1. Introduction

In recent years, the development of new energy industry, especially the pure electric vehicles are increasingly growing rapidly [1-4]. The deputy director of pollution prevention and control department in Ministry of Environmental Protection Jian Wang said, motor vehicle's amount of China continues to be sustainable growth. In 2014, the production and sales of nationwide cars reached 3.723 million and 23.492 million, respectively. Compared with 1980, the national motor vehicles owned increased by 33 times, and reached 245.772 million, among which, 144.522 million are cars, 9.72 million cars at low speed, and 91.53 million motorcycles. Classified by emissions standards, the achieved IV and above standard cars accounted for 22.7% of total car ownership, the III standard cars 52.5%, the II standard cars 10.4%, the I standard cars 10.6%, and the remaining 3.8% of the cars cannot reach the I standard. According to the classification of environmental mark, the "green-label cars" accounted for 93.2%, and high emissions of "heavy-polluting vehicles" still 6.8% [3]. In 2016, the energy department website in the United States (U.S.) announced a novel wireless charging technology, which can be up to 20 kW charging powers, is about three times of the current charging pile, is expected to replace the traditional charging pile, and becomes the charging infrastructure of the electric vehicles. The energy department of Oak Ridge National Laboratory (ORNL) recently cooperates with Toyota, cisco systems, Evatran and Clemson university international center for automotive research in Tennessee to show the new wireless vehicles’ charging technology, tested vehicle model is Toyota RAV4 (10 kWh battery) that is filled with 80% electric quantity only to need 18 minutes, while 100% 30 minutes. Now the research and development of 50 kW system has begun, if successful, the fast charging operation of general electric cars only need 7 minutes [4]. Therefore, it is for the charging modes’ diversification and convenience of electric vehicles to put forward higher requirements. There are three energy supply ways of electric vehicles: battery...
replacement, slow charging alternating current (AC), and fast charging direct current (DC). The form of battery replacement faces two key challenges: the realization of standardizing the battery box and the practical utilization of fast battery replacement; The shortcoming of slow charging AC is the lengthy of filling charging time; The form of fast charging DC will greatly shorten the service life of batteries. The changes of large current will impact on power grid. While using wireless charging can make charging equipment stealth, the wear rate of equipment is lower, the applied range is wide, public charging area is relatively small, which can realize non-contact charging. Even to realize that when electric cars are driving, they can be non-contact charging. Wireless charging form not only has the convenience, but also can adapt to the rapid development of the electric car industry. Meanwhile national policies can be also the support and planning of electric cars, which has a great impetus role on wireless charging. The wireless charging technology of electric vehicles belongs to a kind of brand-new energy supply technology, which fully conforms to carry out the demand of saving energy, protecting environment and developing low carbon economy initiated by the electric vehicles, which will become a main direction of electric cars for power supply technology [5].

2. The principle of wireless charging technology

Wireless charging technology refers to the devices with batteries do not rely on the electric wires, using the principle of the electromagnetic induction (EMI), or other relevant AC induction technology, in the senders and receivers with the corresponding equipment to send and receive the induced AC signals, is a technology for charging, deriving from the technology of wireless electronic power transmission. Mainly analyze from the perspective of near field charging and far field charging as follows [1, 6, 7].

2.1. Near field charging

2.1.1. Near field inductive charging Nikola Tesla proved energy delivered by oscillating magnetic field in the early 1880s, which can charge the battery by near field or magnetic resonance (MR) [8]. The near field induction charging system is shown in Fig. 1 [9]. The current and voltage from the transmitter to the receiver must be AC. By converting AC network voltage to step-down and DC, provide the drive and controller circuit of transmitters for bias. Drive and controller generates switch signals and adjusts switching frequency, which converts DC into AC, and then inputs to the primary coil. At the receiver, to rectify AC signals, and then adjust by synchronized transformation, for the battery charging. According to the needed watt level of the receiver, the coil of frequency changes. Through signals superimposed on the power signals, so both know equipment is placed on the charging mat. Inductive charging efficiency is higher, but whether coil alignment is sensitive. Need to adjust coupling coil to slightly deviate from the resonant frequency, in order to optimize power transmission.

![Figure 1. The near field inductive charging system.](image-url)
between the transmitter and receiver. A single 6.78 MHz transmitter can support multiple receivers, without physical alignment. However, the strict frequency match is required between the receiver and transmitter, and to farthest extend the power transmission distance in the specific coil size. With the increasing number and extending distance of connected equipment, transmission power will go down. At the same time, the standard requires has independent two-way communication channels (Bluetooth) between the transmitter and each receiver [10].

![Figure 2. Qi-compliant wireless power transfer model.](image)

AirFuel Inductive is another standard, and Powermat is a good example of bridging technology that provides a common ring, can be used with the charging mat, to recharge portable devices. Because there are two standards, general motors (GM) company announced that its cars will simultaneously support AirFuel Inductive and Qi standard [11, 12]. Samsung Company also decided its mobile phones will support two standards. The related technical indicators of near field charging standards is as shown in Table 1 [9].

**Table 1. The comparison of three near-field charging standards: Qi, AireFuel Inductive, and AirFuel Resonant**

| Technical indicators       | Qi (WPC) | AireFuel Inductive | AirFuel Resonant |
|---------------------------|----------|--------------------|------------------|
| Power frequency           | 100–205 kHz | 277–357 kHz        | 6.785 MHz        |
| Data communication        | Superposition | Superposition      | Bluetooth: 2.4 G |
| Free receiver position    | ×        | ×                  | √                |
| Multiple receivers        | ×        | ×                  | √                |
| Modes                     | Induction | Induction          | Induction        |
| Power transmission        | Good (~5 W) | Weak              | Weak             |

### 2.2. Far field charging

Both inductive charging and resonance charging have requirement for the distance between the transmitter and receiver. In the far field charging, energy needs to be transferred from power hub to a specific device. Bluetooth, WiFi, ultrasonic and infrared ray, etc., were ever explored to be used. Based on radio frequency (RF) system (for example, WattUp™ and Cota™) uses one or more antenna to broadcast energy and proceed to communication. In October 2015, Energous company announced it can provide the first radio frequency power receiver IC, which will make radio frequency rectify DC signals, this integration technology-Cota™, in fact, use the existing WiFi and Bluetooth antenna to realize data communication and wireless power reception, and then these micro-signals are added to the battery’s charging current. The receiving device of response and specific battery charging characteristic data transfer back to the router of power source in the way of wireless [12-14].

After continuous link is established, the router of power source emits energy beam to the receiver’s position. In the ultrasonic system represented by uBeam, the signal generator in the router generates electrical signals, which are sent to the amplifier, and then the amplified signals are connected to the transducer, producing ultrasonic wave, and through focusing sent to the receiver. Ultrasonic wave
imposes on piezoelectric sensor, resulting in a charging current. Sensors used by the two sides of the system are needed to support high efficiency and high power. Another entrepreneurial firm—Wi-Charge, concentrates on converting the line of sight light to energy. The transmitter uses laser diode to accurately transmit infrared beam to the receiver, and then photo-voltaic cells of the receiver convert light back to electric energy. This company is for system to function demo in February 2015 in San Francisco [9]. Infrared technology has an obvious advantage of no EMI radiation.

3. The latest achievements achieved by wireless charging technology

As early as in 2011, Perry, at the University of Pennsylvania in the U.S., invented her first wireless charging system, which is mainly composed of boxes with the size of two electric ovens, and can implement electricity transmission within the scope of 2 inches. Thereafter, Perry showed its working performance and principle of wireless charging system at the summit of science and technology, called her equipment as uBeam, and subsequently, UBeam Company continues to the research and development of wireless charging technology and shows it will launch its research and development of prototypes in the near future. For some existing wireless charging equipment on the market, Perry thinks they cannot reach the technology level of uBeam. Nowadays, there are quite a number of electronics manufacturers that have applied wireless charging technology in the electronic products, but it is mainly adopted by one-to-one charging mode, which do not have the charging ability of many sets of electronic equipment, while American manufacturers roll "Wait Up" wireless charging equipment that can be realized to charge the electronic equipment within the scope of the emitter as the center for radius of 4.6 meters (m), and can drive the 12 sets of electronic equipment at the maximum and its transmission is not higher than 0.25 W power supply, or four sets no more than 4 W, and its charging speed is inversely proportional to the charging distance, this device depends on its internal Bluetooth to realize for the positioning of the required charging equipment and electricity detection, after detecting that the battery is low, emitting wireless signals about 5.8 Hz implements the power transmission. With the constant depth of wireless charging technology, WaitUp Company is committed to research and development of the corresponding hardware equipment to improve its industrial chain, and strengthen the competitiveness of its products [9-11].

Meanwhile, in early 2015, the U.S. Patent Office has received a patent application submitted by Samsung company, its research content is mainly about the research and development of the electromagnetic induction coil of wireless charging technology, Samsung's wireless charging technology has the basic function of charging, at the same time, the most important characteristics is the wireless charger embedded in the function of point of ultraviolet radiation, to make the surface of the charging devices disinfect, the U.S. Patent Office exhibited the appearance, structure, and working principle, etc., of the wireless charging equipment submitted by Samsung. At the same time, Microsoft is also unwilling to feel lonely, formulating automatic positioning smart phones, called AutoCharge, of research and development planing for wireless charging technology, through charging its researched prototype installed on the ceiling indoors to cover a wide range for indoor mobile phones, so as to realize wireless charging for mobile phones. The prototypes of wireless devices are mainly built-in a monitoring module and a charging module, in collecting monitoring module adopting technology is based on image processing to monitor and track indoor phones, through continually testing the indoor equipment such as similar mobile phones and after detected, to use the beam of light produced by the solar power with power technology provides remote wireless charging service for smart phones, at the same time, AutoCharge detects the electronic quantity of electronic equipment through its Bluetooth, and after completion of charging, stops battery charging [1,6,12,13].

In brief, wireless charging technology is an important direction of the electronic technological development nowadays and even for a period of time in future, through the application of wireless charging technology that can make people liberated from multifarious wires, which to plays an important role in better implementing the popularization and utilization of the electronic equipment and new energy vehicles [14, 15].
4. Conclusion
In two sessions of 2016, topics related to automobiles once again become a significant issue for discussion. Keqiang Li, the prime minister, not only mentioned the "active used-car market", "speeding up the construction of the urban parking lot", and "constructing the charging infrastructure of new energy vehicles", etc., in the government report, when talking about the problem of environmental pollution, more put forward "put forth effort to reduce emissions of fire coal and vehicles", "comprehensively generalizing vehicles to use the V standard of fuel oil", and "weeding out 3.8 million yellow-label cars and old cars".

In a word, how to implement green development, i.e., saving energy, protecting environment, and low carbon, is the problem for automobile industry to face. In the future energy conservation and environmental protection will be the backbone of automobile industry in China.

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