

Market Development Analysis of China's New Energy Vehicle Charging Pile

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Abstract: With the popularity of new energy vehicles, the number of charging piles is growing rapidly, and charging technology is constantly improving, but the market is still in its initial stage, facing problems such as uneven distribution of charging piles, difficult construction, and non-uniform charging facilities. Therefore, this paper puts forward suggestions on improving rural charging network, unifying design and construction standards, and studying sustainable business models to promote the healthy development of the charging pile market. Looking forward to the future, the construction of a charging facility system of "smart slow filling + high-power fast power station" will become an important development trend of the new energy automobile industry and promote the sustainable development of the new energy automobile industry.

Keywords: Charging pile, Charging pile operator model, Charging service market.

1. Introduction

With the widespread popularity of electric vehicles, in order to meet its growing demand, the number of charging piles is rising rapidly, charging technology is also constantly improving, and various operating models have emerged, which provide solid support for the promotion and application of electric vehicles. However, although China has initially built the basic framework of the charging network. However, in the field of charging services, we are still in an early stage of development, and there are still many problems in the construction process of charging infrastructure.

2. Charging Service Market Development Status

2.1. Number of Charging Piles

As the cornerstone and guarantee for the wide application of electric vehicles, charging infrastructure is gradually building a charging service network covering diversified scenarios such as intercity high-speed, to provide convenient and efficient charging experience for electric vehicle users. In recent years, with the large-scale popularization of new energy vehicles and various support policies promulgated by the state, the number of new energy vehicle charging piles has ushered in explosive growth. According to the statistics of People's Daily Online, in 2019, the number of charging piles in China was 516,000 units, by the end of 2023, the number of charging piles in China reached 8.596 million units, the charging and electricity replacement infrastructure covered more than 450 cities, the coverage rate was more than 90%, and the ratio of piles fell from 3.1:1 in 2019 to 2.4 in 2023: 1, the continuous narrowing of the pile ratio indicates that the gap between the supply and demand of piles in China is gradually becoming smaller, and the number of new energy vehicles and charging piles is reasonable.

2.2. Charging Pile Operation Mode

Charging pile charging mode plays a very important role in the development of charging pile market. For charging pile suppliers, the establishment of charging mode can promote

the rapid return of funds, reduce the cost burden of suppliers, and promote the sustainable development of charging piles. For users, the use of charging piles is a rigid demand, and the charging price is an important factor affecting users' choice of charging piles. The reasonable setting of charging modes can meet users' expectations for new energy vehicles, thus promoting the benign development of the new energy vehicle market and driving the rapid development of the charging pile market.

In 2014, the National Development and Reform Commission issued the "Notice on Issues related to the Electricity Price Policy of Electric Vehicles", which clarified that charging pile suppliers can charge users electricity and service fees to make up for the operating costs of charging piles, including electricity costs, venue rental costs and charging pile operation and maintenance costs. The charging mode of charging pile can be divided into two types: the first charging mode is electricity + service fee, and the specific user is charged for charging electricity; The second charging mode is to charge according to the user's charging time, which is charged according to the user's charging time. The supplier can set the charging mode according to the specific needs of the user, so as to better serve the user.

At present, China has built a diversified operation pattern, mainly including the following:

Self-built and self-operated mode: the charging pile enterprise invests in the construction of charging piles by itself, and is responsible for operation and management. The advantage of this model is that charging pile enterprises can carry out unified management of charging piles and improve operational efficiency, but the disadvantage is that the investment cost is high and it takes a long time to recover the cost.

Self-build other camp mode: the charging pile enterprise invests in the construction of charging piles by itself, but the operation management is handed over to a third-party company. The advantage of this model is to reduce the operational risk of enterprises, but the disadvantage is that enterprises have weak control over charging piles.

Co-construction and sharing mode: a number of enterprises

jointly invest in the construction of charging piles, and jointly assume the operation and management. The advantage of this mode is to reduce the investment cost of enterprises and improve the utilization rate of charging piles, but the disadvantage is that the coordination between enterprises is difficult.

In the field of public charging piles, the government-led and enterprise-operated models are mainly used to meet the public charging needs of the majority of new energy owners. Private charging piles are more in the form of owners' self-purchase, community or property installation, providing owners with more convenient home charging services.

In addition, there are some innovative operating models, such as shared charging piles and mobile charging piles, which continue to meet the diversified needs of the new energy market. The shared charging pile allows the owner to rent the charging pile for charging when needed, while the mobile charging pile can be moved to the designated place for charging according to the needs of the owner, providing the owner with more flexible and convenient charging services.

3. Charging Service Market Environment Analysis

3.1. Macro-environment Analysis

In 2012, the "Energy Saving and New energy Automobile Industry Development Plan (2012-2020)" issued by The State Council first proposed the construction of charging piles. In September 2015, The General Office of the State Council issued the "Guiding Opinions on Accelerating the construction of electric vehicle charging infrastructure", which for the first time clarified the policy direction of the charging pile industry. On November 2, 2020, The General Office of the State Council issued the Notice on printing and distributing the Development Plan for the New Energy Automobile Industry (2021-2035). The circular pointed out that it is necessary to vigorously promote the high-quality development of the new energy automobile industry and accelerate the construction of an automobile power. As an important basic guarantee for the development of new energy vehicles, electric vehicle charging piles are closely related to the development of electric vehicles. In 2023, the National Development and Reform Commission, the National Energy Administration and other departments jointly issued the "Implementation Opinions on Strengthening the Integration and Interaction of New Energy Vehicles and the power Grid", vigorously promote intelligent and orderly charging, encourage the pilot demonstration of two-way interaction of the vehicle network, and put forward specific work deployment in terms of technology research, standard improvement, electricity price and market mechanism optimization.

3.2. Analysis of Internal Environment of Charging Pile Market

At present, China's charging industry shows a diversified industrial model, in which nationalized, privatized and mixed ownership enterprises coexist. This diversified business model not only enriches the market supply, but also promotes the competition and development of the industry.

In the context of the coexistence of multiple business entities, the industrial concentration remains at a high level, the market share of the top three enterprises has reached 75%,

there are 8 operators with more than 10,000 charging facilities, these enterprises have more than 90% of the domestic charging pile number, becoming the backbone of the domestic charging pile business.

There is a close linkage relationship between the charging amount of public charging piles and the number of electric vehicles. Due to the attraction of preferential policies such as unlimited travel and free license plates, private passenger cars occupy a significant position in the electric vehicle market, so the charging demand is also mainly concentrated in the field of private passenger cars. However, the main service objects of public charging piles are not limited to private passenger cars, they serve more special vehicles, especially buses in public transportation systems. Although the public charging capacity has been significantly improved in recent years, the use efficiency of a single charging pile is still low, which is related to factors such as the layout of the charging pile, charging speed and user habits.

From the perspective of market share, public charging piles occupy a dominant position, with a market share as high as 75.62%. Inside the public charging pile, DC charging pile and AC charging pile each occupy a certain share, but DC charging pile is favored because of its faster charging speed.

In addition, in order to expand market share, some enterprises have adopted the strategy of building charging facilities with the vehicle, which not only improves the user experience, but also promotes the further development of the electric vehicle market, making electric vehicle owners enjoy convenient charging services at the same time, but also promotes the overall growth of the electric vehicle market.

In summary, with the continuous promotion of new energy vehicles, the market scale of charging piles as a necessity for new energy vehicles continues to expand, and charging piles still have huge development potential and prospects.

4. Charging Service Market Development Issues

4.1. The Distribution of Charging Piles Across the Country Is Not Reasonable

At this stage, China's vehicle-pile ratio has reached 2.5:1, which basically meets the use needs of new energy vehicles in quantity, but from the specific point of view of the national distribution, the distribution of charging piles is still in an unreasonable state. Public charging infrastructure in the eastern coastal zone and economically developed cities accounted for 72.3%, while public charging piles in the northeast and west accounted for less. From the perspective of urban areas, charging infrastructure is more distributed in urban central areas, and the distribution of county seats and lower-level units is seriously insufficient. Even in the counties, towns and villages in the Yangtze River Delta, the Pearl River Delta and the Beijing-Tianjin-Hebei region, the penetration rate of electric vehicle charging infrastructure is far less than 10% or even less than 5%.

4.2. The Construction of Charging Infrastructure Is Difficult

At present, the power capacity of some cities in China is insufficient, and the power load is too large during the peak of electricity consumption, so the design and location of charging piles are very important. On public land, the land

price required for the construction of charging piles is too high, whether it is directly purchased or leased, and the interest demands of the surrounding areas are higher. In terms of the use of charging piles, the proportion of private charging piles of residents in the community has been significantly increased, but in many old communities, residents have no fixed parking space and insufficient power supply capacity, and the utilization rate of charging piles is greatly reduced.

4.3. Charging Facilities Are Not Unified, Charging Methods and Charging Needs Are Diversified

At present, diversified charging methods such as DC fast charge and battery replacement coexist, but the industry has not yet formed a unified charging standard and specification. Due to the differences in charging voltages and interfaces of different models of electric vehicles, the iterative speed of related technologies needs to be accelerated, which undoubtedly brings greater challenges to investment decisions, increases investment risks, and weakens the popularity and convenience of charging facilities as a public service. With the rapid expansion of the new energy vehicle market, the improvement of charging efficiency for fast-charging pure electric vehicles has become an urgent problem to be solved in order to meet the growing market demand.

4.4. Industry is Overly Dependent on Government

Infrastructure construction is significantly influenced by local government investment and support, and this dependence inhibits the core role of the market in optimizing the allocation of resources, thus limiting the active participation of all social forces in the construction of the industry. Many companies rely too much on long-term government subsidies to sustain their operations, leading them to fail to seek the fundamental driving force for self-development from product innovation and service improvement. In short, this development model, which relies too much on government support, inhibits market vitality and enterprises' ability to innovate.

5. Charging Pile Market Development Suggestions

5.1. We will Improve the Rural Network of Charging Facilities

The state should quickly formulate detailed planning guidance for charging infrastructure, clarify the configuration standards for urban and rural public charging services, ensure scientific prediction and evaluation based on actual needs, and determine the reasonable construction scale and structure of urban and rural charging piles. Through well-planned charging infrastructure layout, extensive coverage of urban and rural charging networks is achieved, ensuring that EV users can easily access charging services no matter where they are. Government departments increase investment and support for charging infrastructure in rural areas, and provide more attractive subsidy policies to encourage the construction of charging facilities. At the same time, the relevant procedures are simplified, the construction and operation thresholds are lowered, and the standard slow filling pile is promoted to replace portable charging equipment, so as to improve the efficiency and quality of charging services. In

addition, social capital is encouraged to participate in the construction and operation of public charging infrastructure in towns and villages, and the layout of public DC fast charging piles in rural areas is accelerated through franchising modes, so as to meet the charging needs of different users and promote the diversified supply of charging services.

5.2. Unified Design and Construction Standards, And Promote the Identification and General Understanding of Charging Facilities

With the vigorous development of the electric vehicle market, charging facilities as a key link in the electric vehicle ecological chain, the unification and optimization of its design and construction standards is particularly important. In order to further refine and standardize these standards, we must unify key technical standards such as charging interfaces and settlement methods to ensure perfect compatibility and seamless docking between charging devices produced by different manufacturers in the market and electric vehicles. This not only helps improve the user experience, but also avoids many inconveniences caused by device incompatibilities.

At the same time, we must also see that with the surge in the number of electric vehicles, the power supply capacity of charging piles and the stability of the grid have become new challenges. Therefore, we need to encourage charging pile suppliers to actively develop high-capacity chargers to reduce the potential impact on the grid when a large number of electric vehicles are charged at the same time. This not only relieves the strain on the grid, but also ensures the stability and efficiency of the charging process.

In addition, the safety and reliability of the charging pile can not be ignored. By optimizing heat dissipation and cooling technology, we can effectively reduce the heat generated by the charging pile during the working process, thereby improving the safety and reliability of its operation. This can not only ensure the safety of users, but also extend the service life of charging facilities and reduce later maintenance costs.

To sum up, by unifying key technical standards, developing high-capacity chargers and optimizing heat dissipation and cooling technologies, we can not only promote the sustainable development of the electric vehicle industry, but also provide consumers with safer and more efficient charging services. This will contribute to the overall healthy progress of the electric vehicle industry, while also further increasing consumer acceptance and satisfaction with electric vehicles.

5.3. Study the Commercial Model of Sustainable Development and Improve the Utilization Rate of Charging Facilities

At the important turning point of the charging pile industry from the initial demonstration stage to the full commercial operation, we must make more active use of the power of the market mechanism, dig deep and establish a set of cost-effective and practical operational model. The establishment of this model is of vital significance to ensure that charging facilities can be constructed and put into use smoothly in an efficient and orderly manner.

For charging pile operators, if they want to achieve stable and sustainable profits, they must explore diversified revenue

channels. These channels are diverse and extensive, including basic service fees, income from the price difference between buying and selling electricity, various government policy subsidies, and income from various value-added services. Each of these revenue channels constitutes an important support for the operator's profit model.

In particular, charging electricity charges as a major source of revenue for operators, not only directly reflects the frequency and efficiency of charging piles, but also an important indicator to measure the service quality of operators. At the same time, providing customers with quality services and charging a certain fee accordingly is also a key link to ensure that operators continue to make profits. This charging model based on service quality not only helps to improve the service level of operators, but also can further enhance customer loyalty and satisfaction, thus laying a solid foundation for the commercial operation of charging piles.

6. Future Outlook of Charging Market

With the continuous evolution of technology, the construction of a charging facility system of "smart slow filling + high-power fast power station" is gradually becoming an important development trend of the new energy automobile industry. In the charging solution of electric vehicles, AC piles occupy a dominant position, and the introduction of intelligent charging system can realize the orderly management and regulation of the charging process, so as to achieve off-peak charging. The research results of this project are expected to significantly alleviate the load bearing pressure of China's urban power grid, and achieve "one vehicle, one pile" power supply without additional generation capacity. Through the implementation of the "first come, first charge" charging strategy, combined with the intelligent interaction between the vehicle, charging pile and the power grid, the output power of the charging pile can be fine-adjusted, so as to effectively avoid the peak overlap of domestic electricity consumption and charging demand. Especially in the low hours of electricity consumption at night, the use of intelligent charging system can make full use of the power resources during this period and reduce the pressure on the grid during peak hours. Looking to the future, with the popularity of energy-storage devices, they will provide charging support for electric vehicles during peak hours. Combined with the solution of "intelligent charging + energy storage equipment", it can not only charge at the trough of electricity consumption and discharge at the peak, so as to smooth the peak and valley load of the grid, but also further improve the efficiency of energy utilization and promote the sustainable development of the new energy automobile industry.

The smart charging system has excellent flexibility to meet users' temporary, emergency and long-distance travel charging needs. With the rapid development of the electric vehicle industry and the gradual electrification of taxis, the demand for fast charging has become increasingly prominent, and fast charging stations are born to meet this demand. Whether in response to emergencies or to meet daily temporary charging needs, charging time and the availability of charging piles have become the focus of attention of owners. In order to make more efficient use of time and reduce waiting, owners are more inclined to choose charging piles with high-power DC fast charging function in order to quickly charge the vehicle and continue their journey. This

efficient charging solution not only improves the user experience, but also promotes the utilization of charging piles, further promoting the development of the electric vehicle industry.

From the perspective of operation, there are significant differences in management and operation between AC slow filling pile and DC fast filling pile. Ac slow filling pile, due to its relatively long charging time, the use frequency is naturally low. In this case, how to optimize the allocation of resources to these piles is particularly important. In order to ensure that these slow charging piles can be effectively utilized, operators need to take into account several factors, such as the flow of vehicles in the parking lot, the charging needs of electric vehicles, and the charging habits of users. Through accurate data analysis and scientific planning, it is possible to avoid the waste of resources and ensure that users can easily access charging facilities when they need them.

In contrast, DC fast charging piles have a higher frequency of use because of their efficient charging speed and wide range of needs. However, this also brings higher construction costs and more complex operational challenges. First of all, location is a key link in the operation of DC fast filling pile. The ideal location should be able to reach as many potential users as possible, taking into account grid access and land availability. Secondly, the operation needs to ensure the stability and efficiency of the equipment in order to provide users with continuous and reliable fast charging services. Finally, the issue of security cannot be ignored. Because the fast filling pile involves the transmission of large current, it must strictly comply with the relevant safety standards and specifications to ensure the safety of users and equipment.

7. Conclusion

To sum up, in order to optimize the user experience and provide more convenient charging services, Internet technology should be fully utilized to build an interconnected and intelligent management platform. On this basis, we will actively promote the national layout of new energy charging piles, especially in rural areas, and cover charging facilities to a wider geographical area to meet the growing demand for electric vehicle charging.

In terms of cost control, flexible business models such as financial leasing and time-sharing leasing can be adopted to reduce the overall charging service and management operating costs of users and partners. This not only helps to improve the economic benefits of charging services, but also provides a more economical solution for the layout of new energy charging piles across the country, especially in the promotion of rural areas.

Through the intelligent management platform and flexible business model, it can not only improve the convenience of charging, strengthen the branding and marketing of charging services, but also effectively promote the popularization and application of new energy charging piles. On the basis of accurately targeting the target user group, this method can combine the national layout and rural promotion strategy to quickly seize the market and provide strong support for the production, operation and service of the project products. At the same time, it will also help realize the vision of green travel and promote the sustainable development of the new energy vehicle industry.

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