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A REVIEW ON ELECTRIC VEHICLES AND ITS FUTURE

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ABSTRACT

Electric vehicles (EVs) are gaining popularity as a result of a number of causes, including lower prices and increased climate and environmental consciousness. This article examines the advancements of electric vehicles (EVs) in terms of battery technological trends, charging techniques, and new research problems and possibilities. More specifically, an analysis of the global market situation for electric vehicles (EVs) and their future prospects is conducted. Given that the battery is one of the most important components of electric vehicles, the article provides a comprehensive overview of battery technologies, ranging from lead-acid through lithium-ion. Furthermore, we examine the various charging protocols available for electric vehicles, as well as suggestions for power regulation and battery energy management. Finally, we give our view of what may be expected in the near future in this subject, as well as the research areas that are still accessible to both business and academic groups.

KEYWORDS: *Electric Vehicles, Plug-In Hybrid Electric Vehicle, Battery charging, Batteries technology, charging modes, EV plugs.*

1. INTRODUCTION

The automotive sector has grown to be one of the most significant industries in the world, not only in terms of economics but also in terms of R&D. More technology features are being added to cars to enhance the safety of both passengers and pedestrians. Furthermore, there are more cars on the highways, allowing us to travel more swiftly and pleasantly. However, this has resulted in a significant rise in air pollution levels in urban areas (i.e., pollutants like PM, nitrogen oxides (NOX), carbon monoxide (CO), sulfur dioxide (SO2), and so on)[1].

Furthermore, according to a European Union study, the transportation sector is responsible for approximately 28 percent of overall carbon dioxide (CO2) emissions, with road transport accounting for more than 70 percent of total emissions. As a result, most industrialized nations' governments are promoting the use of electric vehicles (EVs) to reduce the concentration of air pollutants, CO2, and other greenhouse gases. They encourage sustainable and efficient mobility in particular via a variety of programs, mostly through tax incentives, purchasing assistance, or other special measures, such as free public parking or free use of highways[2], [3]. Compared to conventional cars, EVs have the following advantages:

1. Zero emissions: these cars do not emit CO_2 or nitrogen dioxide from their tailpipes (NO2). Furthermore, the manufacturing methods are more environmentally friendly, despite the fact that battery production has a negative impact on carbon emissions.
2. Simplicity: The number of components in an Electric Vehicle (EV) engine is fewer, resulting in lower maintenance costs. The engines are simpler and more compact; they don't need a cooling circuit, and there's no need to include a gearshift, clutch, or noise-reducing components.
3. Reliability: Because these cars have fewer and simpler components, they are less likely to break down. Furthermore, EVs are immune to the wear and tear caused by engine explosions, vibrations, and fuel corrosion.
4. Cost: In contrast to conventional combustion cars, the vehicle's maintenance expenses and the cost of the energy needed are much cheaper.
5. Comfort: Traveling in an EV is more pleasant since there are no tremors or engine noise.
6. Efficiency: EVs are more fuel efficient than conventional cars. However, the total well to wheel (WTW) efficiency will be influenced by the efficiency of the power plant. For example, gasoline cars' overall WTW efficiency varies from 11 to 27 percent, whereas diesel vehicles' WTW efficiency ranges from 25 to 37 percent. EVs supplied by a natural gas power plant, on the other hand, have a WTW efficiency ranging from 13% to 31%, while EVs fed by renewable energy have a WTW efficiency of up to 70%.
7. Accessibility: This kind of vehicle enables entry to urban areas where other combustion vehicles are not permitted (e.g., low emissions zones). In big cities, EVs are not subject to the same traffic restrictions as cars, particularly during high pollution levels. Interestingly, according to a new OECD research, EVs will not enhance air quality, at least not in terms of Particulate Matter (PM) emissions.
8. Range: With a full charge, range is usually restricted to 200 to 350 kilometers, but this problem is constantly being addressed. The Nissan Leaf, for example, has a maximum driving range of 364 kilometers, whereas the Tesla Model S has a range of more than 500 kilometers.
9. Charging time: It takes 4 to 8 hours to fully charge the battery pack. Even a "quick charge" to 80% capacity may take 30 minutes. Tesla superchargers, for example, can charge the Model S up to 50% in 20 minutes and up to 80% in half an hour.

2. ELECTRIC VEHICLES

The author presents a categorization of the many kinds of electric cars in this part, along with comments on their major features. The author also discusses the present market position, examining sales statistics and forecasts for this kind of vehicle in various nations across the globe[2], [4], [5]. Figure 1 shows the classification of electric vehicles.

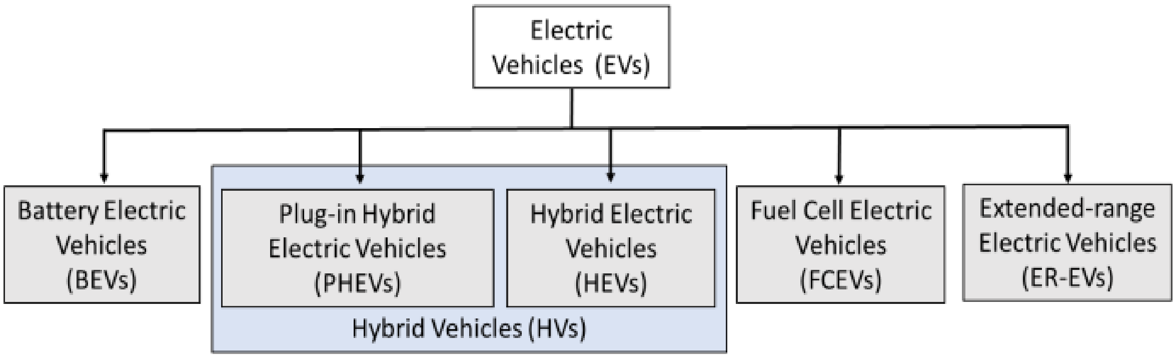

Figure 1: Illustrates the Electric vehicles classification according to their engine technologies and settings

3.1. Taxonomy of Electric Vehicles:

Depending on the technology used in their engines, we can now find several kinds of electric vehicles. They are divided into five categories in general:

3.1.1. Battery Electric Vehicles (BEVs):

BEVs are vehicles that are powered entirely by electricity. BEVs are electric vehicles that do not have an internal combustion engine and do not utilize any kind of liquid fuel. In order to provide a vehicle with sufficient autonomy, BEVs often require huge battery packs. A normal BEV ranges from 160 to 250 kilometers, but some may go as far as 500 kilometers on a single charge. The Nissan Leaf is an example of this kind of car. It is 100 percent electric and presently has a 62-kWh battery that enables customers to go 360 kilometers on a single charge.

3.1.2. Plug-In Hybrid Electric Vehicles (PHEVs):

Hybrid cars with a normal combustible engine and an electric engine powered by a pluggable external electric source are known as plug-in hybrid electric vehicles (PHEVs). In normal driving circumstances, PHEVs can store enough energy from the grid to substantially decrease their gasoline use. The Mitsubishi Outlander PHEV has a 12-kWh battery, allowing it to go 50 kilometers solely on electricity. However, it's worth noting that PHEVs' fuel usage is greater than manufacturers' estimates.

3.1.3. Hybrid Electric Vehicles (HEVs):

HEVs are powered by a combination of an internal combustion engine and an electric motor. The difference between HEVs and PHEVs is that HEVs cannot be connected to the power grid. In reality, the power produced by the vehicle's combustion engine is used to charge the battery that powers the electric engine. The energy produced while braking may also be used to charge the batteries in contemporary models, converting kinetic energy into electric energy. In its hybrid variant (4th generation), the Toyota Prius had a 1.3 kWh battery that supposedly enabled it to go up to 25 kilometers in all-electric mode.

3.1.4. Fuel Cell Electric Vehicles (FCEVs):

These vehicles have an electric engine that runs on a mixture of compressed hydrogen and oxygen taken from the air, with water as the sole waste product. Although these cars are claimed to have "zero emissions," it is important noting that, although green hydrogen is available, the majority of the hydrogen utilized is derived from natural gas. The Hyundai Nexo FCEV is an example of this kind of car, having a range of 650 kilometers between fill-ups.

3.1.5. Extended-range electric vehicles (ER-EVs):

These cars are quite similar to BEVs. The ER-EVs, on the other hand, come with a backup combustion engine that can charge the vehicle's batteries if necessary. Unlike the engines found in PHEVs and HEVs, this engine is solely utilized for charging and is not linked to the vehicle's wheels. The BMW i3 is an example of this kind of car, with a 42.2 kWh battery that provides 260 kilometers of autonomy in electric mode and an extra 130 kilometers in extended-range mode.

4. SUBSIDIES AND MARKET POSITION

Despite the fact that electric cars have a higher purchase price, when compared to the internal combustion engine version of the same vehicle model, the EV sales volume has increased significantly in recent years. Furthermore, several nations are preparing for the mobility shift by limiting the use of fossil fuel-powered vehicles and encouraging the use of electric vehicles. The fact that, after the Paris Agreement, state subsidies for these types of cars have increased is proof of this.In reality, almost all developed-country governments are constantly enacting new laws to encourage the usage of electric cars in order to promote sustainable and environmentally friendly transportation.

According to a study from Belgium, these kinds of cars are eligible for a purchase assistance of 4000 e, and they pay a road tax of just 74 e instead of the 1900 e that conventional vehicles pay. In France, customers who buy an EV get a bonus of between 4000 and 6000 euros for BEVs and 3500 euros for PHEVs. In addition, a 50 percent to 100 percent discount on the registration cost is available. In the United Kingdom, an incentive of up to £4500 will be given with the purchase of an EV, and the car will be free from circulation taxes if its value is less than £40,000. In Germany, customers get an incentive of 4000 euros for buying a BEV and 3000 euros for buying a PHEV. Furthermore, BEVs do not have to pay property taxes, while PHEVs get a 50% discount. In Spain, monetary assistance of between 1300 and 5500 euros is available for the purchase of BEVs and HEVs, depending on their autonomy. The property tax on BEVs and PHEVs in Norway is 47 e, whereas the rate for gasoline-powered vehicles ranges from 290 e to 340 e. Furthermore, BEVs do not pay tolls or circulation fees, and they do not pay for parking in designated locations. Finally, in the United States, the federal government offers $2500 for electric car purchases and an extra $417 for each kWh of battery capacity over 4 kWh, up to a maximum of $7500.As can be seen in Figure 2, all of these incentives and policies (e.g., vehicle buying tax exemption, VAT exemption, reduced license tax, tolls exemption, and free parking) are resulting in a significant rise in the number of sales each year (particularly in the past two years). As can be seen, China and the United States have by far the highest EV sales, but Norway stands out as the only nation in the world where EVs have a greater market share, with almost three out of every four cars sold in 2020 being electric[6]–[8].

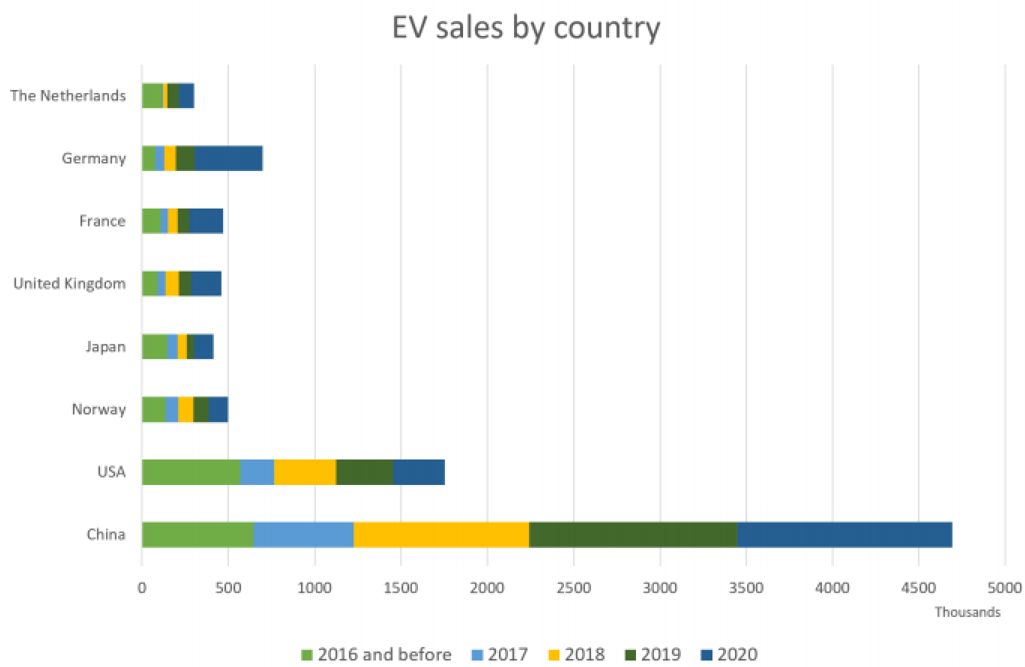

Figure 2: Illustrates the evolution of the number of electric vehicle sales worldwide.

According to, these figures are likely to rise in the coming years, since many nations have indicated a desire to outlaw internal combustion engines in the near future. Norway, for example, has said that by 2025, all cars and vans sold would be zero-emission vehicles. India, Israel, and the Netherlands, for example, have declared that all cars sold in 2030 would be electric. Germany and the United Kingdom have postponed this deadline until 2040, the same year that combustion cars will be outlawed in California. In a more stringent manner, Germany is contemplating prohibiting the circulation of diesel cars in cities, while Paris has declared that diesel vehicles will be prohibited from circulating in the city beginning in 2024, and internal combustion vehicles would be prohibited beginning in 2030. From 2024, Rome will prohibit the circulation of diesel cars, while Madrid, Athens, and Mexico City will do so in 2025. However, in addition to the good sales figures, it is worth noting that 95 percent of electric cars were sold in just ten nations (i.e., China, USA, Japan, Canada, Norway, United Kingdom, France, Germany, The Netherlands, and Sweden). Finally, it should be noted that a variety of BEV and PHEV models are now available for purchase. The Tesla Model 3 (BEV), Toyota Prius Prime (PHEV), Chevrolet Volt, Nissan Leaf (BEV), Tesla Model S (BEV), Ford Fusion Energi (PHEV), and BMW i3 (BEV) are among the most popular models.

5. BATTERIES

In this part, you'll learn about fascinating facts about batteries, such as global production growth, cost reductions, key features, and the many technologies used in the manufacturing process. There have been significant advances in the development of batteries in recent years. Furthermore, global manufacturing of batteries for electric cars has risen by 66%, which is certainly linked to an increase in the number of vehicle sales, with forecasts indicating that demand for batteries will continue to rise. In fact, it is expected that the supply and demand for electric vehicles will grow much more in the future years[9], [10].

5.1. Characteristics of Batteries:

The following are some of the most important features of batteries:

- Capacity: One of the major issues with electric power is the difficulty and expense of storing it. As a consequence, large sums of money are now being invested in the creation of new batteries that are more efficient and reliable, thus increasing battery storage capacity. Under specific circumstances, the battery capacity indicates the greatest amount of energy that can be recovered from the battery. This unit may be represented in either ampere hour (Ah) or watt hour (Wh), but electric cars prefer the latter. Given that the capacity of an electric vehicle's battery is a critical factor because it has a direct impact on the vehicle's autonomy, the development of new technologies that enable the storage of a greater amount of energy in the shortest amount of time will be a critical factor in the success of this type of vehicle.
- Charge state: This refers to the battery's capacity as a percentage of its total capacity.
- Energy Density: Obtaining the greatest possible energy density in the creation of batteries is another essential factor to consider. This means that a battery of similar size and weight can store more energy. The energy density of a battery is defined as the amount of energy it can provide per unit volume (Wh/L).
- Specific energy: The amount of energy a battery can provide per unit mass (Wh/kg). This characteristic is also known as energy density, and it may be measured in Wh/L or Wh/kg.
- Specific power: The amount of electricity a battery can provide per kilogram of weight (W/kg).
- Charge cycles: A charge cycle is finished after the battery has been fully charged.
- Lifetime: Another factor to think about is the battery's lifespan, which is determined by the number of charging cycles it can withstand. The aim is to develop batteries that can withstand a higher number of charging and discharging cycles.

6. DISCUSSION

The connection is one of the most essential considerations while charging an electric car. The J1772 standard recommended connections for the American and Japanese markets, whereas the IEC-62196 standard recommended connectors for European cars. Despite the fact that these markets are very diverse and distinct, this fact is undesirable since it may create problems for consumers while charging their cars; adapters may be needed, raising the cost of electric vehicles and perhaps posing safety concerns.Although Tesla, for example, has bet on the fact that some of its vehicles have multiple types of connectors, we believe it is more important to progress toward the creation of a unified standard that would allow for charging all vehicles through a universal connector when taking into account regional differences in energy systems. This universal connection, we believe, will benefit EV drivers, but it will also have a major environmental effect.

Another element that has the potential to change the charging process is the application of sophisticated algorithms to improve the charging process, either by lowering the cost or increasing the efficiency of the electrical infrastructure. Currently, the charging process begins when the vehicle is connected to the charging point (a process known as Plug & Charge); however, because electricity prices vary throughout the day in most countries, the charging start could be adjusted to significantly reduce charging costs by avoiding peak demand periods (where the economic cost is higher). Intelligent plugs may help electric cars win market share from internal combustion engines. Although there are preliminary works and proposals in this area, we believe that there are still several open issues and potential works to be done in this field, such as the use of communications between vehicles and electric infrastructure, as well as new Artificial

Intelligence-based technologies (e.g. Deep Learning techniques or Optimization Strategies), will enable highly enhanced chariot performance.

7. CONCLUSION

There are many kinds of EVs, the technology utilized, the benefits over internal combustion engine cars, the development of sales over the past few years, as well as the various charging ways and future technologies in this study. The major research problems and possibilities in depth. In the case of electric vehicles, batteries are crucial since they define the vehicle's autonomy. The author looked at a variety of batteries based on these characteristics. Author also discussed upcoming technologies, such as graphene, which is anticipated to provide a solution for storing larger quantities of electricity and charging in shorter periods of time. This kind of technology may also assist the EV, allowing it to go longer distances, which may aid in its acceptance by drivers and users. Higher-capacity batteries will make it easier to utilize the quickest and most powerful charging modes, as well as more advanced wireless charging technologies. Another element that may help with the adoption of electric cars is the development of a unique connection that can be used worldwide. In the future, electric vehicles will play a critical part in Smart Cities, and having a variety of charging methods that can adjust to the requirements of users will be very essential. As a result, future BMS should take into account the new situations brought by modern batteries and Smart City standards.

REFERENCES

1. F. Liao, E. Molin, and B. van Wee, "Consumer preferences for electric vehicles: a literature review," *Transp. Rev.*, 2017, doi: 10.1080/01441647.2016.1230794.

2. N. Daina, A. Sivakumar, and J. W. Polak, "Modelling electric vehicles use: a survey on the methods," *Renewable and Sustainable Energy Reviews*. 2017, doi: 10.1016/j.rser.2016.10.005.

3. C. Panchal, S. Stegen, and J. Lu, "Review of static and dynamic wireless electric vehicle charging system," *Engineering Science and Technology, an International Journal*. 2018, doi: 10.1016/j.jestch.2018.06.015.

4. O. M. Govardhan, "Fundamentals and Classification of Hybrid Electric Vehicles," *Int. J. Eng. Tech.*, 2017.

5. N. Bodenschatz, D. Schramm, M. Eider, and A. Berl, "Classification of electric vehicle fleets considering the complexity of fleet charging schedules," 2018, doi: 10.1145/3208903.3212056.

6. H. Wang, V. Anant, Q. Wang, and M. Ouyang, "An analysis on the market features of light hybrid electric vehicles in the USA," *Qiche Gongcheng/Automotive Eng.*, 2013.

7. FKA and R. Berger, "E-mobility Index Q2 2017," *Fka*, 2017.

8. P. Ahi *et al.*, "New multi-regional input–output databases for Australia – enabling timely and flexible regional analysis," *Econ. Syst. Res.*, 2015.

9. V. Alimisis and N. D. Hatziargyriou, "Evaluation of a hybrid power plant comprising used EV-batteries to complement wind power," *IEEE Trans. Sustain. Energy*, 2013, doi: 10.1109/TSTE.2012.2220160.

10. M. Aziz, T. Oda, T. Mitani, Y. Watanabe, and T. Kashiwagi, "Utilization of electric vehicles and their used batteries for peak-load shifting," *Energies*, 2015, doi: 10.3390/en8053720.