

# Research on Real-Time Charging Demand of Electric Vehicle on Distribution Network Operation

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**Abstract:** With the rapid development of social economy and the strong support of national new energy policy, China's electric vehicle industry has officially entered a period of vigorous development, and various types of electric vehicles have been rapidly developed and mass production. At the same time, the large-scale production of electric vehicles has also led to the progress and development of a series of related industries and public facilities.

**Keywords:** Electric Vehicle; Real-Time Charging; Electric Load; Distribution Network; Internet of Vehicles

With the rapid development of social economy, people's living standard is improving day by day, and there are new requirements and standards for daily travel. Since the reform and opening up, China's car ownership has been growing. Although the rapid development of the automobile industry has promoted the upgrading and development of the domestic economy to a certain extent, the environmental pollution and energy shortage caused by a large number of cars are becoming more and more serious. Therefore, in recent years, the government has issued a series of policy documents on promoting clean energy, such as electricity, in order to vigorously promote the development and innovation of the electric vehicle industry. Compared with traditional fuel and coal-fired vehicles, electric vehicles not only have the advantages of zero emission and low energy consumption, but also alleviate the problem of traditional energy shortage in China to a certain extent.

## 1. Research status and significance of real-time charging demand for electric vehicles

### 1.1 Development status of research on real time charging demand of electric vehicles

As the large-scale production and use of electric vehicles will produce a large amount of charging load, and compared with traditional coal-fired vehicles, electric vehicles have greater randomness and uncertainty in real-time charging demand. The nonlinear characteristics of charging devices also enhance the impact index of national distribution network to a certain extent. With the continuous promotion and popularization of electric vehicles, scholars and experts at home and abroad have carried out research on the impact of electric vehicles on distribution network. Through the preliminary research, it is found that most scholars have studied many factors, such as the difference of penetration rate of electric vehicles, the difference of vehicle types, the difference of production investment of electric vehicles and the difference of charging modes, and mainly with the help of the two research methods: model simulation and trend calculation are used to analyze the load of distribution network, line loss of power grid and voltage variation law, so as to better study the actual impact of electric vehicles on national distribution network.

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## **1.2 Significance of research on real time charging demand of electric vehicles**

Research on the impact of large-scale electric vehicle real-time charging demand access to distribution network and the research of electric vehicle charging control method to reduce the negative impact have become a hot topic of widespread concern in the community, with high theoretical and practical significance. By studying the impact of electric vehicle real-time charging demand connected to distribution network, on the one hand, it can better meet the real-time charging demand of electric vehicles, and use feasible economic or technical measures to guide electric vehicles to charge orderly and efficiently. On the other hand, by studying the impact of the real-time charging demand of electric vehicles into the distribution network, we can effectively realize the load peak shaving and valley filling in the distribution network, reduce the variance of the load curve, and ensure the coordinated development of the electric vehicle and the power grid, in order to realize the economic maximization on the benefit level. From a practical point of view, through the study of the impact of the real-time charging demand of electric vehicles into the distribution network, it can promote the rational and effective use of electric energy, and upgrade the stability and overall benefits of the electricity price mechanism, so as to better promote the development of the electric vehicle industry, and embark on the zero emission and low energy consumption of new energy vehicles.

## **2. Main methods of research on real-time charging demand of electric vehicles**

### **2.1 Sample acquisition and clustering algorithm for real-time charging requirements of electric vehicles**

Due to the randomness and uncertainty of the driving path and charging demand of electric vehicle users, in order to study the charging demand of electric vehicle more scientifically, the measurement and analysis of spatial distribution of real-time charging demand of electric vehicle can be realized by combining the advanced intelligent vehicle networking technology. Therefore, the Internet platform itself has a natural data advantage, which can access a large number of electric vehicle data in the Internet of vehicles in real time, which is conducive to the construction of a certain time dimension of electric vehicle sample data set. According to the real-time sample data of the Internet of vehicles, we can more accurately calculate the sample clustering algorithm according to the charging demand. In the process of using the clustering algorithm, the number of clusters can be defined according to the actual development number, distribution and scale of electric vehicles. According to the distribution density and relative distance of real-time charging demand of electric vehicle samples, the clustering center is automatically selected according to the threshold value of clustering elements and contour coefficient, and the clustering results are obtained. Finally, establishment of distribution model for real-time charging demand of electric vehicles is realized.

### **2.2 Distribution characteristics and application summary of real-time charging demand for electric vehicles**

Through the data research of electric vehicle batteries in the current market, it is not difficult to find that most of the battery types of electric vehicles are lithium-ion batteries, which have no memory effect on the charging process. Therefore, the real-time charging process itself has little impact on the on-board battery, and there is no serious shortage of electricity. In this context, electric vehicle users do not need to reach a certain power value to charge. There is not only the actual demand of charging more than 50% of the remaining electricity, but also the possibility of actual charging demand of about 20%. Therefore, for the running electric vehicle, as long as the battery is not fully charged in the true sense, then the lithium-ion electric vehicle can be regarded as having charging demand.

## **3. Research on the influence of real-time charging demand of electric vehicles on distribution network operation**

### **3.1 Main types of influence of electric vehicle real-time charging demand on distribution network operation**

Through the investigation of sample data of electric vehicles in the Internet of vehicles and the practical application of clustering algorithm, it is not difficult to find that the impact of real-time charging demand of electric vehicles on the operation of distribution network mainly lies in the following aspects: First, large-scale electric vehicle charging demand access will lead to a new round of rapid growth of power load. Second, due to the randomness and uncertainty of charging demand in time and space dimensions of electric vehicles, the operation conditions of distribution network will change at any time, which brings certain operation risks for the overall stability of power system. Third in view of the large-scale popularization and application

of electric vehicles, the construction of public charging places needs more financial and human cost investment. This is a good development opportunity for the grid company, and also a huge project challenge. According to the statistics of electric power department, the peak value of domestic urban power consumption is generally concentrated at noon and afternoon in the daytime, and the nighttime is relatively the low power consumption period. If users can be guided to charge electric vehicles in the low power consumption period at night and use the vehicles during the peak period of daytime power consumption, it is conducive to the overall peak valley balance of China's distribution network and improve the load characteristics of power grid. At the same time, it is more conducive to improve the overall utilization of charging equipment. In addition, electric vehicles can also be used as mobile energy storage equipment without affecting the normal travel of electric vehicle users, so as to delay the construction of power grid infrastructure.

### **3.2 Strategy research on the real-time charging demand of electric vehicles on the operation of distribution network**

At present, electric vehicle charging has been carried out in China the key project of V2G aims to connect the non use electric vehicles into the power distribution network, and realize the two-way exchange of energy and information between the vehicle and the distribution network. As a distributed energy storage unit, the on-board battery can automatically improve the charging efficiency in the non peak period of the grid load, and realize the reverse energy feedback to the power distribution network without affecting the travel of electric vehicles. This is of great significance for improving the operation efficiency of power distribution network and reducing the peak valley difference on the demand side. In addition, the coordinated charging project can also be used to effectively reduce the negative power grid benefits caused by the scale aggregation of electric vehicles. As a widely used charging mode, the coordinated charging and discharging mode divides the distribution network system into three main modules, namely, the power supplier, the electric vehicle user and the power intelligent controller as the front-end medium. The Intelligent Energy Management System (IEMS) for electric vehicles in smart grid environment realizes the coordination and optimization of energy distribution, charging time and power grid stability through online real-time monitoring and intelligent algorithm.

## **4. Conclusion**

Compared with the traditional fuel coal-fired vehicles, electric vehicles can achieve stronger environmental benefits, and play a very important role in promoting the development of domestic automobile industry and ensuring energy security. Therefore, in order to achieve the overall consideration of the real-time charging demand of large-scale electric vehicles and the safe and efficient operation of distribution network, it is necessary to construct a scientific and feasible optimal charging model of electric vehicles based on the theoretical model of charging demand of electric vehicles, so as to realize the function of peak load cutting and valley filling in distribution network, reduce the charging fault caused by network loss and voltage drop, and effectively reduce the investment and construction cost of distribution network.

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