of the college also pointed out the direction of our academic path with their profound professional knowledge and rigorous academic attitude. Finally, I would like to convey my gratitude to all those who have provided me with assistance and support. I will cherish this valuable experience, make continuous progress, and lay a solid foundation for my future studies and life.

## References

- [1] Daimler AG. Observation on investment opportunities in China's electric vehicle industry , 2022.10. <https://www2.deloitte.com/content/dam/Deloitte/cn/Documents/consumer-business/deloitte-cn-fa-investment-opportunities-observation-on-new-energy-auto-in-china-zh-221018.pdf>
- [2] Keqiang Li. (2020). Current status and countermeasures of the development of intelligent connected vehicles. *Robotics industry*. (06), 28-35. doi:10.19609/j.cnki.cn10-1324/tp.2020.06.005.
- [3] Di Liu, Sha Liu, Xinyu Teng, Guohua Zhang. (2023). Research on the interaction between the development of China's electric vehicle industry and industrial policies. *Automotive Industry Research* (03), 30-35.
- [4] International Energy Agency. Global EV Outlook 2024, 2024, 4. <https://www.iea.org/reports/global-evoutlook-2024>
- [5] Notice of the General Office of the State Council on Issuing the Electric vehicle Industry Development Plan (2021-2035) [J]. *Gazette of the State Council of the People's Republic of China*, 2020(31):16-23.
- [6] Jiao Jia. (2023). The current situation, advantages and strategies of the development of my country's electric vehicle industry under the "dual carbon" goal. *Administrative Science Forum* (05), 54-58.
- [7] Jichao Hong, Fengwei Liang, Jingsong Liang & Kerui Li. (2023). Current status and prospects of electric vehicle industry and its technological development. *Science and Technology Review* (05), 4959.
- [8] Gansu Provincial Tax Service, State Taxation Administration, 2023.9.8, [http://gansu.chinatax.gov.cn/art/2023/9/8/art\\_10\\_367064.html](http://gansu.chinatax.gov.cn/art/2023/9/8/art_10_367064.html)
- [9] Xiaolin Wang. (2023). Analysis and solution strategies of safety issues of power batteries for electric vehicles. *Times Automobile* (24), 112-114.
- [10] Can Wang. (2022). Analysis of the current status and development prospects of electric vehicles in my country. *China Equipment Engineering* (22), 263-265.
- [11] Yan Xu. (2020). Current status and trends of electric vehicle development. *Automobile Practical Technology* (24), 13-15.
- [12] Pin Wang. (2024). The current status and countermeasures of China's electric vehicle development. *Automobile practical technology* (08),187-191.
- [13] Xing Xing & Chunfu Huang. (2024). Research on the impact of different types of motor vehicle emissions on air pollution. *Shanxi Chemical Industry* (05),237-239.
- [14] Baojun Tang, Xiangyu Wang, Bin Wang, Yun Wu, Ying Zou, Huangchen Xu & Ye Ma. (2019). Analysis and Prospect of the Development Level of China's Electric vehicle Industry. *Journal of Beijing Institute of Technology (Social Science Edition)* (02), 6-11.
- [15] Hongjiang Liu & Xinrui Wang. (2022). Current status and development trend of battery replacement mode for electric vehicles. *Cooperative Economy and Technology* (04),14-16.
- [16] Deshi Yin, Zhenzhen Sun, Hailan Tian, Hongxing Yi & Huijing Ning. (2023). Research on the impact of automobile exhaust emissions on the environment and prevention and control measures. *Leather Manufacturing and Environmental Protection Technology* (11), 77-79.