Technology and Development of Electric Vehicles Charging Infrastructures

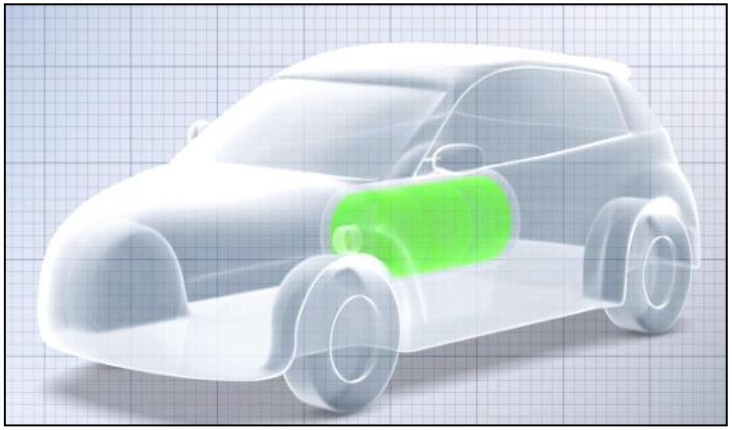
NARI Group - Beijing State Grid Purui UHV Power Transmission Technology Co., Ltd

Li Wufeng Nov. 2014

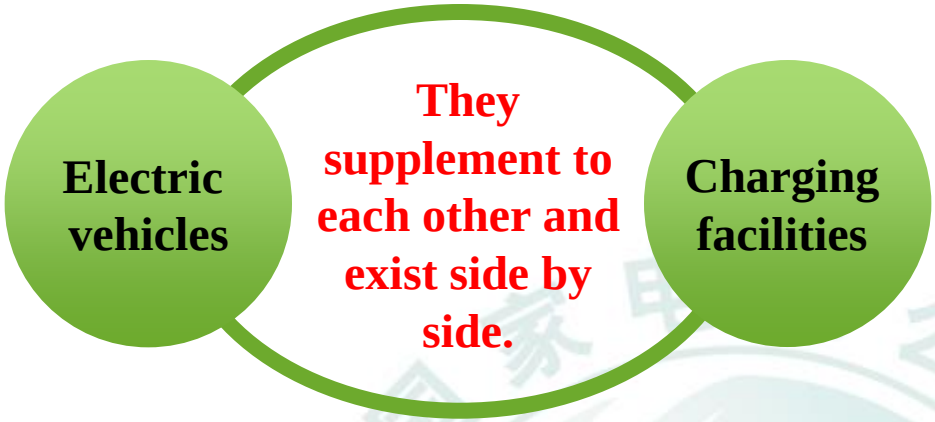
Content

I. Key technology of electric vehicles charging facilities

Charging facilities are very important infrastructures in the development of electric vehicles.



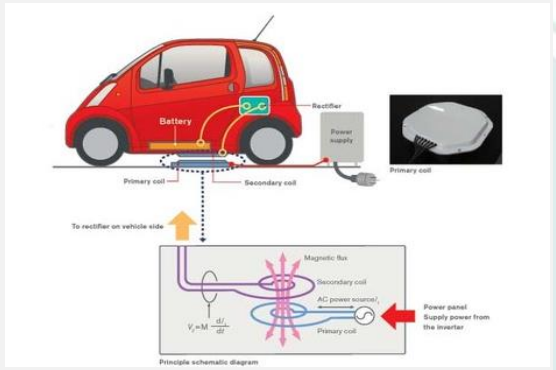
Electric vehicles are driven by Electric Energy.



I. Key technology of electric vehicles charging facilities

Power supply mode of electric vehicles

- Power supply mode of electric vehicles
  - Charging
    - Conventional charging and quick charging
    - Conductive charging and non-contact charging
  - Battery-swap
    - Battery swap of commercial vehicle and passenger vehicle
    - Battery swap from the side and from the chassis



I. Key technology of electric vehicles charging facilities

Infrastructure	AC charging point	Charging station	Battery-swap station
Appearance			
Capacity	It has a capacity of 3-10kW and can complete the conventional charging of a small electric vehicle within 4-8h.	It has a capacity of 20-450kW and can complete the conventional or quick charging of an electric vehicle within 0.2-3h.	It uses automation equipment and can swap the entire battery packs of an electric vehicle within 10min.
Advantage	Low cost, less land occupation and easy to establish	Short charging time	Fast recharging, easy battery maintenance and convenient to keep the charging in order
Disadvantage	Long charging time	Great impact on power grid	Higher requirement on vehicle model

I. Key technology of electric vehicles charging facilities

国家电网 STATE GRID

Main type of charging facilities

Bus

Charging station

Battery-swap station

Taxi

Charging station

Battery-swap station

Environmental sanitation vehicles

Charging station

Battery-swap station

I. Key technology of electric vehicles charging facilities

Main type of charging facilities

Intercity quick charging station

Charging point of private use

Public charging network in the city

Public charging point

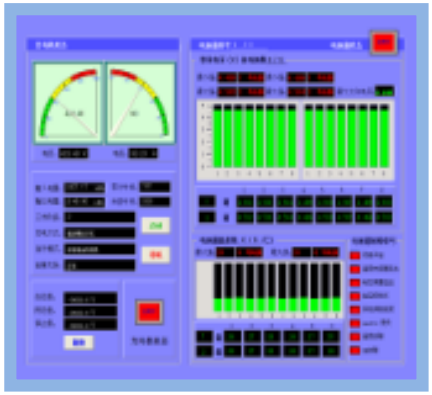
Charging tower

Stereo charging garage

I. Key technology of electric vehicles charging facilities

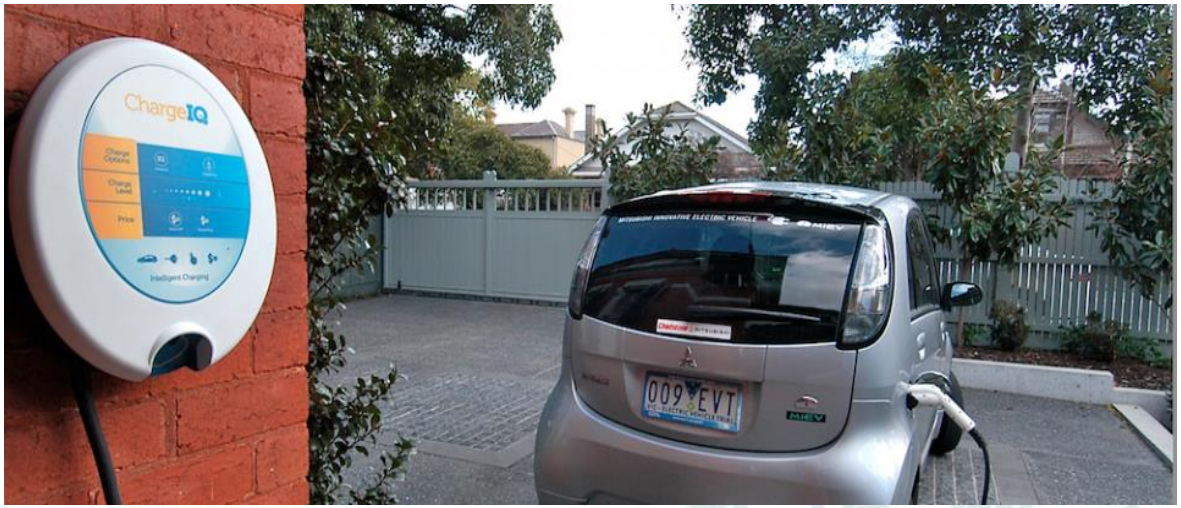
Key equipment

- AC charging point
- DC battery charger
- Battery-swap system
  - Battery-swap system of bus
  - Battery-swap system of passenger vehicles from the chassis
- Monitoring system of charging station
- Operation monitoring system
- Battery-swap system of passenger vehicles from the chassis



I. Key technology of electric vehicles charging facilities

AC charging device



I. Key technology of electric vehicles charging facilities

DC charging device

Type	Box-type battery charger	Separated DC battery charger	Integrated DC battery charger	Integrated AC & DC battery charger
Appearance				
Features	It is used in battery-swap station and can directly charge the power battery that is removed from the vehicle; it usually has a lower voltage output.	It is in the mode of combining rectified cabinet and DC charging point with lower requirement on environmental suitability of battery charger and IP protection; it can be configured with high-power.	It is easy to install & use and has a high level of integration and high requirement on IP protection & reliability; it is mainly used for passenger vehicles and has a power of not more than 100kW.	It can output both DC and AC electric energy and has a high level of integration.

I. Key technology of electric vehicles charging facilities

Battery-swap system - battery-swap station for electric bus

1 Charging station for electric vehicles in Beijing Olympics

2 Charging station for electric bus in Shanghai World Expo Park

3 Charging stations in Shenzhen Universiade

4 Xuejiadao charging station for electric bus in Qingdao City

5 Gaoantun station of electric vehicle in Beijing City

6 Charging station in Guangzhou Asian Games

I. Key technology of electric vehicles charging facilities

国家电网 STATE GRID

Battery-swap station for electric passenger vehicles (from chassis)

1

2

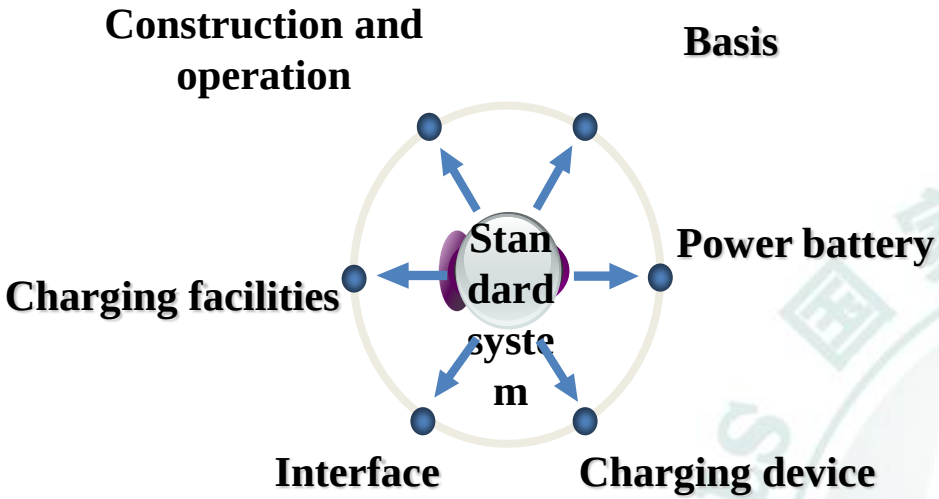
4

3

目录

II. Present situation of charging facilities standardization

We have established a charging standard system of advanced technology and full coverage, built a framework for this standard system and completed **16** national standards and **20** industrial standards; State Grid Corporation of China has established **39** enterprise standards.



II. Present situation of charging facilities standardization

Relevant national standards

	Standard Code	Standard Name
1	GB/T 20234.1-2011	*电动汽车传导充电连接装置 第一部分 通用要求*
2	GB/T 20234.2-2011	*电动汽车传导充电连接装置 第二部分 交流充电接口*
3	GB/T 20234.3-2011	*电动汽车传导充电连接装置 第三部分 直流充电接口*
4	GB/T 27930-2011	*非车载充电机和电池管理系统间的通信协议*
5	GB/T 29317-2012	*电动汽车充换电设施术语*
6	GB/T 29318-2012	*电动汽车非车载充电机计量要求*
7	GB/T 28569-2012	*电动汽车交流充电桩计量要求*
8	GB/T 29772-2013	*电动汽车电池更换站通用要求*
9	GB/T 29781-2013	*电动汽车充电站通用要求*
10	GB 50966-2014	*电动汽车充电站设计规范*

II. Present situation of charging facilities standardization

Relevant industrial standards

	Standard Code	Standard Name
1	NB/T 33001-2010	*电动汽车非车载充电机技术规范*
2	NB/T 33002-2010	*电动汽车交流充电桩技术规范*
3	NB/T 33003-2010	*电动汽车非车载充电机监控单元和电池管理系统的通信协议*
4	NB/T 33004-2013	*电动汽车充换电设施施工与竣工验收规范*
5	NB/T 33005-2013	*电动汽车充换电站监控系统技术规范*
6	NB/T 33006-2013	*电动汽车电池更换设备通用要求*
7	NB/T 33007-2013	*电动汽车充换电站和充换电设备间的通信协议*
8	NB/T 33008.1-2013	*电动汽车充电设备检验与测试规范 第一部分 非车载充电机*
9	NB/T 33008.2-2013	*电动汽车充电设备检验与测试规范 第二部分 交流充电桩*
10	NB/T 33009-2013	*电动汽车充换电设施建设技术导则*

II. Present situation of charging facilities standardization

Relevant enterprise standards

	Standard Code	Standard Name
1	Q/GDW 233－2008	电动汽车非车载充电机 通用要求
2	Q/GDW 234－2008	电动汽车非车载充电机 电气接口规范
3	Q/GDW 235－2008	电动汽车非车载充电机 通信协议
4	Q/GDW 236－2008	电动汽车充电站 通用技术要求
5	Q/GDW 237－2008	电动汽车充电站 布置设计导则
6	Q/GDW 238－2008	电动汽车充电站 供电系统规范
7	Q/GDW 397－2009	电动汽车非车载充放电装置通用技术要求
8	Q/GDW 398－2009	电动汽车非车载充放电装置电气接口规范
9	Q/GDW 399－2009	电动汽车交流供电装置电气接口规范
10	Q/GDW 400－2009	电动汽车充放电计费装置技术规范
11	Q/GDW Z 423－2010	电动汽车充电设施典型设计
12	Q/GDW 478-2010	电动汽车充电设施建设技术导则
13	Q/GDW 485-2010	电动汽车交流充电桩技术条件
14	Q/GDW 486-2010	电动汽车电池更换站技术导则
15	Q/GDW 487-2010	电动汽车电池更换站设计规范

II. Present situation of charging facilities standardization

International standard- standard for charging interface

◆ Various schemes of charging interface

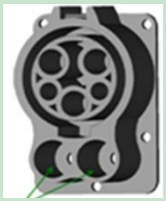
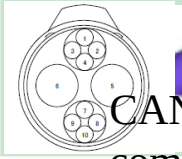
Specifications for voltage and current of charging interface in each standard

SAE J1772-2010		
AC level I	120V single-phase	12A/16A
AC Level II	204-240V single-phase	<=80A
DC Charging	Underdetermined	Underdetermined
IEC 62196.2-2011, IEC 62196.3-2014		
Type1	250V single-phase	<=32A
Type2	250V single-phase	<=70A
	480V three- phase	<=63A
Type3	250V single-phase	<=16A (Single lead) <=32A (Double lead)
	480V three-phase	<=63A
DC Charging	600V	200A
	1000V	400A
GB/T 20234-2011		
AC	250V single-phase	16A/32A
DC	750V	125A/250A

II. Present situation of charging facilities standardization

International standard- standard for charging interface

IEC proposals for charging interface of various countries

	AC interface	DC interface	Mixed interface
USA			 PLC communication
Europe	  		 PLC communication
Japan		  CAN communication	
China		 CAN communication	

II. Present situation of charging facilities standardization

Quicken up the compilation of charging standards - Perfection of standards for charging interface

国家能源局 National Energy Administration

国家电网公司 STATE GRID CORPORATION OF CHINA

Technical Committee for Standardization of Electric Vehicles Charging Facilities in Energy Industry NEA/TC3

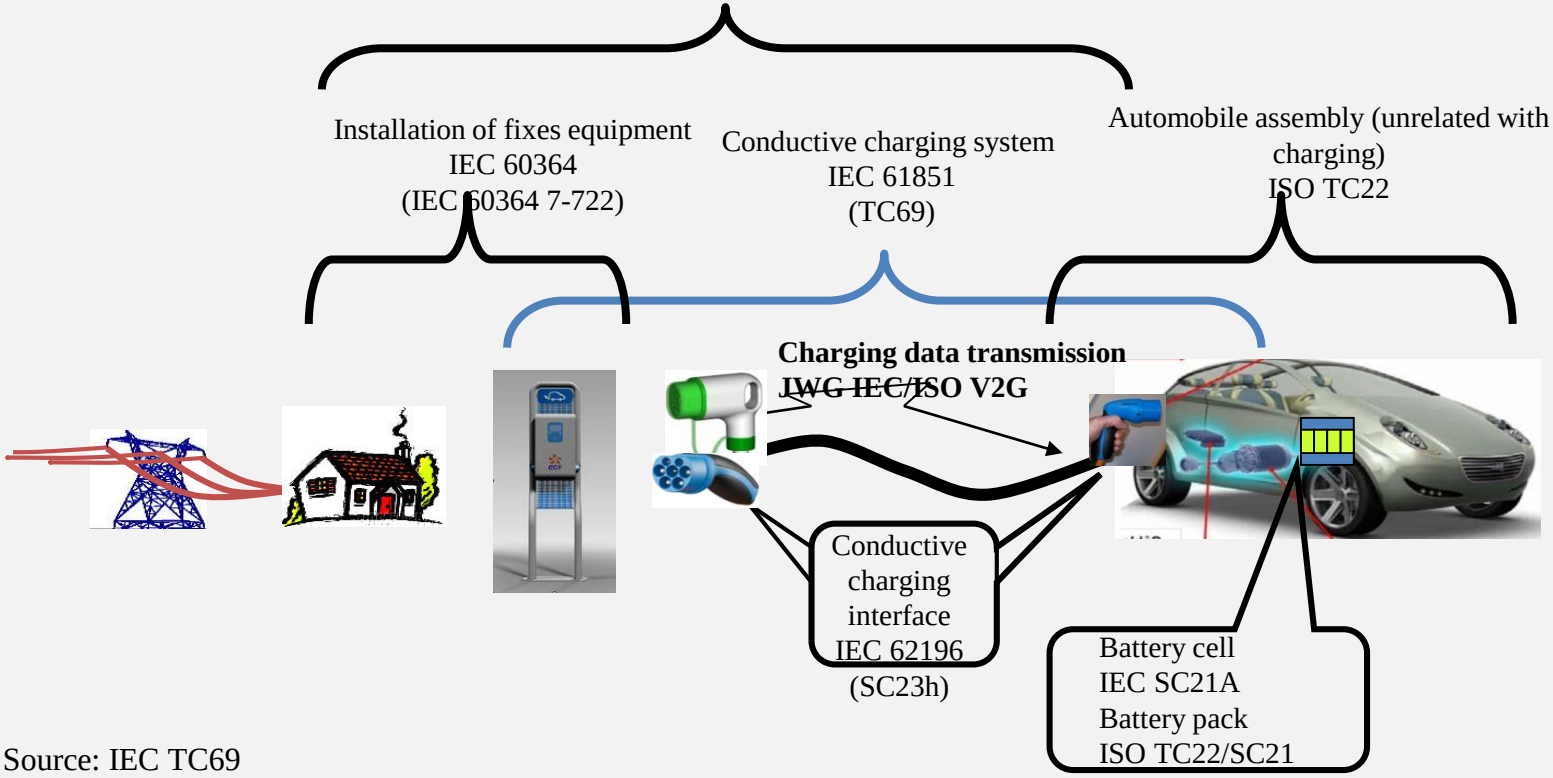
GB/T 20234.1, .2, .3 GB/T 27930

It perfects the PWM curve, control sequence and insulation detection, etc.

II. Present situation of charging facilities standardization

International Standard of electric vehicles

- Various standards are under compilation.
- It is very complicated in contents and involved in various TCs so that it requires the coordination between ICE and ISO and various TCs.



Source: IEC TC69

II. Present situation of charging facilities standardization

Quicken up the compilation of charging standards - Positive participation in development and revision of international standards

CATARC

国家电网公司 STATE GRID CORPORATION OF CHINA

IEC 61851
IEC 62196
IEC 15118
……

IEC 62840-1 电动汽车换电系统 第一部分：系统描述与通用要求
IEC 62840-2 电动汽车换电系统 第二部分：安全要求

Content

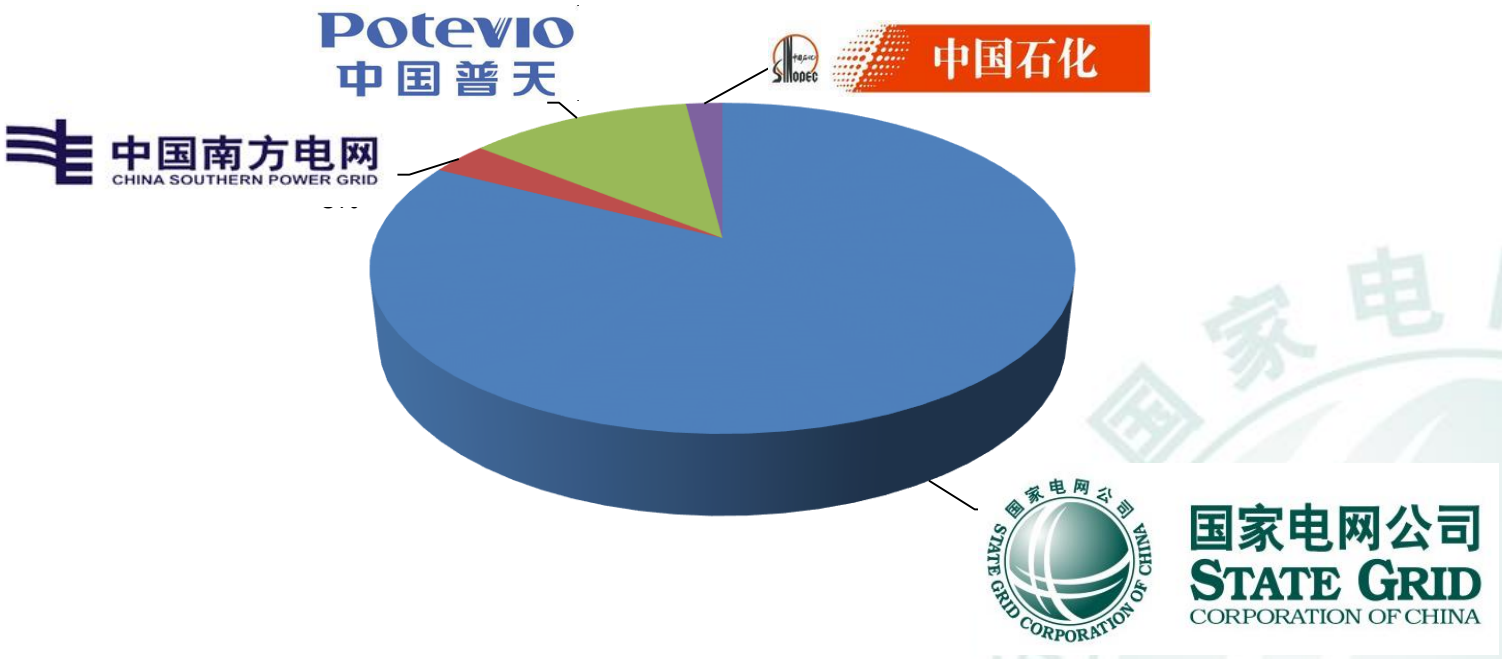
I. Key technology of electric vehicles charging facilities

II. Present situation of charging facilities standardization

III. Construction of electric vehicles charging facilities

III. Construction of electric vehicles charging facilities

China has become one of countries with largest number of charging devices put into use and operation in the world.



China has completed the construction of 640 charging stations and 28,000 charging points.

III. Construction of electric vehicles charging facilities

Since 2006, State Grid Corporation of China has implemented the national policies of energy strategy, atmospheric pollution prevention and energy conservation & emission reduction, paid high attention to the development of electric vehicle industry and its popularization & application in demonstration city and carried out a series of work in facilities construction, standard compilation, technical study, communication & cooperation and wire connections.

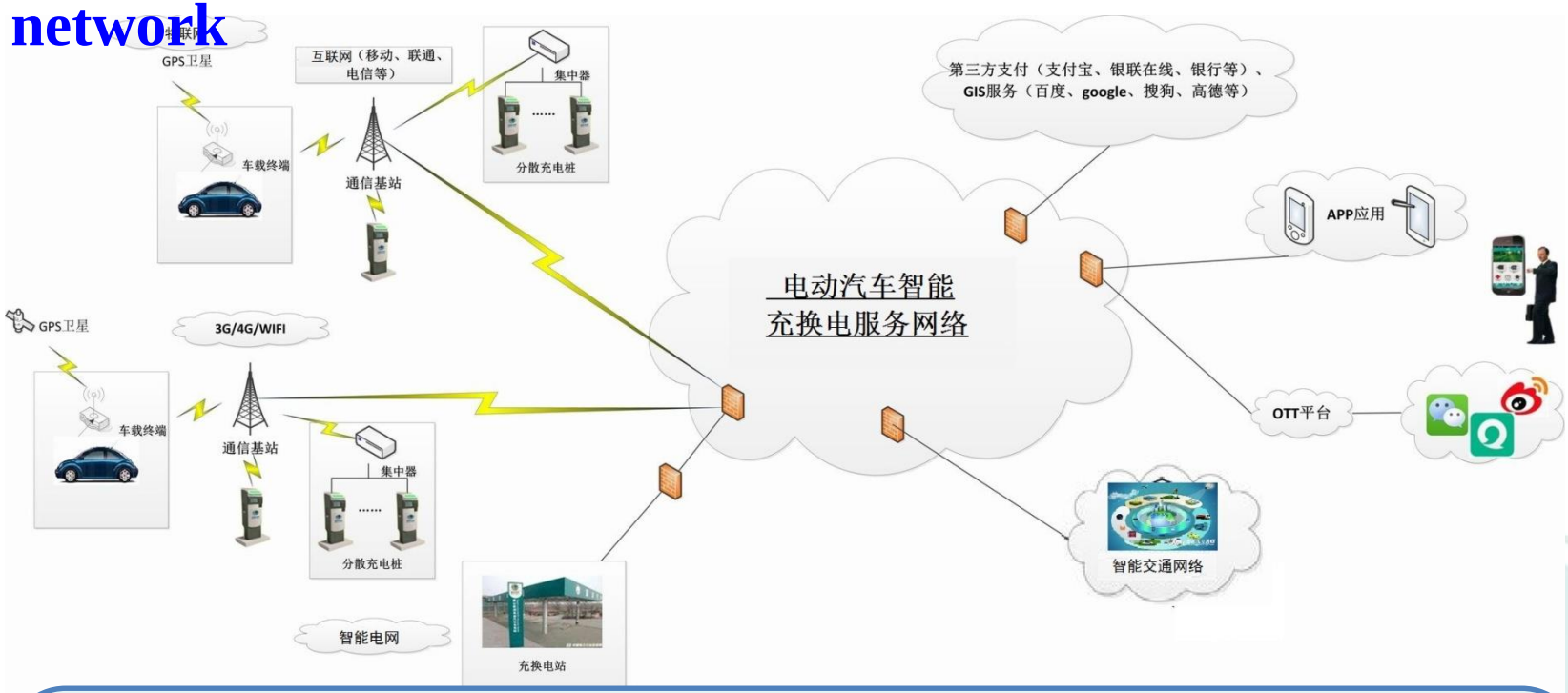
Atmospheric pollution prevention

National energy strategy

Energy conservation and emission reduction

III. Construction of electric vehicles charging facilities

Construction mode of charging facilities: charging service network

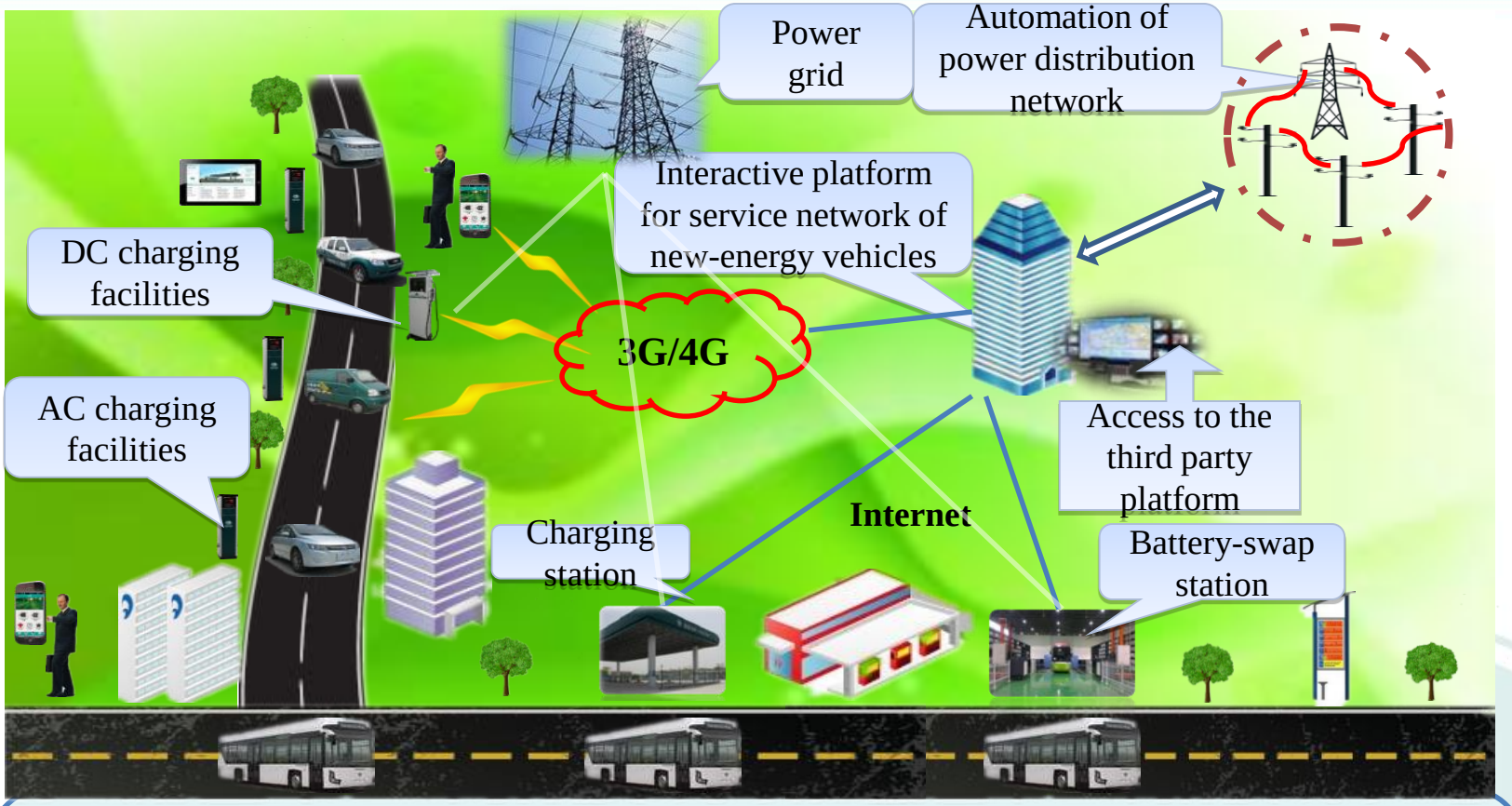


According to our exploration and practice of many years, the charging facilities will develop into intelligent charging service network that combines the technologies of smart power grids, internet, internet of things and intelligent communication network rather than separated charging stations and points.

III. Construction of electric vehicles charging facilities

State Grid Corporation of China has established the development patterns of intelligent charging service network, integrated the three-network technology of smart power grids, internet of things and communication network, implemented the three-aspect management of networked, informationization and automation and provided the three-same services of the same network, same quality and same price to cross-regional users of electric vehicles. Meanwhile, it gives full supports to charging and battery-swap technology to meet such demands of electric vehicle users.

III. Construction of electric vehicles charging facilities



Hold together the electric vehicles, users, charging facilities, roads, public information networks and grids so as to realize the information and energy interaction, develop the electric vehicle into a carrier of intelligent information platform and provide enjoyable driving experience to the drivers of electric vehicles.

III. Construction of electric vehicles charging facilities

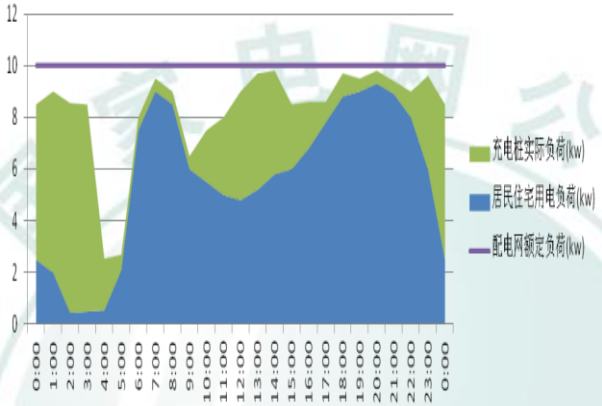
Up to Sep. 2014, it has constructed **540** charging stations and **23,000** charging points as well as provided 4,113,000 times of charging services with electric quantity of **260 million** KWH and vehicle miles travelled of 290 million km.

III. Construction of electric vehicles charging facilities

Establish a operation monitoring system for intelligent charging service network of large-scale, cross-regional and full coverage to lead the technical level of the world. With this system, the charging facilities can be operated in an online monitoring and intelligent scheduling mode so as to provide the users with value-added information services such as charging reservation and navigation, etc.

On-line monitoring

Reservation and navigation

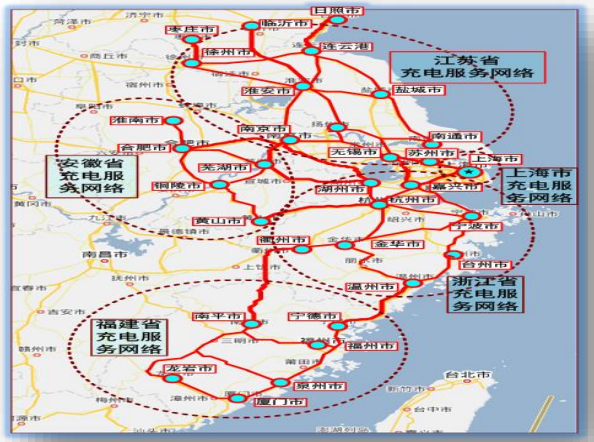


Intelligent scheduling

III. Construction of electric vehicles charging facilities

Complete the demonstration projects of Beijing, Qingdao, Hangzhou and Suzhou-Shanghai-Hangzhou intercity internetwork.

Establish new intercity quick charging networks for the three expressways of Jinghu (Beijing-Shanghai), Qingyin(Qingdao-Shijiazhuang) and Beijing-Hong Kong-Macao (Beijing-Chenzhou) and develop an initial framework of 5-mile public charging district in the demonstration cities such as Beijing, Shanghai and etc.



Suzhou-Shanghai-Hangzhou intercity demonstration project

Quick charging station at Beijing-Shanghai Expressway service area

III. Construction of electric vehicles charging facilities

Demonstration project in innovative construction

Hangzhou

Construct 75 charging stations and serve for 800 electric vehicles.

Qingdao

Construct 4 charging stations and serve for 450 electric buses.

Beijing

Construct 77 charging stations and 2995 charging points.

Suzhou-Shanghai-Hangzhou

Realize the free driving of electric vehicles within this area.

III. Construction of electric vehicles charging facilities

国家电网 STATE GRID

Speed up the smart power grids construction to meet the electricity demand of charging facilities.

State Grid Corporation of China speeds up the construction of UHV-based smart power grids and promotes the rapid development of clean energy such as wind power, solar power generation and hydro power so as to offer sufficient and clean power energy to electric vehicles. Meanwhile, the Corporation gives full supports to charging facilities construction for electric vehicles (conventional charging and quick charging) and provides convenient, efficient and quality power supply services for motor vehicles.

Thank you!