Future Development Trend and Sustainability Analysis of Electric Vehicles

Jiyuan Xiao *

Department of Statistics and Analysis, 2023 University of North Carolina at Chapel Hill, North Carolina, United State

* Corresponding Author Email: jxiao@unc.edu

Abstract. Technology is the important driving force to improve the society. Due to the Industrial Revolution and World War II, the automobile industry develops rapidly and becoming increasingly popular and safe for daily transportation. However, due to concerns about environmental issues and fuel fossil shortage, the invention and promotion of electric vehicles gradually alleviated these issues. This paper aimed to explore the future development trend for electric vehicles. At the same time, it will analyze the issues and potential solutions for electric vehicles and the possibilities that gasoline vehicles might be replaced by electric vehicles by comparing both advantages and disadvantages of gasoline vehicles and electric vehicles. As the increase of development trend for electric vehicles, the sales volume continues increase. The reason why the sale volume keeps increasing is because of high gas price, governmental policies, and the increase awareness of environmental issues. This paper could help people to understand the reason why electric vehicles are more sustainable than gasoline vehicles.

Keywords: Future Trend, Charging, Gasoline Vehicles, Electric Vehicles.

1. Introduction

Throughout history, technology is one of the most important factors that lead the society to be improved. Technologies not only play a huge role in society, but it is also defined as an indispensable part in daily lives. Taking the automobile as an example, it is one thing that people could not live without it. After the automobile was invented, it continued to evolve over the years. The evolution was not only for the exterior of the automobile, but also the inside functions. Because of the industrial revolution and World War II, the automobile industry developed dramatically. Since the automobile industry developed throughout the years, automobiles became more and more widespread and safe. The kinetic energy for automobiles transferred from steam to gasoline that led them to have longer range compared to the steam vehicles. On the other hand, gasoline vehicles produce carbon monoxide which is harmful to the global environment. The significant numbers of automobiles that people use daily create environmental issues to the earth. Due to concerns about environmental issues, electric vehicles were invented. Although electric vehicles were invented in the 19th century, it was not popularized; due to the limited knowledge and resources, the continued evolution stopped [1]. As the technology and knowledge improved, the process of inventing and promoting electric automobiles reduce the concerns about environmental issues. Other than the concerns about environmental issues, there is another factor that promotes the evolution of electric vehicles which is the gas shortage. Electric vehicles are highly popularized and widely used. There is a question raised, will the traditional gasoline vehicles be completely replaced by electric vehicles? In this paper, it will compare these two different kinds of vehicles, investigate the possible issues, solutions, and some future references.

2. Development Trend of Electric Automobiles

Currently, the development trend of electric vehicles continues to rise. This trend is evidenced by the continued increase in sales of electric vehicles over the past few years. To be more specific, especially in 2022, the number of electric vehicles that were sold increased 3 percent compared to

2021 worldwide. Not only did the number of electric vehicles that were sold increase, but also the number of plug-in hybrid electric vehicles that were sold increased. The total number of new energy vehicles which include electric vehicles and plug-in hybrid electric vehicles that were sold exceeded 10 million in 2022 and it is relatively 55 percent higher compared to 2021. The reason why the sales number of new energy vehicles increased dramatically is that the gas prices are extremely high which promotes people to transfer their vehicles from gasoline to electric. This transformation is also influenced by the government policy and the rising awareness of environmental issue. As Fig. 1 shows below, from 2010 to 2022, the number of electric vehicles that were sold increased as the year increased [2]. This is not only due to the technology becoming mature, but it is also because of the government policy and people's awareness of sustainability.

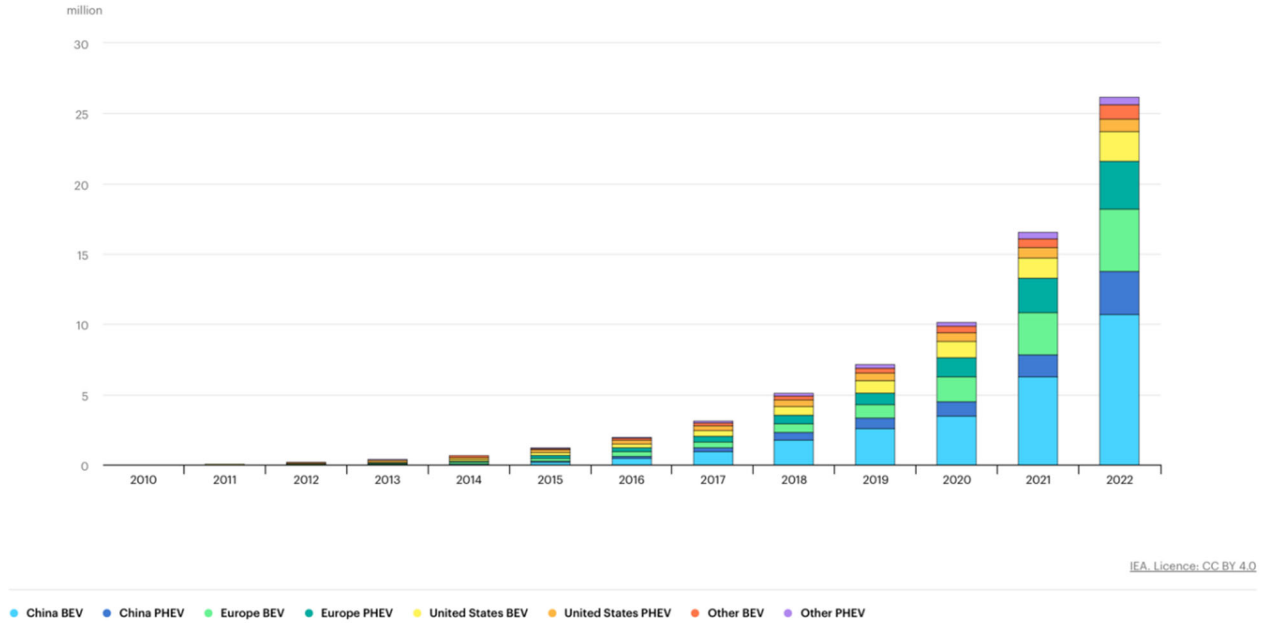


Figure 1. Global Electric Car Stock, 2010-2022 [2].

2.1. Comparison Between Different Type of Vehicles and Future Trend

Both gasoline automobiles and electric automobiles have their advantages and disadvantages. First, compared to electric vehicles, gasoline vehicles have more widespread infrastructure because there are numerous gas stations around the world. It provides people with a more stable and convenient situation to refuel while they travel long distances [3]. To be more specific, gasoline vehicles normally have longer driven ranges than electric vehicles. As well, the refuel time is relatively shorter than electric vehicles. Compared to electric vehicles, customers have a broad range of models when they are shopping for gasoline vehicles such as the heavy-duty trucks. The most advantages for gasoline vehicles are that the technology is well established, and people have a better understanding of gasoline automobiles [4] As people nowadays become more and more aware of sustainability which leads people to concern about the environmental issues that were caused by gasoline vehicles, this is one of the disadvantages about gasoline vehicles. By reducing the usage of gasoline vehicles, it decreases the dependency of fossil fuel. In addition, the cost of repairing and maintenance of gasoline vehicles is higher than the electric vehicles, because the cost of oil change and rotors are higher than the electric vehicles. The advantages of electric vehicles are that it is beneficial for the environment, the cost of electric vehicles is lower, and reduced the reliability of fossil fuel [5].

These advantages and disadvantages that gasoline vehicles and electric vehicles have been one of the most important factors when people decide to purchase their new vehicles. Other than these, government promotes people to purchase electric vehicles in several ways. For example, in the United States, the government returns tax to people who bought electric vehicles and appeals to manufacturers to not sell gasoline vehicles in 2030. As well, using plug-in hybrid electric vehicles to

replace traditional gasoline vehicles first. The issues that occurred are the barriers for adopting electric vehicles completely; however, the government and manufacturers are working on possible solutions to eliminate these problems in order to achieve the process of adopting electric automobiles completely. To be more specific, the United States Federal Government has set a goal to make half of all new vehicles sold in the U.S. in 2030 zero-emissions vehicles, and to build a convenient and equitable network of 500,000 chargers to help make EVs accessible to all Americans for both local and long-distance trips. These policies not only encourage people to purchase electric vehicles, but it also eliminates the concerns about charging issues when driving electric vehicles. Other than this, the US government has a tax return for people who purchased electric vehicles. For example, in several states, customers purchasing electric vehicles are eligible for a tax return of up to $7,500. By returning the tax, the purchasing price for electric vehicles is lower than gasoline vehicles for the vehicles that are in the same class [6]. According to the government policy, the government is encouraging people to purchase electric automobiles instead of gasoline automobiles. On the other hand, since it is impossible now to completely replace gasoline vehicles, the automobile industry started to produce more new energy vehicles which are electric vehicles and plug-in hybrid electric vehicles. Based on this trend, it might be highly possible that gasoline automobiles will be replaced by electric automobiles in the future.

3. Challenges and Solutions

3.1. Charging Equipment

Before gasoline vehicles are completely replaced, there are several issues that the electric vehicles industry needs to face. If these issues are solved, gasoline vehicles will be completely replaced by electric vehicles. Charging infrastructure is the most challenging issue that they are facing. To be more specific, many customers give up on purchasing the electric vehicles because of the charging infrastructures. First, charging infrastructure is an issue because there are not as many charging stations as the gas stations. As well, the number of charging stations vary based on different religions; therefore, this issue leads to inconvenience to the customers and creates a barrier for adopting electric vehicles.

The best way to solve this issue is that all groups such as the government, utilities, and companies should work together to expand the charging network to provide a more stable and convenient situation for people to charge their electric vehicles. As well, the charging stations along the highways are very essential to step over the barrier for adopting electric vehicles. Except for the number of charging stations, the charging port currently is only allowed to charge one vehicle at the time, even if there are more connectors. By solving this issue, technicians need to consider building more charging ports at the same station in order to reduce the charging infrastructure. As well, the permit should be required for electric vehicle owners because it prevents other people from entering the charging station that may cause the station to be occupied and not used by electric vehicle owners.

3.2. Charing Time

Charging time is another issue that should be conquered to use electric vehicles to replace gasoline vehicles. As mentioned above, the charging time is one of the disadvantages that electric automobiles have. This disadvantage leads people to be unwilling to purchase electric vehicles because of the inconvenience. Moreover, the charging time for electric vehicles is much longer than filling the gas tank. Therefore, when people have a road trip, they need to spend much longer time to charge instead of enjoying the trip.

There are several solutions for this issue. First of all, fast charging technology should be more developed and complete. The fast-changing technology is the best way to reduce the charging time for the owners. For example, the level 3 charging should be more widespread. This kind of charging technology could charge electric vehicles up to 80 percent within twenty to thirty minutes. As well, level 3 charging technology could provide a more sustainable driving condition for owners. For

example, the battery will not reduce as fast as the normal charging technology. Currently, only Tesla charging stations have this kind of charging technology. This kind of charging technology should be more widely spread in order to reduce the charge time for all electric vehicle owners. By extending the battery capacity is also a way to solve this issue. There are electric vehicles that do not have a high battery capacity which lead to the battery dying faster than others and provide longer driving ranges. Therefore, if the technicians could work on inventing a battery that has higher battery capacity, the charging time should be reduced as well. For instance, solid-state batteries have the potential to reduce the charging time and expand the battery capacity because of its low density [7]. However, scientists are working on the use of this kind of batteries in the electric vehicles because they need to consider whether it is safe enough to use on the electric vehicles. Swapping batteries at the charging station might be a possible solution as well. However, it could be hardly achieved in the real world, because of the high costs and pollution [8]. To be more specific, the cost of producing batteries is high and the replaced batteries could cause pollution to the earth which is against the original ideas of sustainability. As a result, swapping batteries is just an ideal solution to solve this issue; however, other solutions could be helpful to eliminate this [9].

3.3. Battery Issue

Furthermore, consumers are concerned about the used electric vehicles market because of the battery life. To be more specific, the battery is the most essential part in the electric vehicles, basically everything is run by the battery; therefore, the health of the battery that consumers will be considered the most. The solution for this is that the factories and companies should implement a battery health report for the consumers in order to help them to check the battery health. Battery health is extremely important for people who want to purchase used electric vehicles. Before purchasing used electric vehicles, the dealerships should check the battery health and provide the report which includes the battery capacity and the condition of the electric vehicles to the customers. This could limit the concerns that consumers have when purchasing used electric vehicles. The factories and companies should provide a longer warranty for their customers because this could increase the willingness that people have to purchase an electric vehicle. Other hand, dealerships should educate their customers about maintenance of the electric vehicles, how to maintain battery health, and how to access the report by themselves.

4. Conclusion

In conclusion, the traditional gasoline vehicles and electric vehicles both have advantages and disadvantages. These advantages and disadvantages become the concerns for people about what kind of vehicles they should drive. However, the trend of replacing gasoline automobiles to electric automobiles is becoming higher and higher because of the environmental issues and less cost for purchasing electric vehicles. Replacing gasoline vehicles will be significant in the future. Although there are significant issues that should be solved, the possibility of replacing gasoline vehicles has increased dramatically throughout the years. The process of replacing gasoline will not be complete in a short time, but it will be achieved in the future. As well, using plug-in hybrid electric vehicles to replace traditional gasoline vehicles first. The issues that occurred are the barriers for adopting electric vehicles completely; however, the government and manufacturers are working on possible solutions to eliminate these problems in order to achieve the process of adopting electric automobiles completely. In the future, scientists could focus on using other fuel sources to make the automobile to be more sustainable that could eliminate the concerns about environments.

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