PROCEEDINGS OF THE
INTERNATIONAL CARBON NEUTRALITY TRAINEESHIP PROGRAM
Volume.02, Number.1, 2024, 68-75

The Advantages and Lessons to be Learned from the Development of New Energy Vehicles in European Countries in the Context of Carbon Neutrality and Carbon Neutrality-Taking Norway and Sweden as an Example

Weiyu LI

Capital Normal University, Beijing, China, 100048

Email: li_weiyu_icnt@iexchange.world

***Corresponding author**

Abstract

A stable climate is the environmental basis for the progress of modern civilization and the development of agriculture. From the perspective of sustainable economic and social development, "carbon neutrality" means that people's way of production and life will further move from rough to fine; economic development will fundamentally change the mode of high-carbon development towards "low carbon and green", and will be transformed from resource-driven to science and technology-driven, and society will further shift towards resource-driven and science and technology-driven.

The future direction of global automobile development is new energy, which has become the consensus of countries and enterprises all over the world. There are four major types of new energy vehicles: hybrid electric vehicles (HEV), pure electric vehicles (EV/BEV, including solar vehicles), fuel cell electric vehicles (FCEV), and other new energy vehicles.

This paper adopts a case study approach to analyze the development market of new energy vehicles and the factors affecting the application of new energy vehicles in the context of carbon neutrality. There are three parts to this paper, in addition to the abstract and references. The first part introduces in detail what carbon neutrality is, the generation and classification of new energy vehicles; the second part focuses on the commitments given by various countries in fulfilling their carbon neutrality obligations, as well as the application market of new energy vehicles in various countries; the third part focuses on the European market, taking Norway and Sweden as examples, and comparatively analyzes the similarities and differences between the two countries in the field of new energy vehicles.

The purpose of this paper is to summarize the different practices of Norway and Sweden in the application of new energy vehicles, summarize the common points, compare the differences, and thus trigger a reference to think about.

Keywords: Carbon neutrality; new energy vehicle; high-carbon development; application market.

1. Introduction

1.1. An overview on carbon neutrality

Carbon peak is the peak of carbon dioxide emissions, which is used to consider a carbon emission organization at a certain point in time, carbon dioxide emissions peaked and no longer grow, and then gradually reduce the indicator. Carbon neutrality is a measure of the total amount of carbon emissions generated directly or indirectly by a carbon emitting organization over a period of time, and the relative "zero" emission of carbon dioxide is achieved by offsetting its own carbon dioxide emissions through other carbon reduction behaviors, such as the use of green energy, energy saving and emission reduction, and planting of trees and forests. At present, carbon neutrality is an important goal and direction to prevent greenhouse gases from affecting climate change.

Decades of research by scientists have shown that human activities cause climate change. After the industrial revolution, human economic activities have emitted huge amounts of greenhouse gases into the earth's atmosphere, and the rising concentration of greenhouse gases in the atmosphere has had a significant impact on the earth's climate system. A variety of climate and environmental problems have arisen, including rising global temperatures, rising sea levels, melting glaciers, and frequent occurrence of extreme weather. The gradual emergence of these catastrophic consequences, and the vocalization of scientists, environmentalists, politicians, and other knowledgeable people, have contributed to the gradual awakening of environmental protection awareness in countries around the world, and have led to the embarkation of countries on a journey of environmental governance and carbon neutrality.

In order to better understand and respond to climate change, the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) jointly established an organization of scientists called the United Nations Intergovernmental Panel on Climate Change (IPCC), which is dedicated to collating and reporting on the results of scientific research on climate change, and contributed to the adoption of a landmark international convention, the United Nations Framework Convention on Climate Change (UNFCCC). -The United Nations Framework Convention on Climate Change (UNFCCC) was adopted by the United Nations General Assembly in 1992 and signed by more than 150 countries and the European Economic Community. The goal of the Convention is to maintain greenhouse gas concentrations in the atmosphere at a stable level in order to avoid dangerous anthropogenic interference with the climate system. In accordance with the principle of "common but differentiated responsibilities", the Convention requires developed countries to take specific measures to limit greenhouse gas emissions and to provide financial resources to developing countries to meet the costs of fulfilling their obligations under the Convention. Developing countries, on the other hand, are only obliged to provide national inventories of sources and sinks of greenhouse gases, and are not obliged to make legally binding reductions.

In 1997, the parties to the United Nations Framework Convention on Climate Change convened the Third Climate Conference. After arduous negotiations, the participants finally adopted the Kyoto Protocol, which for the first time established legally binding mandatory emission limits for greenhouse gases. This landmark agreement specifies the types of greenhouse gases to be reduced by major developed countries by 2012, as well as the timetable and quota for such reductions.

In December 2015, at the Paris Climate Conference, the Paris Agreement was adopted. It is a legally binding agreement on a wider range of member states, requiring countries to voluntarily submit emissions reduction targets and to regularly assess and review the targets at least every five years; developed countries are obliged to continue to provide climate finance to developing countries. For the first time, the Paris Agreement formally sets "reducing the risks of climate change by limiting the increase in global average temperature to less than 2°C and moving towards a temperature control goal of 1.5°C as the objective of the world's climate change mitigation efforts". This is a long-term cooperation that transcends national boundaries and marks the transition of mankind to a low-carbon world.

The 1.5°C temperature control target in the Paris Agreement requires the world to achieve zero emissions, or carbon neutrality, in most countries around the world in about 30 years. The autonomous emission reduction commitments in the Paris Agreement, on the other hand, can only slow the rate of increase in global greenhouse gas emissions and fall far short of the carbon-neutral target by 2050. This requires parties to build on their original plans to reduce greenhouse gas emissions more vigorously, and the world still has a long way to go on the topic of climate governance.

1.2. An overview on new energy vehicle

Pure electric vehicles were used long before the advent of fuel cars. Early electric car batteries were relatively simple and non-rechargeable. With the development of engine technology, the invention of the internal combustion engine and the improvement of production technology, fuel cars developed a definite advantage at this stage. Advantage points are mainly manifested in that fuel is easy to carry, and can carry enough fuel to travel a long distance. Electricity, on the other hand, is not easy to carry, and the capacity of the battery is limited, so the distance traveled is limited, and charging is also inconvenient. The biggest problem hindering the development of electric vehicles is the lagging development of battery technology, no major breakthroughs in batteries have led to no breakthroughs in the charging box range, so that electric vehicle manufacturers are facing huge challenges. Traditional automakers, under market pressure, began to develop hybrid vehicles to overcome the problems of batteries and short range. This time is best represented by PHEV plug-in hybrids and HEV hybrids.

1.3. Types on new energy vehicle

There are four major types of new energy vehicles: Hybrid electric vehicles (HEVs), pure electric vehicles (EV/BEVs, including solar-powered vehicles), fuel cell electric vehicles (FCEVs), and other new energy vehicles.

Hybrid electric vehicle (HEV)), is a fuel vehicle that is simultaneously equipped with an electric motor to improve low-speed power output and fuel consumption. This type of vehicle, based on the traditional engine, is equipped with an electric drive system that allows for hybrid drive. It is capable of driving in electric-only mode, fuel-only mode, and hybrid mode. It will also store and charge the vehicle's battery. Compared to fuel vehicles, hybrids have low gas mileage and quick acceleration. Hybrid vehicles are equipped with a smaller battery capacity and do not require an external power source to charge the battery. Daily use is no different from traditional fuel vehicles and it is considered the most practical model at this stage.

Pure electric vehicles contain an electric motor and a power battery. The electric motor provides power to drive the car forward, and the driving process is completely zero-emission, typically represented by Tesla in the United States. Most of the vehicles powered by electric drive are directly driven by electric motors, and the driving process is almost zero emission. Taking China as an example, due to the relatively low manufacturing threshold of pure electric vehicles and the gradual maturity of battery technology, etc., the government has given a lot of support in terms of manpower, material and financial resources as the main way to reduce carbon emissions, and has made it a key focus of China's strategic emerging industries to develop. Currently China's new energy vehicle market has entered a stage of rapid development, mainstream manufacturers have launched pure electric models, pure electric vehicles are gradually approaching the cost-effectiveness of traditional fuel vehicles, the first and second-tier cities infrastructure is gradually improved, fast-charging technology is gradually improved, electric vehicle range has basically met the needs of consumers. Under the joint action of many factors, the sales of pure electric vehicles show a high-speed growth trend.[5]

Fuel cell vehicles are automobiles that rely on electric motors to drive them, using hydrogen, methanol, etc. as fuel and generating electric current through a chemical reaction. The energy of its battery is directly turned into electricity or by the chemical action of the gas, not by combustion. Fuel cell vehicles have the advantages of zero or near-zero emissions, smooth operation and no noise.

2. Results

2.1. Promises from countries on carbon neutrality

There remains a gap between the commitment of members of the international community to carbon neutrality and its implementation. At present, the carbon neutral commitments of most countries still lack policy documents to support their concrete implementation, and among the countries that have explicitly put forward carbon neutral policy documents, there are large differences in the expected degree of implement ability and strength of the carbon neutral

commitments of various countries.

In general, carbon emissions in the world are in three stages. Developed countries such as the United Kingdom, France, and the United States reached their peak in the 1970s and 1980s, and are now in a declining stage; developing countries such as China are in the stage of industrialization and upgrading, and their emissions have entered a plateau; emerging countries such as India have gradually increased their emissions due to the rapid development of their industries and economies, and have not yet initiated carbon-neutralization. Therefore, we analyze European countries as representatives of developed countries, China as representatives of developing countries, and India as representatives of emerging countries.

Europe, as an industrial pioneer in the 19th century, has far exceeded the world's average total emissions, both in terms of total emissions and incremental emissions, until the middle of the 20th actual year. Europe not only developed an industrial economy based on coal, steel and oil in the early stage, but also shifted the responsibility of carbon emissions to developing countries in the later stage.

Europe has a well-designed carbon-neutral planning system at the global top level, and the management system is divided according to the type of carbon emissions. Europe is the economy with the earliest start and the best legal system for carbon neutral action in the world, and plans to achieve carbon neutrality by 2050. Although developed countries are ahead of other countries in terms of their carbon emission systems, carbon emission intensity and carbon emission targets, this does not mean that developed countries have agreed to take on responsibilities that they should have taken on due to historical reasons.

China, as a representative of developed developing countries, the requirements of the times and its own development have determined its pivotal role in carbon neutrality, and it is committed to achieving carbon neutrality by 2060. The stage of China's economic development has entered the stage of industrialization and upgrading, changing from development at the expense of the environment to energy green development. Moreover, China's development in space exploration, cutting-edge military technology, and artificial intelligence cannot be left out of the picture in the area of carbon emissions. In addition, our economy is expected to continue to grow, playing a leading role compared to the climate stance of emerging and developing economies.

India is still in a rapid development phase and the energy transition is not yet complete, with a commitment to achieve carbon neutrality by 2070. Adequate energy supply is necessary to ensure urbanization. India's indigenous coal resources are abundant, but its oil and gas reserves are insufficient. If the price of coal increases and coal imports decrease, India faces an energy crisis at the same time. Therefore, in order to ultimately achieve the large goal of carbon neutrality, India needs to first complete the goal of ensuring a stable energy supply and improving the energy mix by 2030, while reducing carbon emissions. This is more difficult to achieve.

2.2. Fields on carbon neutrality

Carbon neutrality involves a wide range of fields, covering a series of industries such as electric power, chemical industry, iron and steel, cement, transportation, construction, etc., and is closely related to the national energy structure and industrial structure. To realize the reduction of anthropogenic carbon emissions and the enhancement of anthropogenic carbon sinks involves energy, resources, ecology, atmosphere, oceans, engineering, technology, management and many other disciplines and their comprehensive research, and at the same time, this major issue that has lasted for decades will also lead to the iterative development of cutting-edge technologies and subversive technologies.

2.3. Application on new energy vehicle

The Global Electric Vehicle Outlook 2023 reports that the vast majority of global EV sales are now concentrated in 3 major markets - China, Europe and the U.S. In 2022, the Chinese market accounted for 60% of global EV sales, and more than half of the world's sold EVs are now in China. In the same year, electric vehicle sales in Europe and the U.S. increased by 15% and 55% year-on-year respectively, with electric vehicles accounting for more than 1/5 of the new cars sold in Europe, and electric vehicle sales in other regions also showing rapid growth.

Relative to the United States, China and Japan, European car companies in general in the field of new energy vehicles started late. The reason for the late start is closely related to the advantages of European car companies in

the field of traditional automobiles. On the one hand, the European Union and European governments by the pressure of environmental protection organizations, through the formulation of harsh carbon emission regulations to promote the development of new energy vehicles; but on the other hand, European car companies, especially German car companies, due to their own fuel car emission reduction technology has the advantage of a delay in choosing the electrification of the development of the road. Until 2015 Volkswagen "diesel door" event broke out, only to force the Volkswagen Group to change its strategy, abandon the traditional diesel car route, completely embarked on the road of electrification, and formulated a comprehensive electrification development goals. Similar to the Volkswagen Group's electrification layout late, Germany's Daimler Group and France's Peugeot Citroën Group also began to shift the focus of development to the electrification route only in 2016.

On the electrification path of European car companies, it is worth mentioning the French Renault Group. Renault Group's pure electric vehicle development strategy was formulated the earliest. With the advantage of the alliance with Nissan, Renault Group announced its development strategy in 2008, clearly focusing its development on pure electric vehicles, and began mass production of four pure electric vehicles in 2012, of which the small passenger car Zoe was very popular. Zoe adopts a pure electric exclusive platform, and it is the first modern version of pure electric passenger cars in Europe. In addition to Renault, BMW and Volvo's electrification layout is also earlier, but their focus on plug-in hybrid vehicles. 2013, BMW launched the 1st pure electric car BMW i3. with the local advantage, Renault, BMW in the European new energy market for many years has been at the top of the list, and with the United States of America's Tesla, Japanese Nissan, Mitsubishi, share the top 5 brands in the European market. Tesla has occupied the top sales position in the European new energy vehicle market for many years. Compared with fuel vehicles, European new energy vehicle brands obviously lack advantages, even in the local market can not occupy a dominant position.[4]

According to IEA projections, the global outlook for the 2030 sales share of electric vehicles has increased to 35% based on existing policies and automotive industry targets. In China, the European Union and the United States, the average share of electric vehicles in total vehicle sales is expected to rise to around 60% by 2030.

The process of automobile life cycle assessment is to collect and summarize the data on the inventory of material extraction, component manufacturing and fuel production and use of different power types of automobiles, to comprehensively derive the environmental impacts of different power types of automobiles, and to summarize the evaluation opinions based on the impact results. The full life cycle assessment of automobiles provides powerful technical support for the green ecological development and optimization of automobile products, the formulation of strategic planning by automobile enterprises and the formulation of standard policies by the government, and provides reference opinions for the formulation of carbon neutral action plans in the field of transportation to achieve carbon peak. [1]Accurate calculation of energy consumption of new energy vehicles is the basis of carbon emission accounting. Due to a variety of factors, the energy consumption of new energy vehicles during driving is often different from the declared standard energy consumption value. This is mainly due to three factors: driver-related factors, environmental factors and the performance of the vehicle itself. Compared with traditional fuel vehicles, new energy vehicles are less expensive to use because they are powered by cleaner and more environmentally friendly energy sources. At the same time, they cause lower carbon dioxide emissions and contribute less to greenhouse gases in the air. During driving, new energy vehicles are smoother and quieter, so they can also reduce noise pollution and give consumers a better ride.

3. Discussion

In this paper, two European countries, Norway and Sweden, will be selected for comparison to analyze the similarities and differences between the two countries in the field of new energy vehicles, so as to provide experience for both sides to learn from, promote the better development of new energy vehicles in their own countries, and help achieve the goal of carbon neutrality.

3.1. Similarity

3.1.1. Geography

Located in the Nordic Scandinavian Peninsula on the west side of Norway covers an area of 324,000 square kilometers, less than two Beijing large countries mountainous area of 70%, and rich in water resources, abundant rainfall throughout the year, the average annual precipitation of 1380mm, water resources can be developed up to 38 million kW, is the world's per capita water resources, one of the richest countries.

Sweden's hydroelectric power generation capacity is relatively advanced. Rivers are short and fast flowing, with abundant water, small navigable value, and abundant hydraulic resources. One of the world's largest lakes, a total of 92,000 large and small lakes, many lakes have rivers between the communication, but because of the water level is not equal, often forming rapid waterfalls, conducive to the development of hydropower. It is possible to utilize 80% of this power, which is enough to satisfy the country's needs, and to export it to foreign countries.

3.1.2. Charging Highway

European countries are stepping up preparations for the infrastructure needed to achieve fossil-fuel-free travel after the European Union passed a landmark law in April requiring all new cars sold from 2035 to emit zero carbon dioxide, according to a recent report by Euronews.

In response to the new EU law, Sweden has decided to open the world's first permanently electrified highway in 2025. The electrification of the E20 highway follows a series of successful ERS pilot projects that have allowed electric cars and trucks to be recharged on the go and travel longer distances between charging stations, thus eliminating "mileage anxiety" and promoting sustainable mobility. The electrification of the E20 highway follows a series of successful ERS pilot projects. The Swedish Transport Administration is still considering whether to use conductive or inductive charging for the road.

In Norway, an Israeli company called Electreon has been awarded a tender to build wireless charging highways in both France and Norway. Electreon will use its Electric Road System technology, which helps to wirelessly charge local electric buses, on a road near a bus station operated by AtB AS. Their ultimate goal is to create a complete electric road in Trondheim, Norway that can charge electric buses, trucks and cabs.

3.1.3. Consumption tendencies

Global turmoil has increased the price of fossil fuels and made internal combustion engine vehicles more expensive compared to electric vehicles, which has fueled an increase in demand for electric vehicles globally. At the same time, Sweden is a country where the gap between the purchase cost of an electric car and an internal combustion engine car is small. On average, electric cars in Sweden are only 21% more expensive than combustion engine cars. At the same time, Swedish consumers are to a large extent willing to pay a premium for electric cars; on average, Swedish consumers are willing to pay 18% more for a tram than for a combustion engine car. The match between willingness to pay and the price difference may be one of the reasons why Swedish consumers prefer electric vehicles.

3.2. Difference

3.2.1. Government subsidies

As of October 2021, Norway's new energy vehicle penetration rate has reached 81.6%, ranking first in the world! With the penetration rate of new energy vehicles increasing, Norway has announced that it will ban the sale of fuel vehicles by 2025.

In addition to the nearly 100% private pile installation ratio, the Norwegian government has spared no effort to build more than 73,335 public charging piles, so that the Norwegian people travel to realize 0 anxiety. It is worth noting that with the arrival of the power exchange leader, Azera, in Norway, Azera will build 20 power exchange stations in 2022, so that Norwegian users can also enjoy the quality service of "5 minutes, the feeder becomes full power". The high penetration rate of new energy vehicles and the construction of convenient energy supply facilities cannot be separated from the government's promotion. In order to promote new energy vehicles to achieve zero emissions road traffic, help the national carbon neutral, the Norwegian government is worried about. Since 1990, the Norwegian government has introduced a series of incentives, including tax breaks, free parking, access to bus right-

of-way, etc., sparing no effort to make the user's new energy travel costs down to attract more people to choose new energy vehicles.

In the electric car purchase policy, the Norwegian government to reduce the electric car purchase tax, which directly allows electric car consumers to save 7 to 10 million yuan, plus the use of cost and parking concessions, Norway electric car consumers will enjoy than fuel car consumers cheaper than nearly 150,000 yuan of affordable, known as the world's cheapest electric car prices in the country.

Since 1990, the Norwegian government has introduced a series of financial incentives and subsidies for electric vehicles, which have effectively reduced the cost of purchasing and using electric vehicles in Norway. Thanks to this, Norway has become the most receptive country in the world to electric vehicles. According to the Norwegian Road Traffic Information Committee (OFV) data, in 2021, Norway sold a total of 176,276 new cars, up 25% year-on-year, including 113,715 electric vehicles, accounting for 64.5%, significantly higher than the 54.3% in 2020, the new energy vehicle market penetration rate ranks first in the world. Moreover, Norway does not have a local electric car brands, for foreign car companies on an equal footing, there is no policy to protect the local industry, natural attraction of new energy vehicle enterprises layout here. Norway is one of the earliest countries in the world to establish a carbon trading system, located in Oslo, Norway, the Nordic Power Exchange was established in 1993, is Europe's first exchange to provide carbon emission allowances and CERs, mainly to provide CO_2 spot contracts and some futures derivatives contract transactions, Norway is also the first country to levy a carbon tax, after several decades of accumulation, Norway has accumulated a wealth of experience in carbon trading as well as carbon pricing. After decades of accumulation, Norway has accumulated rich experience in carbon trading and carbon pricing.

Sweden's subsidy policy for new energy vehicles is mainly to reduce the purchase tax and carbon emission tax for green vehicles. Under the definition of green car, depending on the displacement, the use of biogas and ethanol cars can get 20 to 50 kronor/100km tax relief. Some local governments, e.g., Stockholm City, offer reductions on parking fees for green cars and on the running costs of green cabs. In Sweden, the Green Vehicle Incentive Policy stipulates that during the period from April 1, 2007 to December 31, 2009, purchasers of electric vehicles that meet the Green Vehicle Standard are entitled to a purchase subsidy of 10,000 kronor and exemption from the vehicle CO_2 emission tax. Other than this, there is currently no other supportive policy in Sweden. In order to promote electric cars and plug-in hybrids to the market, to increase the subsidy for them is the trend of the future development of electric cars in Sweden. The most likely option is to provide subsidies to car buyers. At present, the additional cost of an electric car or plug-in hybrid vehicle in Sweden is estimated at 50,000 to 150,000 kronor. The Swedish Energy Agency predicts that in the next few years, as the technology matures, the additional cost will be reduced.[3]

According to foreign media reports, the new Swedish government has canceled the state subsidies for pure electric cars and plug-in hybrids. The Swedish government announced that it will no longer provide incentives for the purchase of electric cars. The reason given by the Swedish government is that the cost of buying and driving such cars is now comparable to the cost of gasoline or diesel cars, and therefore the state subsidies introduced to the market are no longer justified.[2]

3.2.2. Hydroelectric power plants

In Norway, electricity is almost free for civilian use, while the development of power-consuming industries such as aluminum and magnesium using cheap hydroelectric power earns foreign exchange, while the trading of electricity through the sale and purchase of electricity, staggered storage of water resources, and neighboring countries to carry out power trading, to achieve good economic results. Even so, electricity is still a surplus in Norway as a country. "This opens the door for Norway's electric cars, free charging has become the most fundamental reason for Norwegian electric car consumers to buy an electric car, rather than the so-called environmental protection that many people keep describing," and Norway's neighboring many Swedish locals described, "and Norway than, Sweden in environmental awareness can be no worse than Not bad, but the God of electricity did not favor the other Nordic countries, the God of electricity to Norway nearly 1.5 Three Gorges hydroelectric power plant.

3.3. Outlook

As time goes by, more countries will realize the goal of carbon neutrality, and the application of new energy vehicles will become more widespread. At the same time, many new zero-emission technologies will emerge to continuously improve and develop the new energy vehicle market. Therefore, the country should continue to enhance government subsidies, actively create more infrastructure to facilitate the construction of new energy vehicles, do not engage in trade protectionism, and actively update the concept of consumers to adapt to the concept of low-carbon green, to help achieve the goal of carbon neutrality, and ultimately build a harmonious and beautiful world.

References

[1] Chen Yisong, Lan Libo, Hao Zhuo, et al. Review and Future Prospects of Life Cycle Assessment of New Energy Vehicles Towards Carbon Neutrality [J]. Chinese Journal of Automotive Engineering, 2022(004):012.

[2] Duan Liping. The Industry Development of Electric Vehicles and Relevant Policies in Sweden [J], Global Science,Technology and Economy Outlook, 2015, 000(001): 23-28. DOI: 10.3772/j.issn.1009-8623.2015.01.005.

[3] Liu Di. Research on the International Cooperation Model of China and Norway's New Energy Vehicle Industry [J], Auto Time, 2023(20): 120-123.

[4] WANG Shanjin, CHENG Yuan. Current status and development trends of European new energy vehicles [J]. Journal of Automotive Safety and Energy, 2021,12(2): 135-149.

[5] Zhang Zhenli. Opportunities and challenges of new energy vehicles in the context of "dual carbon" [J]. Special Purpose Vehicle, 2023(3): 10-12.