

## **ANALYSIS OF ADVANTAGES AND DISADVANTAGES OF ENERGY REPLENISHMENT METHODS FOR ELECTRIC VEHICLE CHARGING STATIONS**

Conventional charging. Conventional charging generally refers to the use of AC voltage and low current for charging. Generally, it adopts single-phase 220 V or three-phase 380 V alternating current, and the charging current is generally about 15 amperes, and the time required to fully charge a car is generally more than 8 hours. At present, most of the charging piles built in neighborhoods, units and public parking lots adopt this charging method. This charging method has obvious advantages:

- 1) the cost of building and maintaining charging piles is low;
- 2) very suitable for free time charging, work, shopping malls, evening rest time can be a long time charging;
- 3) less loss to the battery, the conventional charging method is lower power and gentler, which can effectively extend the service life of the battery;
- 4) less impact on the power grid, because of its smaller charging current, less impact on the existing grid load, and can be constructed in most of the sites.

The disadvantage is that the charging time is too long to cope with the charging needs during long-distance traveling and emergency charging needs, etc.

From the above analysis, it can be seen that this type of charging method is very suitable for personal and corporate EV users for daily power supply, but cannot meet the charging demand in emergency situations.

Fast charging. Fast charging generally refers to what is often referred to as "DC fast charging", generally using a three-phase four-wire power supply, the charging process can reach more than 150 amps of current, charging power is very large. It takes less than 2 hours to charge an uncharged electric vehicle to 80 % of its capacity, but when the capacity is higher than 80 %, the charging pile will reduce the charging current to protect the battery and adopt trickle charging mode. This charging mode is currently used in highway parking areas and centralized electric vehicle charging stations. The advantages of fast charging mode are:

- 1) charging speed is very fast, suitable for continuous use of vehicles and emergency situations;
- 2) charging mobility can be compared to gas stations and gas stations, do not need a large parking lot.

The disadvantages of this type of charging are:

- 1) in the current battery technology, and the limitations of heat dissipation capacity, rapid charging on the vehicle battery damage is greater than the conventional charging method, is not suitable as a conventional means of charging;

2) the cost of construction and maintenance of charging piles is higher, and the corresponding charging service fee is also higher;

3) due to the high charging current, this charging method has high requirements for safety umbrella;

4) the impact on the power grid is great, the charging load of the centralized charging station has a great impact on the power grid, which generally requires the reconstruction and expansion of the corresponding distribution network.

From the above analysis, it can be seen that the fast charging method is very suitable for emergency power supply, and its application in highway charging station and centralized charging station in the city is very promising.

**Battery replacement method.** The battery replacement method generally refers to the method of directly replacing the on-board battery when the electric vehicle needs to be replenished with electric energy. This method of replenishing electric energy isolates the electric energy supply of electric vehicles from the power grid, which is very suitable for electric vehicles with uniform standard batteries. The State Grid Corporation, the Southern Power Grid Corporation, and most new energy vehicle manufacturers are working on this charging method, which is now mostly used in large-scale demonstration electric vehicle projects such as electric buses.

The advantages of the battery swap method are:

1) the efficiency of the vehicle for electrical energy replenishment is very high, which greatly improves the flexibility and practical efficiency of electric vehicles;

2) the replaced batteries are generally charged centrally, and reasonable planning of the charging time can match the adjustment of the power grid load;

3) the testing of the replaced battery has a positive effect on the maintenance and service life extension of the battery.

At the same time the disadvantages of this method are:

1) it requires a lot of human and material resources to maintain the battery, which raises the cost of charging;

2) at present, there is no unified standard for the battery and charging supporting technology produced by different companies and enterprises, and there are technical barriers between each other;

3) it has not been able to adapt to the charging needs of individual users, and is only used in the group users in this way. From the above analysis, we can see that this way of electric energy replenishment, there are still large limitations, and there are still many problems that need to be overcome if we want to apply it on a large scale.

In summary, the three types of electric vehicle charging stations can be taken in the electric energy supply method has its own advantages and disadvantages.

Combined with the existing technical conditions, the new electric vehicle charging station in the city is the most suitable for fast charging method of electric energy supply among the current electric energy supply methods.

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## **АНАЛИЗ ПРЕИМУЩЕСТВ И НЕДОСТАТКОВ МЕТОДОВ ПОПОЛНЕНИЯ ЭНЕРГИИ ДЛЯ ЗАРЯДНЫХ СТАНЦИЙ ДЛЯ ЭЛЕКТРОТРАНСПОРТНЫХ СРЕДСТВ**

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## **ПРЕОБЛАДАЮЩАЯ РОЛЬ ВЕКТОРА КАЧЕСТВА НА СОВРЕМЕННОМ ЭТАПЕ ОРГАНИЗАЦИИ ЖЕЛЕЗНОДОРОЖНЫХ ПЕРЕВОЗОК**

На современном этапе экономического развития в нашей стране железнодорожные перевозки играют весьма значимую роль – обеспечение своевременной и качественной организации доставки грузов и пассажиров является важнейшим аспектом «комплексной услуги» или «комплексного продукта». Поэтому развитие железнодорожного транспорта должно двигаться направленно, в соответствии с установленным в государстве вектором качества. Качественное преобразование процессов организации перевозок на основе использования актуальных современных технологических решений, с поэтапным привлечением искусственного интеллекта является одним из наиболее перспективных направлений для эффективного функционирования транспортной системы Республики Беларусь. Применение указанных решений позволит не только на качественно новом уровне подойти к совершенствованию эксплуатационной деятельности отдельных структурных подразделений железной дороги, но и скоординировать деятельность отдельных служб и административных подразделений на основе интеллектуальной оптимизационно-интегративной управленческой модели. В качестве примера можно привести автоматизированную систему управления хозяйством сигнализации и связи Белорусской железной дороги (АСУ Ш БЧ), представляющую собой программу, направленную на автоматизированную выработку множества оптимизационных решений для повышения качества координации рабочего процесса организации. С помощью этой программы можно повысить эффективность работы предприятия за счет автоматизации тех операций, которые сотрудникам приходилось выполнять вручную, таких как учет, планирование и управление ресурсами компании. А применение информационно-электронной системы с использованием современного метода QR-кодирования данных для учета устройств, идентификации приборов с