The development of New Energy Vehicles and environmental governance

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Abstract. Today more and more people are willing to choose New Energy Vehicles (NEVs) as travel tools. The automotive industry has witnessed a significant transformation over the past few decades, driven by the urgent need to reduce greenhouse gas emissions, combat climate change, and enhance energy efficiency. This article explores the relationship between environmental governance and NEVs, which encompass a range of technologies, including electric vehicles (EVs), hybrid electric vehicles (HEVs), and fuel cell vehicles (FCVs). This paper review explores the state of research and development in the field of NEVs, highlighting key advancements, challenges, and future prospects.

Keywords: environmental governance, New Energy Vehicles, energy conservation and environmental protection.

1. Introduction

The environment is the basic prerequisite for human survival and development. The environment provides the necessary resources and conditions for people's survival and development. Protecting the environment and reducing environmental pollution have become essential governance tasks. As we all know, the automobile industry is the engine of the economy. Every 1% increase in the output of the automobile industry can drive an overall increase of 10% in the output of all links in the economy. The automobile industry can drive many upstream-related industries such as steel, metallurgy, rubber, petrochemicals, plastics, glass, machinery, electronics, textiles, etc., and it can extend to many other upstream related industries such as maintenance services, commerce, insurance, transportation, and road and bridge construction. Downstream-related industries absorb various new technologies like new materials, new processes, and new equipment, which form considerable production scale and market size, create huge profits and provide numerous jobs. In 2017 alone, global car production reached more than 97 million units, and the number of cars in stock was close to 1 billion. With the scarcity of energy and the deterioration of the environment, new energy vehicles will undoubtedly become the direction of future automobile development [1]. A typical car emits about 4.6 metric tons of carbon dioxide per year. NEVs refers to vehicles fueled by alternative sources of energy, contrasting to traditional gasoline or diesel fuels. These vehicles are equipped with innovative technologies utilizing renewable energy resources and exerting lesser environmental impact, predominantly reducing greenhouse gas emissions. The key advantage of NEVs is reducing fuel consumption and exhaust emissions substantially while offering a driving range similar to conventional vehicles.

2. The impact of traditional cars on the environment

Traditional automobiles mainly use internal combustion engines as power sources and gasoline, diesel, etc. as energy sources. The environmental pollution caused by traditional cars mainly includes three aspects, which are emission pollution, noise pollution, and electromagnetic pollution. Emission and noise pollution take a strong or significant impact on people's living environment. Electromagnetic pollution does not directly affect human health. The fuel of traditional automobiles is mainly petroleum products, which are driven by combustion in internal combustion engines. Not all exhaust gases emitted by automobile engines are harmful, such as N2, O2, H2, and water vapor,

which are substances that will not cause direct harm to the human body and living things. The harmful substances emitted by automobiles mainly include the following CO, HC compounds, NO compound, Soot, CO2, and SO2. CO is the product of incomplete combustion of fuel. The worse the engine is working, the more CO in the exhaust. After it combines with human red blood cells, it will reduce the amount of oxygen delivered. In mild cases, it will cause headaches fatigue, and reduced reaction ability. In severe cases, it will cause headaches and fatigue. Coma and death, inhaling too much car exhaust can also lead to carbon monoxide poisoning. HC compounds are caused by automobile cylinder quenching, fuel evaporation, and incomplete combustion. They contain more than 200 harmful substances and are carcinogenic. NO compound is composed of N and O under high-temperature conditions in the car cylinder, is emitted into the atmosphere and becomes NO2. It is extremely toxic and has adverse effects on the human body and plants. It is also the main cause of acid rain and chemical smog. one of matter. Soot, contains a variety of particles, including carbon particles, sulfides, lead compounds, etc., is formed by insufficient combustion and crankcases, contains a large number of carcinogens, and is also the main culprit of smog. CO2 is the main product of complete combustion of fuel, is the main component of exhaust gas. The world emits more than 30 billion tons of CO2 every year, of which automobile emissions account for 10-15%. CO2 is the main factor causing the global greenhouse effect. SO2 is a product of fuel combustion, which very harmful to human breathing, causing chronic bronchitis, asthma, and other diseases. It is also the main substance of acid rain. According to surveys on urban air pollution sources in the United States and Japan, more than 90% of CO, more than 60% of HC compounds, and more than 30% of NO compounds in urban air come from vehicle emissions. These polluted gases pose a great threat to the human living environment. Vehicle pollution has become a global public hazard, and its contribution to the increase in greenhouse gas concentrations cannot be ignored. These harmful substances are mainly combustion products of automobile engines, which accounts for 65% to 85% of total automobile pollution.

3. The advantages of new energy vehicles

The concept of NEVs dates back to the 19th century, but it wasn't until the late 20th century that significant advancements were made. The new energy vehicles refers to automobiles which take unconventional fuels which are for automotive applications as the source of motive power [2]. Early electric vehicles were limited by battery technology, range, and charging infrastructure. However, these limitations gradually diminished with the advent of modern lithium-ion batteries, paving the way for commercially viable electric cars. The rapid growth of EVs has been a central focus of NEV research. This section delves into the evolution of EVs, including advancements in battery technology, improvements in charging infrastructure, and the development of electric vehicle architectures. Key milestones and breakthroughs in electric mobility are discussed, such as the emergence of Tesla, the proliferation of affordable electric cars, and the expansion of charging networks. Hybrid Electric Vehicles (HEVs) represent a bridge between traditional internal combustion engine vehicles and fully electric cars. This section explores the evolution of HEV technology, including parallel and series hybrid systems, regenerative braking, and the role of HEVs in reducing emissions and improving fuel efficiency. Fuel Cell Vehicles (FCVs) use hydrogen as a fuel source, have garnered attention due to their potential to provide long-range and rapid refueling. This section examines the progress in FCV development, challenges related to hydrogen production and infrastructure, and the role of FCVs in achieving sustainable transportation.

Electric vehicles (EVs) are a subset of NEVs that operate entirely on electricity. Direct-current (dc) charging is a method of charging that facilitates rapid energy transfer from the electric grid to plug-in vehicles [3]. Unlike conventional vehicles running on gasoline or diesel, EVs are driven by one or more electric motors, powered by a stacked set of batteries which need to be recharged by plugging into an external power source. EVs propose several remarkable advantages over their conventional counterparts. Primarily, they are considered zero-emission vehicles as they emit no tailpipe pollutants,

substantially reducing harmful air pollution. Additionally, EVs are significantly more energy efficient. They convert over 77% of the electrical energy from the grid, compared to only about 12-30% of the energy stored in gasoline consumed by internal combustion engines. On the sustainability front, EVs diminish the dependence on oil for transportation, in turn, facilitating energy diversity. From an economic perspective, the operation and maintenance costs of EVs are generally lower because of fewer moving parts and no expenses for oil changes. However, some challenges persist. The driving range of EVs, though improving rapidly, still lags behind conventional vehicles. The lack of charging infrastructure, particularly in remote and rural areas, and long charging times are considerable barriers. The initial cost of EVs poses another limitation, although this is anticipated to decrease as technology advances and economies of scale come into effect. Despite the challenges, the surge in EV demand in recent years is a testament to their growing appeal. EVs are becoming an integral part of the global mission to reduce carbon emissions and mitigate adverse environmental impacts. Technological advancements and increasing public awareness of environmental issues are catalyzing this shift towards electric mobility.

Hybrid Electric Vehicles (HEVs) represent an important category of NEVs, offering a unique blend of internal combustion engines (ICEs) and electric motors. Fuel cells are of great interest due to their high energy density, hence their application in hybrid electric vehicles [4]. Publicly popularized with the advent of the Toyota Prius in 1997, HEVs have paved the path for the larger adoption of electrified transportation. HEVs utilize both an ICE and electric propulsion systems. While the ICE can be fueled with gasoline or diesel, the electric energy is stored in batteries that are recharged via regenerative braking and by the ICE itself when it's operating at a higher efficiency regime. The dual-propulsion system is orchestrated by sophisticated control algorithms that decide the optimal mode of operation, providing a balance between fuel economy and power delivery. The key advantage of HEVs revolves around their significant boost to fuel economy and consequential reduction in CO2 emissions. By leveraging the electric motor during low-speed operations (where ICEs are typically inefficient), and the ICE for cruising or high-speed operations, HEVs reduce fuel consumption and exhaust emissions substantially while offering a driving range similar to conventional vehicles. Additionally, the regenerative braking feature in HEVs converts kinetic energy into electric energy during deceleration or braking. This energy is stored in batteries and is utilized when needed, thereby improving overall efficiency. Nevertheless, HEVs serve as a viable stepping stone towards fully electric vehicles, offering consumers improved fuel efficiency and reduced emissions without the worry of range anxiety or the need for charging infrastructure. The advancements in hybrid technology also lay the groundwork for technological developments in electric and plug-in hybrid vehicles.

A Plug-in Hybrid Electric Vehicle (PHEV) is a Hybrid Electric Vehicle that further leverages electric propulsion by being able to recharge its battery using an external power source. It is one which can reduce carbon dioxide emission and global warming [5]. PHEVs combine the advantages of EVs and HEVs to provide a more flexible solution for consumers wanting to make the switch to sustainable mobility. The key defining feature of PHEVs is their ability to be plugged into outlets of electric power for recharging the battery, from a home's wall socket to public charging stations and dedicated fast-charging points. This allows the vehicle to operate over extended distances using only electric power, thereby eliminating tailpipe emissions for daily commutes or short trips. When the battery depletes, the PHEV seamlessly transitions to operate as a conventional hybrid using a combination of a combustion engine and an electric motor. The operational flexibility of PHEVs makes them an attractive proposition amidst concerns over range anxiety which is a pressing issue for EVs. The gasoline engine's presence ensures long driving ranges analogous to conventional vehicles while capitalizing on the environment-friendly nature of electric power for shorter trips. While the benefits of PHEVs are manifold, certain challenges persist. PHEVs are typically more expensive than conventional hybrids due to additional batteries and more complex powertrain components. Further, the fuel efficiency and emissions depend largely on how often the vehicle is charged and the proportion of the journey completed in electric mode.Despite these challenges,

PHEVs serve as a vital technological bridge between conventional hybrids and pure electric vehicles. The development and acceptance of plug-in hybrid technology represent an important step toward ecosystem familiarization with charging infrastructure and a larger adoption of all-electric vehicles in the future.

Fuel Cell Vehicles (FCVs) are a type of new energy vehicle that uses a fuel cell instead of a battery, or in combination with a battery or supercapacitor, to power its onboard electric motor. FCVs have been considered as the best power source for next generation transportation due to their unique characteristics, including greet efficiency, quick starting speed, and minimal environmental impact [6]. FCVs commonly use hydrogen as fuel, but can also run on natural gas or a hybrid of hydrogen and natural gas. A fuel cell vehicle generates electricity using a process called reverse electrolysis. In this case, hydrogen and oxygen are combined to generate electricity, with heat and water released as byproducts. This approach distinguishes FCVs from conventional vehicles, which run on gasoline or diesel, and from battery electric vehicles, which are powered by stored electricity. The main advantage of FCVs is that they produce zero harmful tailpipe emissions, the only byproduct is water vapor. Additionally, FCVs are more energy-efficient than conventional internal combustion engine vehicles and have a longer driving range than most battery electric vehicles. Moreover, FCVs can be refueled in approximately the same amount of time as conventional vehicles, minimizing the inconvenience of long charging times associated with electric vehicles. However, few challenges obstruct FCVs' path to mass adoption. Primarily, hydrogen refueling stations are significantly less common than either gasoline stations or electric charging stations, making driving range and refueling a potential issue. Additionally, hydrogen is extremely flammable, creating safety concerns, and the production of hydrogen is often reliant on natural gas, a fossil fuel. Despite these challenges, interest in FCVs continues to grow. As a technology, fuel cells, particularly those used in FCVs, align with global initiatives towards clean energy, and hence attract favorable government regulations, incentives, and investments. Moreover, the excitement in the research community and industry around FCVs is palpable, as it is viewed as the propellant for the next generation of green vehicles.

Solar Powered Vehicles utilize photovoltaic cells, commonly known as solar panels, to convert sunlight into electric energy. These vehicles comprise of a large number of solar cells that convert sunlight into electricity, which is stored in batteries and used to power electric motors. Solar vehicles promise a renewable energy source for operations, distinctively leveraging the abundant and universally accessible sunlight. When solar energy and electric vehicle (EV) charging is coupled, our reliance on fossil fuels is greatly decreased [7]. They strike as an epitome of sustainable transportation since they produce no harmful tailpipe emissions, directly alleviating climate change and air pollution concerns. Vehicles powered entirely by solar energy have often been used in specially designed races, like World Solar Challenge in Australia, as a means to demonstrate technology prowess and spur innovation. Although these solar vehicles are not practical for regular use, the technology has been found valuable in other applications such as charging stations for electric vehicles and supplementary power source in consumer vehicles. The challenge with solar vehicles primarily lies in the energy intensity of sunlight and the efficiency of photovoltaic cells. With available technology, it is difficult to generate enough power to run a typical passenger vehicle solely on solar power. Further limitations include dependency on sunlight availability and geographical location, which restrict their widespread application. Solar-powered vehicles may not replace our typical means of transportation in the immediate future; however, they have the potential to significantly contribute towards sustainable transportation, particularly in conjunction with other forms of renewable energy. Technological advancements in lightweight vehicle design, energy storage, and solar cell efficiency may indeed fast-track this journey. Solar powered vehicles, another variant of NEVs, are a more niche area of study combining physics, engineering, and environmentalism. These vehicles use solar energy to power all or part of a vehicle’s propulsion. A network of photovoltaic cells (solar cells), usually placed on the roof of the vehicle, convert solar radiation from the sun into electric energy. This energy, either used immediately or stored in a battery, powers an electric motor which propels the vehicle. Today, solar vehicles have primarily been limited

to racing and experimental implementations. Major challenges include the significant area required for sufficient photovoltaic cells and the variable intensity of solar radiation depending on the geography, weather, and time of year. However, recent advancements in solar cell technology, battery technology, and vehicle design promise potential future viability.

4. The energy conservation and environmental protection of NEVs in environmental governance

There are about 30% of the pollution sources come from vehicle emissions. One of the most compelling reasons for the development and adoption of NEVs is the reduction of greenhouse gas emissions. Recent years most urban buses have significantly reduced pollution after switching to EVs. On the one hand the proportion of new energy has increased a lot, about 33%, and is still increasing. On the other hand the proportion of coal-fired power generation is constantly decreasing, ultimately reducing air pollution. From a policy perspective, China is currently vigorously promoting the development of new energy. Not only does it have favorable policies such as tax on car purchases, but some cities have also implemented exemptions for new energy vehicles in terms of travel. From an environmental perspective, NEVs reduce our dependence on fossil fuels and lead to improved air quality and a healthier planet. To fully realize the environmental benefits of NEVs, it is crucial to consider the source of electricity used for charging. The integration of renewable energy sources such as solar, wind, and hydroelectric power into the charging infrastructure to make NEVs even more sustainable. The environmental benefits of NEVs emphasize their role in mitigating climate change and improving air quality, especially in urban areas. While NEVs offer environmental benefits in terms of reduced emissions, their manufacturing processes and energy sources are not without environmental impact. The life cycle analysis of NEVs has huge amount considering factors such as raw material extraction, production, and end-of-life disposal. As the world grapples with escalating environmental concerns, exacerbated by climate change and global warming, transition to NEVs offers a promising solution against the backdrop of conventional fossil-fuel vehicles. Predominantly, the use of NEVs helps in drastically cutting down harmful vehicular emissions, combating air pollution and contribution towards a healthier and cleaner environment. NEVs can also alleviate dependence on oil imports, fostering energy security and promoting domestic industrial growth. The rise of NEVs reflects a paradigm shift in social attitudes toward environment-friendly solutions. It represents the convergence of technology with sustainability, acting as a lever to evolve our transportation architecture and energy consumption patterns. Increasing government incentives, stringent emission norms, and consumer awareness are enabling growth and adoption of NEVs. However, the path is fraught with challenges as lawmakers and industries grapple with infrastructure development, cost constraints, and technological limitations.

5. Conclusion

The research and development of New Energy Vehicles have made remarkable strides in recent years, driven by technological advancements and environmental imperatives. As governments, industries, and researchers continue to invest in NEV innovation, the transition to sustainable and efficient transportation systems becomes increasingly attainable. The future of New Energy Vehicles holds the potential to reshape the automotive industry, reduce carbon emissions, and contribute to a greener and more sustainable world. NEVs represent an exciting development in our pursuit of sustainable transportation. These vehicles, powered by alternative and renewable energy sources, present a viable solution to mitigate environmental deterioration and propel us towards a greener future.

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