Innovative ideas for charging piles based on existing problems for new energy vehicles

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Abstract. The emergence, development and promotion of new energy vehicles are gaining more and more public scrutiny in terms of science, technology and policy. China's policy subsidy has alleviated the development crisis to a certain extent, but the energy consumption problem and charging facilities layout still cannot be alleviated. Based on the current situation of charging facilities construction, this paper puts forward suggestions for mobile charging piles and charging vehicles to solve the problems of improper charging and unreasonable distribution, and puts forward reasonable prospects for the future development trend of a shared new energy vehicle economy to help people better use the convenience and environmental protection brought by new energy vehicles.

1. Introduction

An energy-saving and environmentally friendly lifestyle has been advocated from the emergence of automobiles to the widespread use of new energy vehicles, so the eternal theme of automobiles "environmental protection, energy saving and safety" is important. New energy vehicles emerged as required, driven by the developments of science, technology and environmental problems, and have become a competitive industry. However, it faces such problems, such as driving distance, charging facilities, policy subsidies and safety performance, which need to be solved. Improving charging facilities and scale is the focus of future electric vehicle (EV) development and is also the premise of low-carbon economic development in the international environment.

In today's serious environmental situation, to meet the multiple objectives of energy conservation, emission reduction, industrial upgrading and energy security, the state has issued a series of policies to increase the promotion of new energy use. New energy vehicles have naturally become the focus of policy protection. Our government has set a target of completing the total sales of new energy vehicles by 2020. In 2015, although the world's largest sales volume was achieved, it was achieved under the guidance of industrial policies. It only accelerated technological breakthroughs, product enrichment and market formation objectively. As a result, the industry developed rapidly, making the new energy automotive industry the focus of capital pursuit and requiring a large amount of financial support, but also produced excess production. With the problems of excess energy and blind investment, the new energy automobile industry has entered a period of reform.

As a strategic emerging industry determined by the State Council, EVs, as an important part of energy savings and the new energy strategy, will become the focus of the future development of China's automotive industry and energy industry. The construction of EV charging stations is the premise and
foundation for the promotion of the EV industry and improving the efficient energy supply network is one of the necessary conditions for the wide application of EVs. At the end of 2018, the National Development and Reform Commission and the State Energy Administration jointly issued the Action Plan for Enhancing the Charging Support Capability of New Energy Vehicles, which proposed to strive for three years to substantially improve the charging technology level, improve the quality of charging facilities, speed up the improvement of a charging standard system, comprehensively optimize the layout of charging facilities, significantly enhance the interconnection and interoperability of charging networks and rapidly upgrade charging. Electricity operation service quality can further optimize the charging infrastructure development environment and industrial structure. Therefore, while making great contributions to future industrial development and environmental protection, it also needs improvement and innovation.

2. Development status of the new energy automobile industry

Recently, Professor Cheng Bo of Tsinghua University, jointly hosting the 6th Annual Conference of International Intelligent Network Union Automobile Technology, said that "Intelligent Vehicle has entered a period of rapid development worldwide, but the safety, reliability and supervision system still need to be strengthened. Intelligent Vehicle is not only the change of industrial ecology, but also one of the strategic core of future competition among countries." The global development situation of the intelligent network automobile is pointed out.

Globally, with the rapid development of the past ten years, industrial ecology of the Intelligent Network Unified Vehicle has initially formed in the world. The United States, Japan, China, Europe and other industrial powers now attach great importance to the Intelligent Networked Auto Industry. The competition of the Intelligent Networked Auto is no longer among enterprises but among countries. In recent years, intelligent driving has brought great changes to industrial ecology. Automobiles have changed from mechanical products with electronic functions to electronic products with mechanical functions. Automobiles are gradually separated from hardware and software like smartphones and personal computers; their functions are completely defined by software and online remote upgrades are constantly updated. The development of intelligent networked automobiles will lead to driving without human beings. It will also bring about significant changes in industrial ecology.

Along with vigorously developing smart cars, we should increase infrastructure construction, form the scale-effect of commercial applications, and promote China's smart network industry to follow, run and lead the world.

3. Status quo of new energy vehicle charging facilities

The energy supply system for EVs is an important support of EVs. The construction of charging facilities for EVs is the basis for promoting the development of an EV industry. Charging facilities have been implemented in China. There are charging piles with slow charge and charging stations with fast charge. Meanwhile, most EVs charge slowly at night, and charging piles are widely used because of their small area, low construction cost, high safety and high charge demand. This paper mainly puts forward innovative ideas for charging piles.

Since 2009, China's new energy vehicles have grown rapidly under the stimulation of subsidies. By 2018, the production and sales of new energy vehicles reached 1.27 million, ranking first in the world. There are 25 cities covered. The pilot cities are in three batches. 10% of urban residents use new energy vehicles. The development of new energy vehicles is very promising. The development of charging facilities is in-line with the use of new energy vehicles, of which 40% are public charging facilities.
4. Problems in the development of new energy vehicles can be seen from the current situation

4.1. Distribution problem
The construction layout of charging facilities is directly related to the urban traffic situation and the state of automobile flow, and it affects the whole regional traffic system. At present, the distribution of charging pile construction is unreasonable, resulting in a waste of power land resources. The construction of a charging network is lagging behind, and the service radius of charging facilities is not clear, which affects the charging efficiency and energy consumption of automobiles to affect the whole urban traffic.

4.2. Charging problem
Because of the immature development and inadequate consideration in the installation of charging facilities, the service radius of charging facilities is unreasonable. As well as the moral problems of personal use, the proportion of personal charging piles is too high, so that charging facilities cannot be used, resulting in a large area of waste. There are other vehicles on the market occupying the charging parking space.

4.3. Poor user charging experience
First, the location and charging quality of charging piles are the main influences on the charging experience of users; the design of user service and later management and maintenance of charging facilities are not perfect, and, as a newly developed industry, people lack attention. The construction of information applications on the Internet and mobile terminals is imperfect, and mixed operators and enterprises cause information confusion. For effective charging information, synchronous pile upgrade also needs to be further clarified. In addition, interconnection needs the government and enterprises to increase investment and attention, encourage more technology and innovation, and provide power for the new energy industry.

In the initial stage of EVs and charging facilities, all aspects of development are imperfect, which limits the development of EVs. Therefore, we need to solve this problem from the root, that is, the construction of charging facilities.

5. Ways to improve charging facilities
The development of new energy vehicles must coincide with the development of charging facilities. Based on this, the following two innovative ideas for charging facilities are put forward.

5.1. Portable charging piles
A track structure similar to that of a light rail or tram is installed at the bottom of a charging pile to form a movable charging pile. The track is laid in the parking lot. The movable charging pile is equipped with multiple AC charging ports to meet the needs of a multi-purpose pile with a movable service system, which can locate and share to achieve a good charging experience.

The groove track is used in the design of charging pile track structure. The groove rail is equipped with a wheel flange groove, which integrates anti-derailment and rail protection and can better ensure that the charging pile does not deviate from the track. To improve the operation efficiency of charging piles, reasonable planning in parking lots, referring to various standards for trams; strengthening the construction of economic, technical and safety standards; and establishing greatly improved charging of charging piles will be carried out to improve the operation efficiency of charging piles, which will bring great convenience to the use of EVs.

In addition, we should strengthen the meticulousness of urban traffic planning, let charging piles be implemented in every household, make better use of new energy, protect and care for charging facilities, make contributions to environmental protection and contribute to urban construction.
5.2. Mobile charging vehicle

Mobile rechargeable vehicles have been proposed since the beginning of the 21st century and have not received much attention. By installing onboard charging systems on ordinary buses and cooperating with power supply devices, power devices, safety communication devices, GPS positioning system and other integrated construction, charging is completed, and portable service is realized.

The mobile charging vehicle adopts the RV or CBS-style freight car. The first third of the body is the cockpit, and two-thirds of the body is equipped with an onboard charging system, which is compatible with the charging requirements of EVs provided by different operators, including charging interface, voltage and current requirements. As one of the AC inputs of the system, municipal power is used for energy storage and emergency charging of the charging vehicle, which also has other AC input power supply modes. The system has both automatic control and protection functions and real-time monitoring and protection of users to avoid accidents. The charging car provides a self-service system with a mobile application to achieve fast service.

In addition, vehicle management and maintenance need professionals. Such flexible and mobile charging facilities will surely be popular with the public, and to some extent can alleviate the pressure of urban employment.

The rise of an industry and design of a product must have a team behind the participation of all walks of life. This requires not only the vigorous promotion of the government but also the participation of relevant enterprises, designers and users to build a harmonious charging environment and urban communications.

6. Looking into the future development of charging facilities

Uncertainty about future development still exists. In recent years, the charging facility system in China has developed rapidly. In particular, the construction of public charging piles has completed about 210,000 and is approaching the goal of building 500,000 public charging piles by 2020. However, due to battery technology innovation, new energy vehicle technology development, the popularity of shared travel and other factors, the future of the charging pile industry is still uncertain.

With the continuous improvement of battery management system technology in the future, the proportion of pure EVs will gradually increase. The charging pile structure system, mainly AC slow charging, will inevitably need to adjust. The EV development model, mainly guided by the government, is still far from the citizens' taking the initiative in choosing EV. Functional safety and information security are also core technical difficulties that need to be overcome. In order to enter the market, the Intelligent Network United Vehicle must put the people at its heart. At the beginning of 2019, the state reduced the financial subsidies for EVs, which shows that new energy vehicles are facing both opportunities and challenges in the future.

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References

[1] S. Wang, Research on the layout of electric vehicle charging facilities based on the expansion and utilization of new energy -- A case study of Beijing [A]. Langfang Applied Economics Society.
[2] M. Wan-da ma, Electric vehicle charging station layout planning of the urban planning society of China's urban transportation planning and the academic committee. The new urbanization and transportation development - 2013 China's urban traffic planning the annual meeting and academic seminar on 27th [C], in Proceedings of the Urban Planning Society of China Urban Traffic Planning Academic Committee. The Urban Planning Society of China, 2014-10.
[3] Key technology analysis of bidirectional charging piles [A]. Small and medium-sized wind energy equipment and application [C]. Wind machinery branch, China Agricultural Machinery Industry Association, 2015:3.
[4] S. Zhao, F. Zhao, H. Hao, Z. Liu, Development status and countermeasures of China's new energy vehicle charging infrastructure [J]. China Science and Technology BBS, 2017 (10) 97-104.

[5] G. Han, Discussion on several key issues in the planning of electric vehicle charging facilities [A]. China Urban Planning Society.

[6] F. Lin, Analysis and prospect of EV charging facility construction [J]. Communications World, 2017 (16) 131-132.

[7] F. Xu, Charging facilities should not become a bottleneck in the development of electric vehicles [J]. Sinopec, 2018 (08) 25-28.

[8] X. Yao, D. Jiang, X.-Q. Shao, J. Zhang, Design of charging system for mobile rescue charging vehicle [J]. China Electric Power, 2008 51 (05) 80-86 +117.

[9] T. Jiang, Development strategies and layout ideas of electric vehicle charging facilities: A case study of eastern coastal area of Shenzhen city [A]. China Urban Planning Association, Nanjing Municipal Government.

[10] Monthly data tracking of charging infrastructure [J]. Vehicle Aspect, 2019 (03) 45.