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Evaluating EV Industry: Issues and Developments at the Moment

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Abstract: Nowadays, the vehicles around the world are being converted to powered by electric in order to combat climate change and work in lower pollution levels. Sustaining this process calls for more electric vehicle charging stations (EVCS) to be made available to the general population. The uncoordinated surge of electric vehicles (EV) and the EVCS will have repercussions on the distribution network, environment, EV users, and charging stations, posing significant technical, economic, and environmental issues. This paper is aimed at showing the shortage issue of charging system, the relevant pollution issues, safety concerns and the efforts which the engineers have made. The NSPE codes and ethical implications are also under analysis.

Keywords: Electric Vehicles; Electric Vehicle Charging Stations; Safety Concerns; Ethical Implications.

1. Introduction

The climate change and the environment pollution caused by automotive exhaust has recently become a much severe problem in world. For example, according to WHO report in 2022 [1], air pollution is defined that it can last for a long period of time, and it is also hazardous enough to hurt human health badly. One of the causes in pollution forming is automotive industry. Internal combustion design is the main contributor to toxic gas emissions like carbon monoxide, nitrogen oxide, hydrocarbons, sulfur dioxide, and tiny particles, etc.

Because of the different design of electric vehicles, this form of new type vehicle can promote the process on cutting down the gas emission problem in a large step. The electrification of the total design sharply cut down the consumption on fossil fuels, and reduces the negative impacts of pollution. Because of that, many countries now call on their public to choose their next car powered by electricity. For example, in China, Beijing, Shanghai, Guangzhou governments will give a discount on the price of particular brands of electric cars.

All the trend looks good, but whether there exists risk or disadvantage in EV? The answer is yes. Two main problems are as follows: First, the power distribution is not enough for charging so many cars at the same time, and it also causes related problems like: power quality decreasing, high possibility damage of line, downturn of distribution transformers and increased distortion[2]. Second, there still generates environment pollution in another way: the battery production causes a mining of heavy metal and the disposal of used batteries also consumes a large amount of energy.

The purpose of the paper is to investigate the issues and the problems existing in the EV industry at the moment, and show what fields the engineers have made efforts on. Additionally, the analysis of ethical theories and national society of professional engineering code in this case will be mentioned.

2. Methods

To further explore the idea of electric vehicle and its problems, this paper will have a compilation of different journals and articles that can both be found in public media, as well as peer reviewed journals from sources such as IEEE. Under the citation of these articles, this paper will explore the concerns of EV industry, which includes problem issues. Furthermore, it will also explore the possible solutions and legislation that have been attempting to solve the problems. Lastly, it will explore the ethical theories in engineering field.

3. Results

It is important to provide context to key terms which will be used throughout this paper. The three main topics which will be analyzed in this paper are: The shortage issue of charging system, the improvement in increasing battery performance and the environment pollution caused by EV industry. The shortage issue is mainly because of the large amount of EV with just a few charging stations, and the cut-down endurance mileage in low temperature area. To solve this problem, engineers are trying to invent new techniques in order to extend range. The specific pollution caused by EV is the dealing with waste battery. The dealing process needs a large amount of energy and owns a large risk in leakage of harmful elements.

3.1. The Shortage Issue of Charging System

Not like the traditional vehicles consuming on gas or other fuel which can be added in fuel easily, up till now, the charging of most EV still need more time than that, which means that total efficiency in charging is low compared to traditional vehicles. Statistics from the Ministry of Transport show that as the end of September 2021, the number of charging piles in China's high-speed service area is 10,800, although it can meet people's daily needs, but in the face of the surge of travel during the holiday, it is "a difficult to find". State Grid figures also back this up. From October 1 to 3, 2021, the total charging capacity of the national grid charging service network increased by 59% year-on-year, and the charging capacity of highway charging facilities increased by 56.52% year-on-year[3]. Although several brands like NIO, GEELY, have developed types that can change their batteries in convert stations just shorter than 5 minutes, this is still not quickly enough to satisfy the need of anxious drivers. Temperature is also an important factor which infects the driving distance of an EV. When the lithium-ion battery is in low temperature state, its available capacity is reduced and

the charge and discharge power is limited. If the power is not limited, it will cause the evolution of lithium ions inside the battery, which will lead to irreversible attenuation of the battery capacity, and will generate a safety hazard for the use of the battery. This problem shows again that the charging stations constructing is in high need of quantity.

3.2. The Improvement in Increasing Battery Performance

To solve the shortage issue of charging system, engineers design different methods in order to better fit different needs. In this part, the method analyzed is increasing the efficiency and the life of battery.

The battery is the main costing part in the whole car. As the power source, the distance and the energy response both tightly depend on the efficiency and life of battery. An integrated equalization management system (EMS) is developed to limit the negative effects caused by inconsistencies between the cells in a battery pack, in order to increase the pack's cycle life and performance. One novel multivariable fusion equalization strategy is to design a fuzzy logic controller (FLC). One team in college of Automation, Chongqing University of Posts and Telecommunications, found that the proposed multivariable fusion equalization achieves a 14.9% increase in computational efficiency, and the battery performance increases by 4.9% over a traditional equalization strategy [4].

3.3. The Environment Pollution Caused by EV Industry

Compared to traditional vehicles, the pollution caused by EV industry is also multidimensional. The main kinds of heavy metals are manganese, lead, cadmium, lithium and other elements. The main emerging battery contaminants are as follows: Metal nanostructures, Carbon-based materials, and Ionic liquids[5]. The metal oxide nanomaterial has been proved that it has ecotoxicity to the environment. A similar study was carried out for Shewanella oneidensis [6], a soil bacterium. This report reveals that nickel manganese cobalt oxide may become a strong source for nickel and cobalt ions, heavy metals that limit bacterial respiration in some degree. As for graphene, it causes damage in unicellular and multicellular organisms through physical interaction and generation of reactive oxygen species[7]. For ionic liquids, which is an important component in battery, some derivate salts in liquid have been reported as present in high concentrations at soils located in the vicinity of landfill locations, with promoting effects over mammalian cell apoptosis, and may contribute to the onset of primary diseases when combined with other heavy metal pollutants[8].

4. Discussion

Taking in the information presented in the results section of this paper, a conclusion can be that the shortage issue of charging system will be solved by building more charging stations and enhancing their charging efficiency to form a completed system, and increasing the performance of battery. While, along with attention on technology, the environment pollution problem still needs more concern from both the companies and the public.

Moving onto the next and much more important stage of this paper, to evaluate whether it is feasible for the engineers to finish the task. With the efforts and developments that engineers have made, there also exists trust problems between consumers and EV companies. At the same time, the burden of constructing charging systems is also a big challenge for all EV companies. In this part, the ethical problems will be under discussion.

4.1. The Safety Problems in EV

The tough barrier which prevents consumers from choosing to purchase an EV is the safety problem. The battery safety should be in the very first position in whole vehicle design. In most EV brand products launching events, the topic that companies will choose to contain is their new upgrade on battery safety. According to incomplete statistics, in the first eight months of 2019, there were about 40 fire accidents in the world, and among them, one accident shows that one car belongs to Tesla model series suddenly ignited under uncharged condition in a static state. Such accidents grows the users' doubts seriously about the safety of EV. One of the reasons that makes the battery likely to burn is the existence of lithium ion, which can be very dangerous under unreasonable misuse conditions[9].

Not only in America, but all around the world, enhancing the safety of lithium-ion batteries (LIBs) has emerged as a crucial focus in the advancement of the electric vehicle industry. When a lithium-ion battery is subjected to external forces, its casing can either deform or be penetrated by sharp objects, leading to mechanical damage. With growing safety standards for lithium-ion batteries, detecting and mitigating mechanical abuse has become increasingly critical.

Currently, strategies for enhancing battery safety fall into the following three classifications. For the first one, the basic method is improving intrinsic safety of batteries.

The intrinsic safety mainly depends on many different factors, for example: material used in the cell, cell design, manufacturing quality level, consistency, and reliability of the battery. The improvement in the stability of battery materials has mainly three different technical routes: (1) Surface coating, doping, composition, and structural design adjustments offer optimization ways to enhance the structural resilience of cathode materials under high temperatures. (2) The application of non-flammable solvent and flame-retardant additive has a tight relation with the thermal stability of the electrolyte and the scale of thermal runaway. The development in such material field enhances the success possibility. (3) Designing an artificial solid-electrolyte interphase (SEI) can enhance the thermal stability of the SEI, consequently boosting the battery's durability at elevated temperatures [10].

Relative to improving intrinsic safety, another choice is to design passive strategies for battery safety. When operating in low temperatures, a battery requires preheating to maintain it above the critical temperature. At the moment, the primary method involves heating the battery with a heating film placed at its base. However, more efficient and energy-saving heating techniques like battery self-heating, phase-change heating, or heat pump heating are under development.

The last effective method analyzed in this part is the active strategies for battery safety. The central concept of active safety involves monitoring safety-related indicators in the battery using either built-in or external sensors. The aim is to issue a warning before the battery approaches a critical heat threshold, ensuring timely system shutdown to prevent overheating.

The concept purpose is good enough, but there still needs a

lot of efforts to overcome the obstacles existing: Due to hardware and software limitations, most mainstream platforms can currently only process voltage signals. Identifying changes in the rate of voltage signals is challenging because of the low real-time sampling rate, which captures only one data point every 30 seconds. So the platform can only deal with early warning tasks.

Although the battery safety problem is on the right way to be fixed in the future, the ethical problem should also be into consideration seriously. Currently, many technologies are still under development condition and need a long way to go. Most methods which prevents the battery from burning still only can cut down the possibility, but can not make sure it will not burn. The dilemma of NSPE codes is shown clearly here: As an engineer, he or she should avoid all conduct or practice that deceives the public. In accordance with the NSPE Code of Ethics, it is essential to maintain integrity and truthfulness in the promotion of electric vehicles. Companies should refrain from making exaggerated claims that their vehicles will never catch fire or from unduly criticizing the battery designs of their competitors. Engineers should focus on accurately presenting their advancements in battery safety and ensure that all communications are honest and do not mislead potential customers. Promoting factual and reliable information upholds the standards of professional conduct and fosters trust within the industry, which means that all EV companies will experience a healthy and long-term developing.

4.2. The Burden of Constructing Charging Stations from EV Companies

Although in the future, the current distribution system construction work will get fully developed, up till now, charging waiting is still a problem for many EV drivers. To get a better experience in driving EV, all the companies are trying to upgrade their charging technology and the watts number is increasing year by year. For example, up till now, many EV companies have launched their charging stations working in more than 200kw: XPENG S4 charging station, NIO liquid cooled super fast charging station, and Tesla super fast charging station. Here, the Act Utilitarianism ethic theory is in consideration. As for the engineers, their work on designing next generation charging stations and system is definitely correct because this is aimed at increasing total happiness of all the EV owners: The shorter time consuming on charging leaves more time for travelling or leisure. But the utilitarianism dilemma is also obvious: the spend and the time waiting for construction. At the moment, the super fast charging station is still in experiment stage, which means that you can only see several stations in highway, but not even one near where you are living. What's more disappointing is that, the price for typical EV which is charged in high watts is much higher than normal ones. This phenomenon means that for those who pay more money on the cars can not just enjoy the high speed charging at the moment. What they can only do is to wait for complete construction. This act utilitarianism dilemma can only be solved in the future. Although it takes time, but research and development is still deserved to be advocated.

5. Conclusion

The rapid growth of electric vehicle industry presents a promising avenue for addressing air pollution and its associated challenges. But along with the development, we should also be aware of the disadvantages: The current network of charging stations is often insufficient to meet the growing demand, leading to challenges for EV owners, particularly in regions with sparse infrastructure. This shortage can hinder the widespread adoption of EV and poses a significant barrier to their seamless integration into everyday life. Another critical issue is the environmental impact associated with the disposal of used batteries. As the number of EV on the road increases, so too does the volume of spent batteries that require proper disposal or recycling. Improper handling of these batteries can lead to substantial environmental pollution, including soil and water contamination due to the hazardous materials they contain. When companies are trying to fix the problem and increase their service quality, the ethical dilemma should also be concerned by engineers seriously. Based on actual condition of the EV industry, the work and efforts made by engineers are valid, but consumers should also own the right to know the reality of the EV industry now, and make a much more wise choice.

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