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General Overview and Forecasting of Factors Affecting the Use of Electric Vehicles

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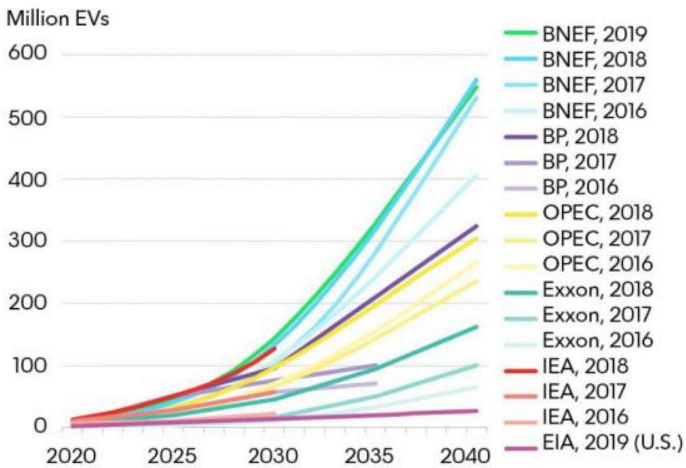
ABSTRACT— Electric vehicles are being promoted in a number of countries as a way to reduce greenhouse gas emissions and fossil fuel depletion. The rate of adoption of electric vehicles, on the other hand, varies per country. The study's goals were to compare factors that influence electric car uptake and to generate policy suggestions. The design of electric vehicles (EVs) is an example of a successful policy. It has been demonstrated that there is no single appropriate policy or country-specific scenario for supplying electric vehicles. Because electric vehicles are becoming more popular, a policy mix that promotes their proliferation in many countries is required. Government support for EV and charging station adoption appears to dwindle when EV and charging station designs advance beyond a certain point, maybe due to dwindling customer demand. Reduce the cost of electric car charging as well as the cost of license plate registration is one of the most essential things the many countries can do.

Keywords— Electric vehicles, fuel depletion, factor influence, rate of adoption.

1. INTRODUCTION

Many countries are promoting electric vehicles as a feasible alternative to reduce greenhouse gas emissions and depletion of fossil fuels. The demand for EVs globally is expected to rise sharply in coming decades, as illustrated in the following chart with stats from BNEF, BP, OPEC, Exxon, and the IEA, this chart shows that industry forecasts have generally been increasing over time with the most optimistic of them from BloombergNEF predicting that there will be 550 million EVs on the road globally by 2040. Norway Motors, India's largest electric vehicle reseller, plans to sell only electric and hydrogen vehicles by 2025. By 2020, electric and plug-in hybrid vehicles will account for 15–20% of new vehicle sales in Japan. Under the “National Electromobility Development Plan,” Germany will produce one million electric vehicles by 2020. Major countries have encouraged the use of electric vehicles, however the penetration rate varies. Norway, Sweden, the Netherlands, Switzerland, the US, and the EU all have greater than average EV sales (Aidi Ayoub, 2020).

Private autos allow global movement, Governments and manufacturers must reduce the environmental impact of private transportation because to climate change, resource constraint, and population growth. Road transport emits one-fifth of all CO2 in the EU. Approximately 13% of total emissions come from private vehicles. New emission standards apply to manufacturers. The EU plans to reduce transportation emissions by 60% by 2050. Electric vehicles (EVs) help reduce GHG emissions (P. Christidis, 2019). Global electric car demand is rising. Customers are increasingly motivated to acquire an EV since it reduces their carbon footprint and is eco-friendly. In addition to the environmental impacts of energy production, other life cycle stages must be considered. Like many other long-lived active items, the use-phase is critical to a product's environmental performance. That is, actual energy usage must be assessed. An LCA assesses a product's environmental impact over its lifetime.



Source: BloombergNEF, Electric Vehicle Outlook 2019.

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Figure 1: Industry forecasts of EVs on the road globally by 2040.

Lack of research on how regional factors affect LCA causes regional variance to be ignored. Several factors influence an electric vehicle's energy use (Jui-Che Tu, 2019). Changing ambient temperatures can impact drive train performance and increase energy usage. Most road traffic begins in cities, making electric vehicles a viable option in congested areas. It differs from highway consumption. In addition to traffic and geography, this is not reflected in any empirical model that forecasts consumption. So, this study will look into how many parameters affect EV energy use (Lee HS, 2017).

Many models must be combined to understand how public policy affects the electric car market: Marketing demand models estimate consumer preferences in order to predict consumer purchase, and a charging service business model estimates projected profit by taking into account charging station allocation, service fees, infrastructure costs, and government subsidies (Jui-Che Tu, 2019). Individual and combination models of this type have been the subject of extensive research. Here, we'll take a deeper look at the existing literature and the modeling work that goes along with it. A set of assumptions sped up our hunt for market equilibrium (Lee HS, 2017).

2. RELATED WORK

Aidi Ayoub et al. (2020). Parametric analysis of key elements that affect the range of an EV is depicted in this project. It is the primary goal of this study to investigate the numerous aspects that affect the electric vehicle's range and performance, and investigate ways to reduce consumption. The above-mentioned optimization techniques resulted in the improvements. P. Christidis et al. (2019). According to this research, electric cars have a long history and are divided into a variety of different categories. Also included in this report were statistics on how fast the global market for electric vehicles is growing and how many nations are selling them. Some countries, such as Jordan, Oman, UAE and Egypt have seen a significant surge in the use of electric vehicles. Due to their relevance in reducing air pollution, we believe that all of these Arab countries will import electric vehicles in the near future because of their low-maintenance requirements and their ability to travel long distances without needing repairs. Jui-Che Tu et al. (2019). According to this study, which fills a gap in the current literature, local circumstances and geographical variance had an important, though not critical, impact in Europeans' plans to acquire electric or hybrid automobiles. A hierarchy of factors influencing consumer preferences resulted in a wide range of demand patterns for H&EVs across the country. Local mobility requirements and support measures largely affected market conditions. T. Yong et al. (2017). This study used a categorization model to analyze the data of two cross-sectional surveys on EU mobility. User feedback via surveys allowed us to discover which features of the product were most essential to customers and how they interacted with each other during the decision-making process. The possibility of owning a hybrid or electric vehicle has risen, as has the potential for adoption across all socioeconomic levels, according to the conclusions of the study. In part, this was due to the fact that when new technologies became more widely accepted, infrastructure was built, prices dropped, and the market shifted from early adopters to the general public, a larger percentage of the population became more open to accepting these new technologies than previously thought. Kim YC. (2017). According to the results of the study, self-control capacity, subjective norms, and attitudes toward conduct have a significant positive impact on behavioral intentions. More important than a consumer's subjective norm and attitude toward action is a consumer's power over the resources required to acquire electric autos. An EV buying choice is influenced by the opinions of individuals in the consumer's immediate surroundings. The degree to which customers are concerned about the environment and comfortable using new technologies is also a factor in their purchasing decisions.

3. FACTORS AFFECTING THE USE OF ELECTRIC VEHICLES

There are a plethora of elements that can have an influence on energy usage of an electric vehicle. From vehicle technology to driver behavior, there are more than 16 major urban driving characteristics in the first study on ICEV (Egede, P., 2015). The following criteria are included and after analyzing the existing models for vehicle consumption. They are divided into six categories, as shown in the below:

3.1. Technology and vehicle factors

The battery system of an electric car determines how much energy it consumes. The battery type, cell count, stacks, and BMS architecture all influence the overall design. These factors affect battery capacity, energy density, and mass. The number of charging cycles also determines battery ageing. The rate of regeneration also influences total energy usage. However, high SOC and battery temperature prevent regenerative braking. The HVAC system is also crucial.

In the absence of combustion engines, a PTC heater or heat pump must be used to supply heating. Despite the fact that this is valid, weather and driving patterns have a significant impact on real-world usage. Auxiliary components include the vehicle's lighting, radio, navigation, and optional seat heating. These devices don't require any form of propulsion at all (Egede, P., 2015). These devices are powered by a 12 Volt battery and a traction battery. The efficiency of the vehicle's drive train and motor, while having only a little impact on consumption, is nonetheless a significant consideration. This comprises the vehicle's weight, dimensions, and drag coefficient, according to (Sierzchula W, 2014).

3.2. Artificial environment factors

The level of urbanization, transportation infrastructure, and other aspects of the human-created environment are all included in the concept of the artificial environment. The volume of traffic, the direction of travel, and the average speed all serve as indicators of congestion. The more congested an area is, the more people use it (Lee HS, 2017). As the volume of traffic increases, so does the amount of time a vehicle must spend braking and accelerating, resulting in increased fuel usage. It is possible to measure traffic factors using a variety of methods, including average speed, idle time or stops per kilometer (Egede, P., 2015).

The density of a city's population is a good indicator of how urbanized it is. A high density of crossroads, traffic signals, and other obstructions to moving traffic are common in urban areas, as are lower average speed limits and lower average speeds during rush hour (Wen Li, 2016). Rural areas, on the other hand, have very different characteristics from highways. Intelligent transportation systems (ITS) and traffic management systems (TMS) are also important considerations (Geng J. 2017).

3.3. Natural environment factors

Natural environment elements include, for example, a location's terrain and climate zone. The average slope, which is the total elevation or decline in meters, can be used to characterize topography. Consumption rises as a result of the greater vertical force, which requires a larger difference in height the weather has a direct impact on the performance of the vehicle and its components, as well as the driver (Geng J. 2017). Driver behavior is influenced by weather conditions, such as severe rain and fog. Heater and air conditioner use has a direct impact on the space's temperature and humidity. If you're concerned about visibility on the road, there are a number of things you can do.

3.4. Driver factors

The driver can be described as aggressive, which is a nice description. The pattern of acceleration and deceleration is an excellent illustration of this. Aggressive driving is connected with higher acceleration and deceleration velocities, as well as higher average speeds. Because of this behavior, there is an increase in consumption. Several factors of a driver's personality, such as his or her age, gender, and so on, have an impact on his or her driving technique. Auxiliaries like as heating and air conditioning are used to provide comfort, which influences the amount of energy consumed by these devices. Range anxiety and the physical condition of the driver are also relevant issues (Wen Li, 2016).

3.5. Travel type factors

The reason for the journey is represented by the travel or route type, which is characterized by a number of factors (Yuksel, T., 2015). The frequency and length of the trip, as well as the time of day, the urgency of the journey, and the type of voyage, can all be used to explain the use pattern. For example, a commuter's driving style and acceleration pattern are distinct from those of a holiday motorist. Several of these variables are connected with driver attributes, as well as with artificial parameters, such as traffic flow (Egede, P., 2015).

3.6. Measurements factor

A specific type of experiment is used as a case study in this section's discussion of the measuring factors. Because cold batteries are less efficient than warm cells, warm-up time may appear to require more energy. The experiment must be valid if all of the driver parameters are present. Different drivers are going to have different results. Additionally, the experimenter's experience, data collecting precision, hard- and software used, and the experiment's design should all be taken into account in addition to the SOC and the battery's particular properties (Wen Li, 2016).

4. FACTOR AFFECTING EV DESIGN

The efficiency of an electric vehicle's drive train has a huge influence on its overall fuel economy. A typical EV power train has a battery, one or more motors, and a final drive. Through the use of a computerized gearbox, power is transferred from the engine and electric motors to the end drive (Geng J. 2017). An illustration of each vehicle's PHEV/BEV powertrain. Batteries in a battery pack are wired together in a single circuit. Series and parallel connections, as well as battery voltage and current limits, affect the output of a motor. Large batteries reduce weight, acceleration, and MPG (Lee HS, 2017).

Final drives convert transmission input into low-speed, high-torque wheel output. The final drive ratio influences maximum speed. In order to accelerate from low to high speeds, a vehicle's final drive ratio needs to be larger. Due to its significant impact on fuel efficiency and pollutants, FDR must be customized for each vehicle. Several HEVs and PHEVs use planetary gear sets to improve efficiency and speed–torque range (Geng J. 2017).

Many methods exist to enhance fuel economy and emissions. Each component is sized for short or long-term travel by city or highway. Therefore, the transmission produces a driving mode. Built-in and switchable driving modes enable vehicle launching or highway cruising (Sierzchula W, 2014). As a collection of vehicle settings, an architecture or configuration can be considered of. Toyota single-mode hybrid and Chevrolet Volt plug-in hybrid a control unit's job is to convert the driver's throttle inputs into engine and motor commands to maximize fuel efficiency while meeting performance targets like 0-60 mph acceleration (s). DP, PMP, and ECMS are used to create offline optimal control rules. Several studies looked into mechanical and electrical component design (Yuksel, T., 2015).

5. THE ELECTRIC VEHICLE MARKET AND PUBLIC POLICIES

In order to better understand how public policy affects consumer, producer, and market development there have been a number of studies undertaken it was shown that changes in state and federal public policy were closely linked to changes in the US car industry between 2000 and 2006. Due to their apparent immediate monetary return, sales tax incentives have the biggest impact of all policy interventions (Egede, P., 2015). Sales tax incentives would be prohibitively expensive to execute and would impair the fuel economy of new conventional autos, according to Morrow et al. The most efficient strategy to reduce GHG emissions, according to

Taeseok Yong, (2017), is to raise the gasoline price first, followed by a sales tax incentive for electric vehicles. It was established by Wen Li, (2016) that education, battery exchange programmes, and robust warranties on batteries are needed to enhance EV adoption. Americans have a poor understanding of fuel economy, according to a new survey. Tax credits based on consumer income should be given to places where plug-in hybrid vehicles provide considerable societal advantages, according to Sierzchula W, (2014).

6. CONCLUSION

In the first place, the authors looked at all the variables that could affect how much energy electric vehicles use while in operation. The research suggests a wide range of elements, which can be categorized into six areas. If you had unlimited resources, it would be great to test every possible combination of the variables and see how they interact. However, this is not always possible in the actual world. Alternatively, the initial focus of this paper was on the interaction between four variables. Nissan Leaf 2011 model is used to evaluate an empirical technique. All of the parameters examined influence the energy consumption of electric vehicles, and some of the interactions between components suggest a secondary impact. There is no bigger influence on energy production than temperature and location, regardless of any other parameters. These findings are corroborated by the binary model that was generated. Predicting the number of persons affected by an outbreak is another use for this tool. The car's range can vary between 100 and 222 kilometers depending on the route and the use of the HVAC.

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