



智能电网实践与发展

Development and Practice of Smart Grid

国家电网公司

State Grid Corporation of China

2011-7



1. 智能电网战略启航
Strategy of Smart Grid
2. 智能电网建设实践
Practice of Smart Grid
3. 智能电网后续目标
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International cooperation

1.1 背景概况

Overview



国家电网公司概况:

Overview of SGCC:

员工人数	156万
Employees	1.56 million
总资产	20775亿元
Total assets	2077.5 billion yuan
地域	覆盖中国88%的领土面积
Service Area	88% of China's geographical area
客户	服务10亿人
售电量	年售电量26891亿千瓦时
Customers	Serving over 1 billion people .
Electricity Sold	Annual electricity sales of 2689.1TWh

26个省级电网公司
26 provincial power grid companies

5家科研机构
5 research institutes

18家直属单位
18 affiliates



全球最大的公用事业企业
2010年总收入超过15427亿元
位居世界500强第8位

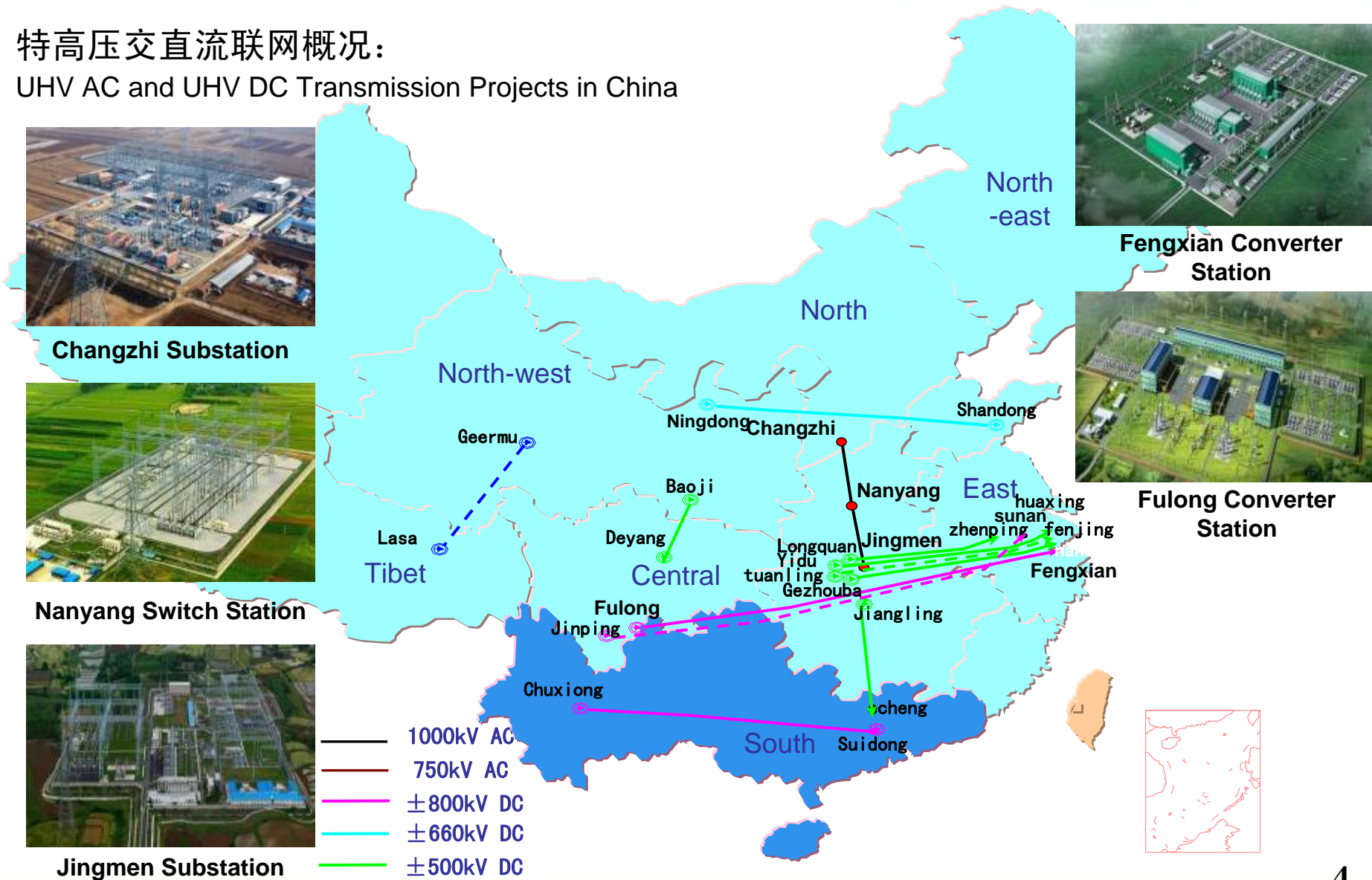
As the largest utility in the world with an avenue of 1542.7 billion yuan, SGCC was ranked the 8th in the Fortune Global 500 in 2010.

1.1 背景概况

Overview

特高压交直流联网概况:

UHV AC and UHV DC Transmission Projects in China



1.2 面临的严峻挑战 Challenges we are facing



能源资源:

传统能源日益短缺, 能源供需矛盾

Energy Resources:

Shortage of traditional energy resources

Contradiction between demand and supply



生态环境:

满足能源可持续发展对生态环境的要求

Ecological Environment:

Sustainable energy development in line with
Ecological environment



气候变化:

气候变化成为共同关注的焦点问题

Climate Change:

Climate change has become the global
concern



1.3 中国政府做出的庄严承诺 Commitments by Chinese Government



2009年9月22日，胡锦涛主席提出：

到2020年非化石能源占一次能源比重要达到15%左右。

On Sep. 22nd, 2009, President Hu Jintao put forward:

By 2020, China will try to increase the percentage of non-fossil energy to 15% among all primary energy consumption.

2009年11月25日，中国政府提出：2020年单位国内生产总值二氧化碳排放比2005年下降40%~45%

On Nov. 25th, 2009, the Chinese government proposed:

By 2020, CO₂ emission per unit GDP to be decreased by 40%-45% than that of 2005.



2010年及2011年，3月5日，温总理政府工作报告：
加强智能电网建设。

On March 5th, 2010 and 2011, in the Government Work Report, Premier Wen pointed out:

To speed up the construction of smart grid.

1.4 中国能源资源和消费分布



Allocation of Generation Resources and Consumption Centers

能源资源与消费呈逆向分布:

The Imbalanced Allocation of Generation Resources and Consumption Centers

西北地区:

2/3的煤炭、风能、太阳能资源

North China & West China:

2/3 Coal & wind & solar Energy

西南地区:

4/5的水能资源

Southwest China:

4/5 Water Energy

东中部地区:

2/3的能源需求

East China & Central China:

2/3 Energy Demand

距离: 1500-3000公里

Distance: 1500-3000km

需要大范围、远距离、大容量输电技术。

Forming large-scale, long-distance, large-capacity transmission pattern.



1.5 坚强智能电网发展战略

Strategic of Strong & Smart Grid



国家电网
STATE GRID



2009年5月21日，特高压输电技术国际会议，国家电网公司提出了坚强智能电网发展战略。

On May 21st, 2009, State Grid announced the development strategy of building a Strong & Smart Grid in the International Conference of UHV Transmission Technology.



坚强智能电网：以特高压电网为骨干网架、各级电网协调发展，具有信息化、自动化、互动化特征的现代电网。

Strong & Smart Grid: An IT-based, automated and interactive transmission network with UHV transmission backbone in coordination with lower voltage grids.

1.6 坚强智能电网发展战略内涵

Five Connotations of Strong & Smart Grid



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Strategy of Smart Grid



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2.1 智能电网第一批试点工程

The First Phase Pilot Projects

2009年8月，9类项目作为第一批试点工程。

In Aug. 2009, 9 projects were selected as the first-phase pilot projects.

综合 Comprehensive	发电 Power Generation	输电 Transmission	变电 Transformation	配电 Distribution	用电 Power Consumption	调度 Dispatching
1. 上海世博园智能电网综合示范工程 1. Shanghai EXPO Smart Grid Demonstration Project 	2. 风光储输联合示范工程 2. Wind/PV/Power Storage/Transmission Joint Demonstration Project 3. 常规电源网厂协调 3. Coordination of Conventional Power Source and Power Grids 	4. 输电线路状态监测系统 4. State Monitoring System on transmission lines 	5. 智能变电站 5. Smart Substation 	6. 配电自动化 6. Distribution Automation 	7. 用电信息采集系统 7. Information acquisition system of power consumption 8. 电动汽车充电站 8. Electric Vehicle Charging Station 	9. 智能电网调度技术支持系统 9. Dispatching Technology Support System of Smart Grid 

2.2 智能电网第二批试点工程

The Second Phase Pilot Projects



2010年初，国家电网公司又推出第二批12项试点项目。
Early 2010, State Grid proposed 12 pilot projects for the second phase.

综合 Comprehensive	发电 Power Generation	输电 Transmission	配电 Distribution	用电 Power Consumption	通信信息 Communication	跨环节 Cross-link Projects
1. 中新天津生态城智能电网综合示范工程 1. Sino-Singapore Tianjin Eco-City Smart Grid Demonstration Project 	2. 大规模风电功率预测及运行控制 2. Large Scale Wind Power Forecast, Operation & Control 	3. 输电线路直升机/无人机智能巡检 3. Helicopter/UAV Smart Patrol for Transmission Lines 4. 柔性直流输电 4. Flexible DC Transmission 	5. 分布式光伏发电接入及微网运行控制 5. Integration of Distributed PV Generation and Micro Grid Operation & Control 	6. 省级集中95598供电服务中心 6. Provincial Centralized 95598 Power Service Center 7. 智能用电小区/楼宇 7. Smart Communities/Buildings 	8. 信息平台及安全 8. Information Platform and Security 9. 电力光纤到户 9. PFTTH 	10. 电网运行集中监控 10. Centralized Monitoring for Grid Operation 11. 输变电设备状态监测系统 11. Transmission Facilities Status Monitoring System 12. 农网营配调管理模式优化 12. Optimization of Sale-Distribution-Dispatching Management Model for Rural Power Grid 

2.3 试点工程总体情况

General information of demonstration projects



试点工程地理分布图：

Map of Demonstration Projects

21类228项试点工程将于2011年底建成

228 pilot projects in 21 types will be built by the end of 2011



开展了世界范围内规模最大的智能电网试点工程建设，覆盖了经营区域的26个省市。

SGCC has implemented in the world largest scale smart grid demonstration projects covering all the service provinces.



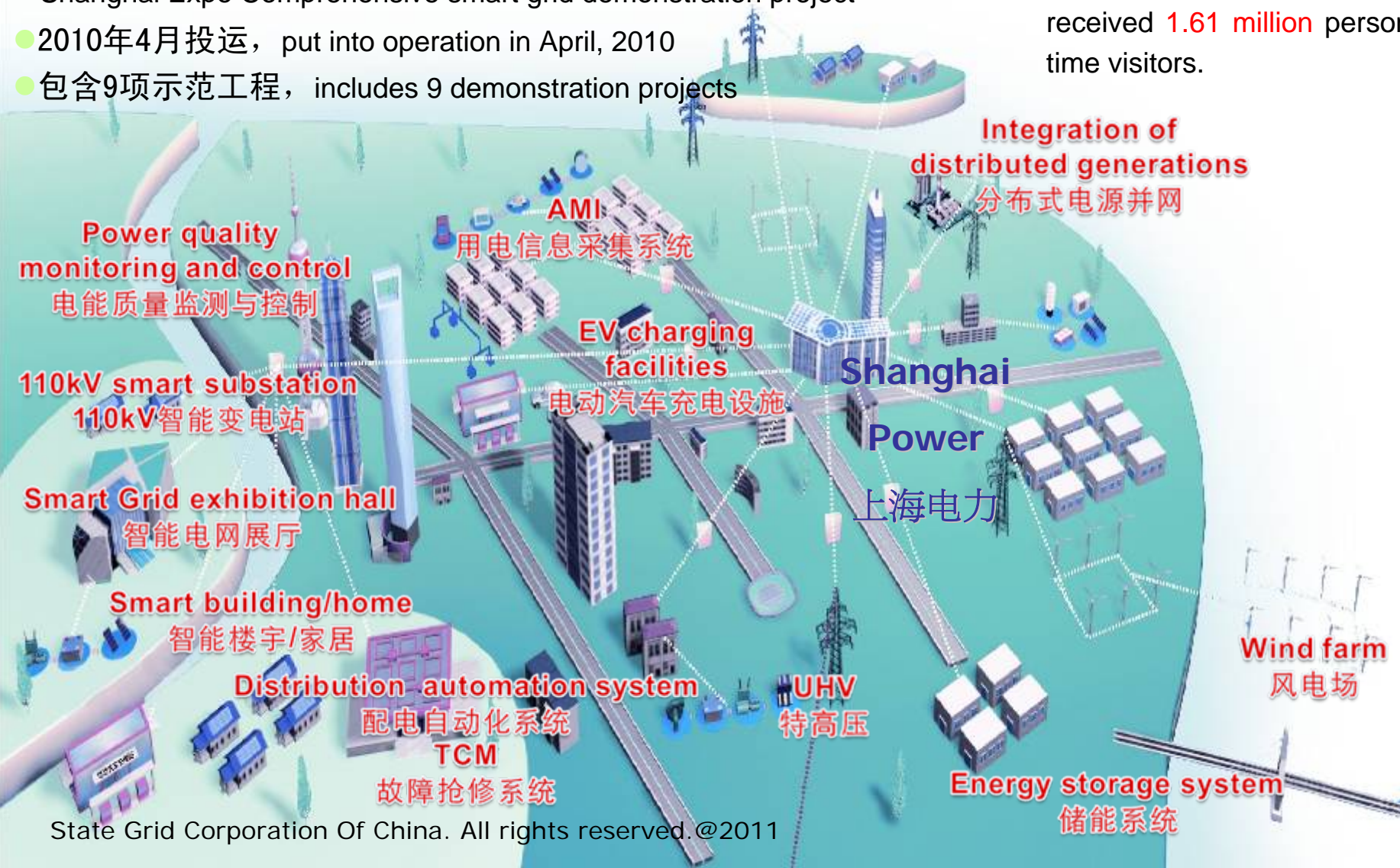
2.4 试点工程—智能电网综合示范工程 Comprehensive smart grid demonstration project

上海世博园智能电网综合示范工程:

Shanghai Expo Comprehensive smart grid demonstration project

接待来访超过161.1万人次
received **1.61 million** person-time visitors.

- 2010年4月投运, put into operation in April, 2010
- 包含9项示范工程, includes 9 demonstration projects



2.4 试点工程—智能电网综合示范工程 Comprehensive smart grid demonstration project



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中新天津生态城智能电网综合示范工程

计划于2011年12月建成

Sino-Singapore Tianjin eco-city Smart Grid demonstration project

Will be completed in December 2011



北京未来科技城智能电网综合示范工程

计划于2013年12月建成

Beijing Future Science and Technology City Smart Grid demonstration project

Will be completed in December 2013



扬州经济技术开发区智能电网综合示范工程

计划于2012年12月建成

Yangzhou Economic and Technological Development Zone Smart Grid demonstration project

Will be completed in December 2012



江西共青城智能电网综合示范工程

计划于2012年12月建成

JiangXi Gongqing City Smart Grid demonstration project

Will be completed in December 2012

2.4 试点工程—智能变电站

Smart substation



延安750kV、西泾220kV等8个智能变电站已经建成投运。

8 smart substations have been completed . Including 750kV YanAn,220kV XiJin substation . etc.

形成了首个智能变电站标准体系。

The first standard systems for smart substation has been developed.



Smart
Primary
Equipment



Electronic
transformers



Smart
facilities

Unified
Secondary
System



Unified
platform



Monitoring
system

Integrated
Functions



Integrated
power source



Image
monitoring

Practical
Advanced
Functions



Smart
alarm



Station
control

Features of a Smart Substation

2.4 试点工程—轻型直流输电系统

HVDC Light demonstration Project in Shanghai



成功研制了轻型直流输电关键设备。建设了输送容量为**20MVA**，电压等级为 **$\pm 30kV$** 的柔性直流输电示范工程。解决上海南汇风电并网问题。

After successful R&D on key technology and key equipment, an HVDC light demonstration project has been constructed, with a transmission capacity of 20MVA, and voltage level of $\pm 30kV$, to solve the integration problem of Nanhui wind plant in Shanghai.

2.4 试点工程—配电自动化

Distribution automation

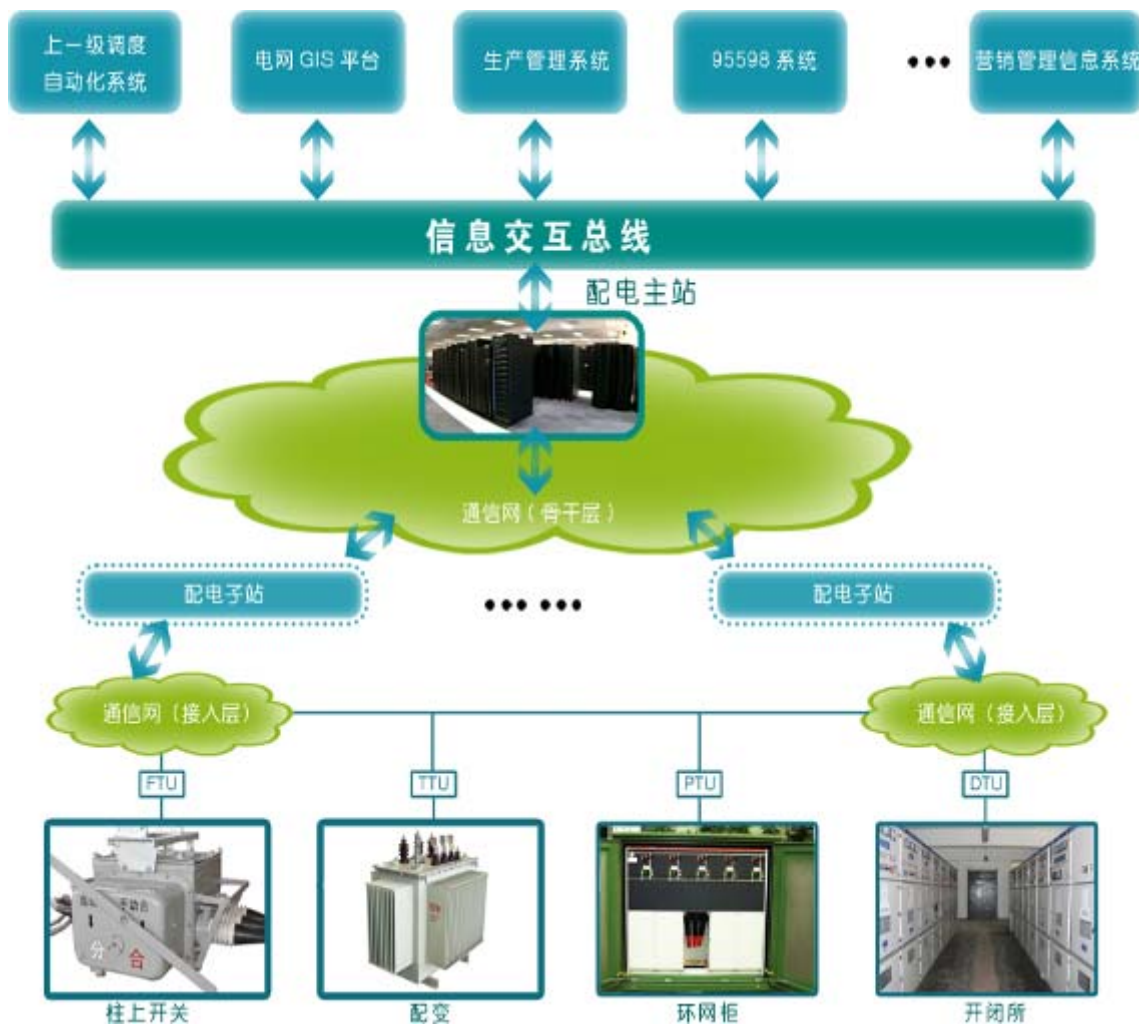


在北京、上海等23个重点城市的核心区域进行配电自动化试点。

2010年已建成杭州、厦门、北京、银川4个试点工程。

Distribution automation pilot projects are carried out in core areas of 23 major cities, including Beijing and Shanghai.

By the end of 2010, 4 pilot projects in Hangzhou, Xiamen, Beijing and Yinchuan have been completed.



2.4 试点工程—电动汽车充电设施

EV charging facilities



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2010年在26个省市开展充电设施试点工程建设，建成了87座公共充换电站和7031个交流充电桩

By the end of 2010, 87 public charging stations and 7031 AC charging poles have been built in 26 provinces.

✓充换电站及充电桩数量世界第一

✓The world's largest scale of charging stations and charging spots

✓制定22项企业标准，基本建立技术标准体系

✓A technical standard system with 22 specifications has been developed.



2.4 试点工程—用电信息采集系统

Information collecting system of power consumption



2009年，在26个省市共选择220万用户进行试点。

2010年，启动全面建设，应用3300万具智能电能表。

2011年，推广应用5000万具智能电能表。

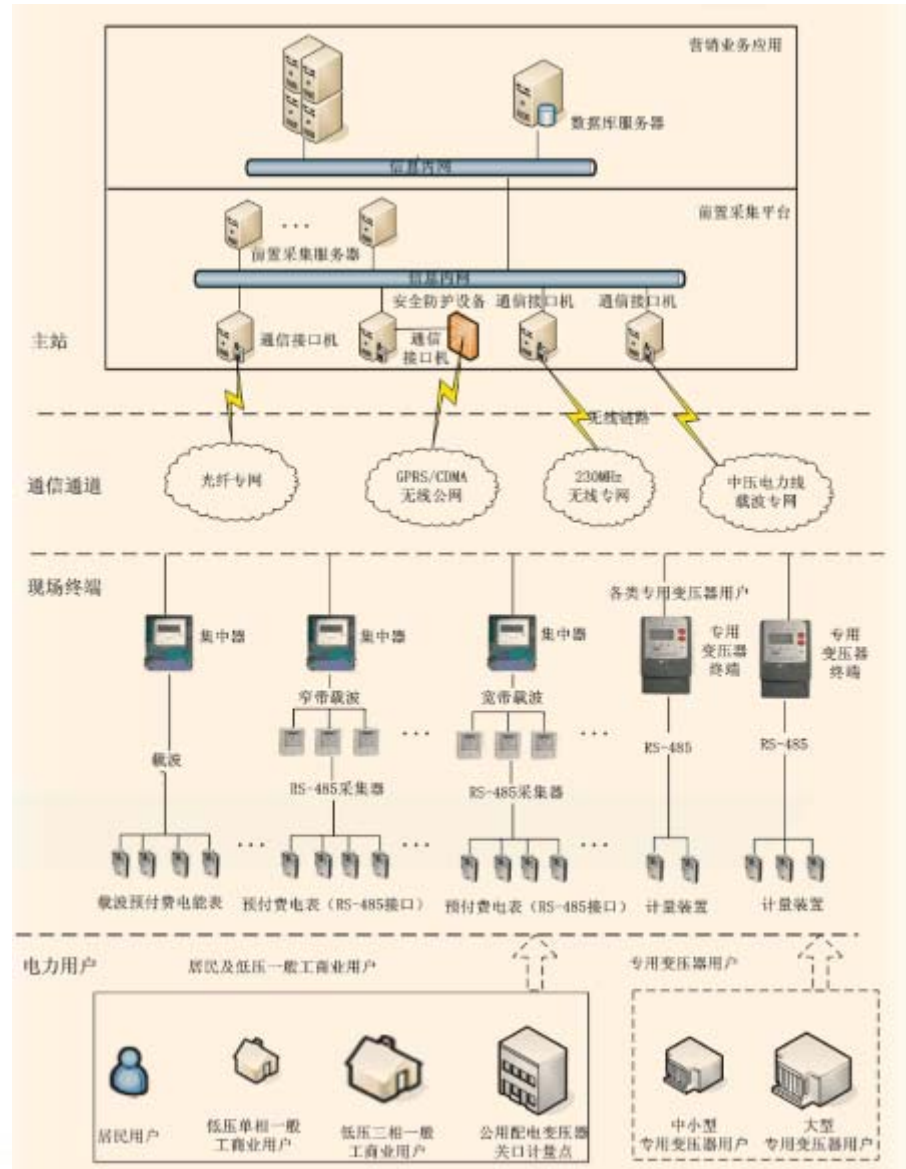
2015年前，覆盖全部用户、采集全部用电信息。

In 2009, this pilot project covered 2.2 million smart meters in 26 provinces.

In 2010, 33 million smart meters have been applied.

In 2011, 50 million smart meters will be applied.

In 2015, all users will be covered and all the consumption information will be collected.



2.4 试点工程—智能小区/楼宇 Smart Communities/ Buildings



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在北京、重庆、廊坊3个城市建设了6个智能小区，在上海建设了1座智能楼宇。

6 smart communities have been built in 3 cities including Beijing, Chongqing and Langfang.

Shanghai municipal electric power company has constructed 1 smart buildings.



图：已建成的重庆加新·沁园智能小区
Smart community in Chongqing



图：智能小区样板间
Show flat in smart community

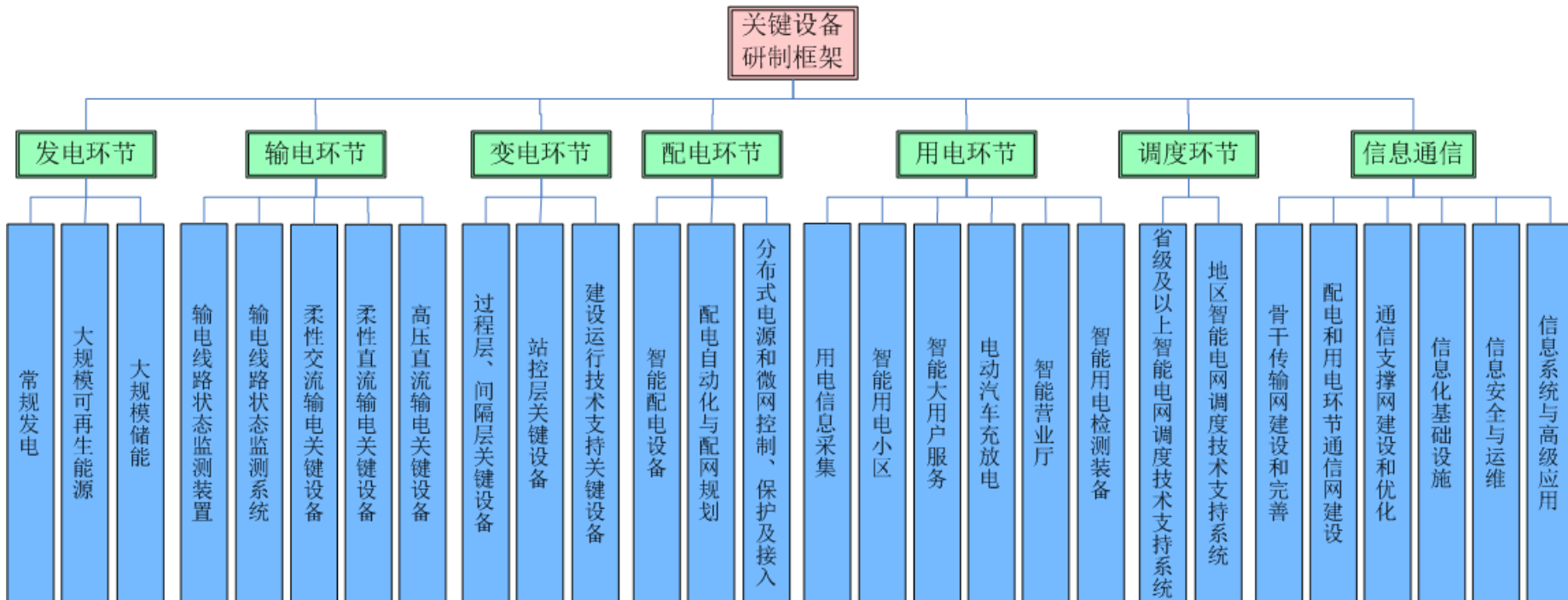
2.5 智能电网关键设备研制规划

Plan of Key equipments development for Smart Grid



提出了涵盖发电、输电、变电、配电、用电、调度、通信信息7个技术领域、28个技术专题和137项智能电网关键设备的研制需求和方向。

SGCC has proposed 28 technical subjects, and 137 items of development requirements and directions for key equipments, which cover generation, transmission, transformation, distribution, consumption, dispatching, as well as information and communication technology.



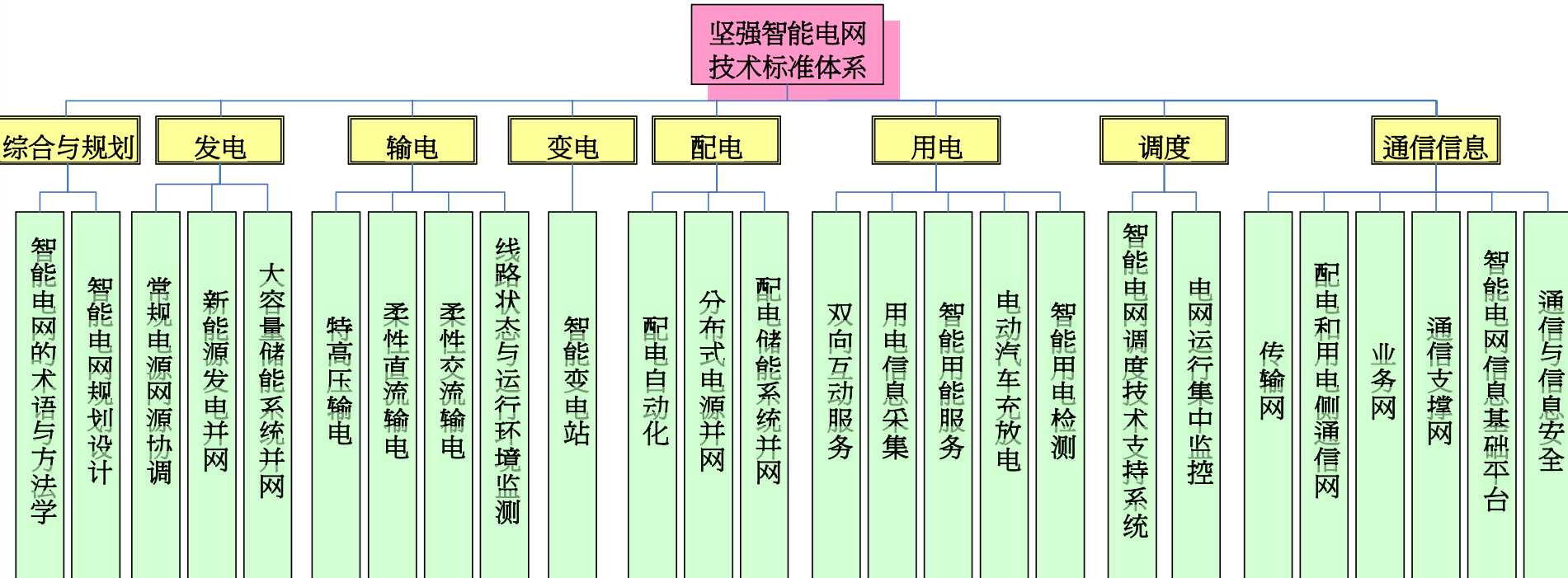
2.6 智能电网技术标准体系规划

Plan of technical standards establishment for Smart Grid



建立了由综合与规划、发电、输电、变电、配电、用电、调度、通信信息8个专业分支、26个技术领域、92个标准系列组成的智能电网技术标准体系。

Established a smart grid technical standards system that includes 8 domains : overall planning, generation, transmission, transformation, distribution, consumption, dispatching, information and communication technology, and 26 technical areas and 92 standards series.



2.7 研究检测能力建设 Research and test capability

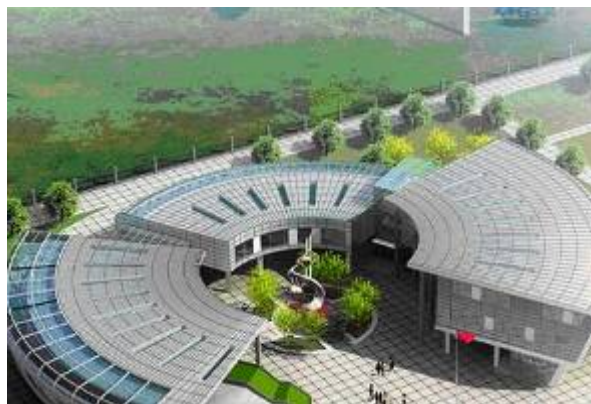


国家级研发（实验）中心建设：

- 1、国家能源太阳能发电研发（实验）中心（南京）
- 2、国家能源大型风电并网系统研发（实验）中心（北京）
- 3、国家能源智能电网技术研发（实验）中心（北京、南京）

Construction of National Research and Test Centers:

1. National Energy Research (Experiment) Center for Solar Power (in Nanjing)
2. National Energy Research (Experiment) Center for Grid Connection of Bulk Wind Power (in Beijing)
3. National Energy Smart Grid R&D (Experiment) Center (in Beijing and Nanjing)



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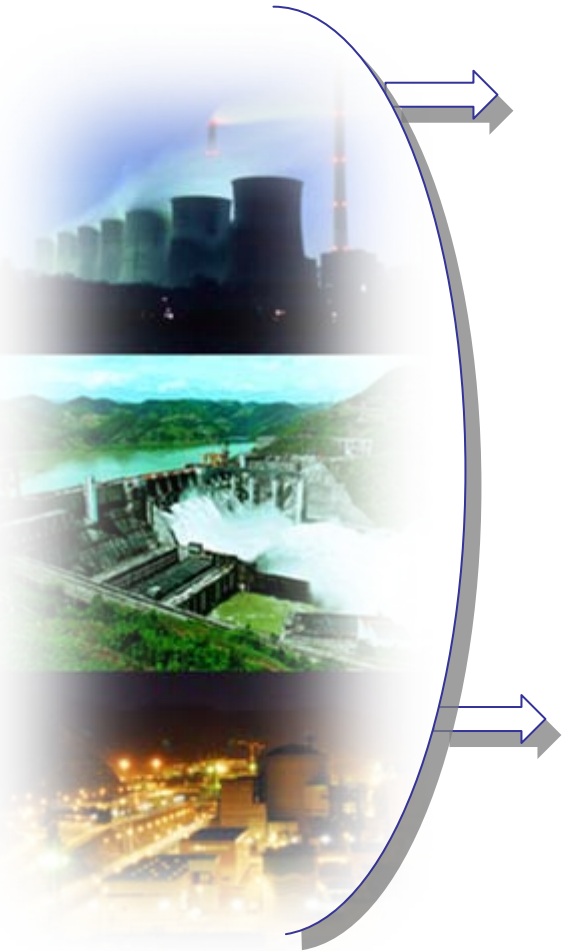
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3.1 发电环节 Generation



2015年，满足9000万千瓦风电和500万千瓦太阳能发电接入。

2020年，满足1.5亿千瓦风电和1800万千瓦太阳能发电接入。

By 2015, Smart Grid can meet the integration requirements of 90 GW wind power and 5 GW solar power.

By 2020, Smart Grid can meet the integration requirements of 150 GW wind power and 18 GW solar power.





3.2 输电环节 Transmission



2015年，全面推广输变电设备状态监测系统、柔性交流输电技术；推广应用多种智能巡检方式。

2020年，特高压及FACTS技术得到广泛应用。



Before 2015, State Grid will promote status monitoring systems for transmission and transformation devices, the FACTS technology and applications of various smart patrol methods.

By 2020, UHV and FACTS technologies will be widely used.



3.3 变电环节 Transformation



2015年，110（66）kV及以上智能变电站占变电站总量的38%左右。

2020年，110（66）kV及以上智能变电站占变电站总量的65%左右。

By 2015, 110/66kV (and above) smart substations will account for 38% of total substations.

By 2020, the percentage of that will reach about 65%.

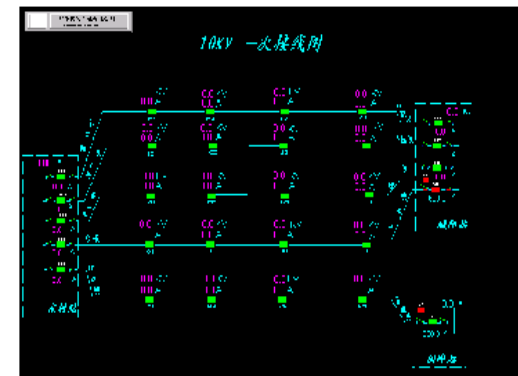




3.4 配电环节 Distribution

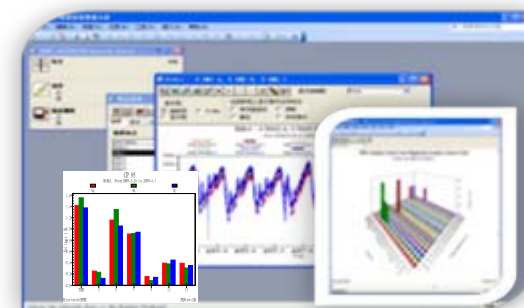
2015年，在31个重点城市的核心区域实施配电自动化系统建设。

2020年，全面建成配电自动化系统，实现分布式电源的灵活接入和安全运行。



By 2015, SGCC will implement construction of distribution automation system in core areas of 31 major cities.

By 2020, the distribution automation system will be fully completed, which can achieve flexible integration and safe operation of distributed generation.



3.5 用电环节 Consumption

2015年，用电信息采集系统覆盖率100%；建成2351座充换电站和22万个充电桩。

2020年，建成满足电动汽车发展的区域充换电服务网络。

By 2015, the service rate of power consumption information collecting system will reach 100%; and 2351 charging stations as well as 220,000 charging poles for EV will be built.

By 2020, a network of EV charging facilities will be completed to meet the requirement of the EV development.





3.6 调度环节 Dispatching

2015年，省级以上调度全面建成智能电网调度技术支持系统；70%的地调按规范建成。

2020年，进一步提升电网调度的资源优化配置能力、纵深风险防御能力和灵活高效调控能力。

By 2015, all the provincial (and above) dispatching centers will complete the construction of dispatching technology supporting systems in smart grid. About 70% of district-level dispatching centers will also finish the construction of such systems.

By 2020, State Grid will further enhance the power dispatching system's capability to optimize resources allocation, reduce risk, and flexibly and efficiently regulate and control the grid.



3.7 通信信息平台 Information platform



2015年，35kV及以上核心通信网光纤化；中压通信网建设光纤通信点120万个；建设电力光纤到户；全面建成SG-ERP，支撑公司和电网运营。

2020年，进一步深化通信网和信息化建设，推广应用基于电力光纤到户技术的增值业务。

By 2015, 35kV (and above) core communication networks will completely be made of optical fiber. 1.2 million optical fiber communication points will be constructed in medium voltage communication networks. The construction of SG-ERP will be completed, which can support the operation of the company and the power grid.

By 2020, State Grid will speed up the construction of communication networks and information technology to promote value-added services based on PFTTH.

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2007年12月，启动与德国技术合作公司（GIZ）的能效合作项目，执行期5年，已组织3次技术交流，2批现场咨询，1次国外培训，促进了SGCC节能服务体系的建设。

After the energy efficiency cooperation with GIZ since December 2007, we have made the technical exchange for 3 times , local consultation for 2 times , foreign training for 1 time, to promote the energy saving service systems of SGCC.

2011年1月20日，与AEP签订合作协议，涉及先进输配电、智能电网领域，在设计/实施、运营、维护和技术标准化等方面开展合作。

On Jan. 20th of 2011, SGCC signed the MOU with AEP, which contains aspects about advanced transmission , smart grid ,standards etc.

2011年2月17日，与NGCP签定了智能电网战略合作备忘录，涉及新能源并网、智能变电站、直流输电、智能电网规划和标准等。

On Feb. 17th of 2011, SGCC signed the MOU with NGCP, which contains aspects about smart substation ,HVDC , smart plan and standards etc.



4 智能电网国际合作情况

International cooperation of Smart Grid



- 国家电网公司是国际电工委员会市场战略局(IEC MSB)成员
- SGCC is the member of IEC MSB.
- 国家电网公司深入参与国际电工委员会标准管理局(IEC SMB)特高压战略组(SG2)、智能电网战略组(SG3)、输变电行业局(SB1)和各技术委员会(TCs)的工作
- SGCC deeply involves in IEC SMB UHV strategy group(SG2), smart grid strategic group(SG3), SB1, and TCs such as TC115, etc
- 在高压直流领域提交的5项IEC新工作提案中,已有三项获得批准立项。在电气与电子工程师学会提交的3项特高压交流领域提案已获得批准立项。
- 5 NPs on HVDC have been proposed and 3 have been approved by IEC. 3 PARs on UHV AC have been approved by IEEE;
- 在智能电网用户接口和智能调度领域提交了5项IEC提案,正处于投票阶段。
- 5 NPs on Smart Grid user interface and smart dispatching have been submitted to IEC and under voting.
- 在IEC MSB技术与市场展望战略组,国家电网公司发起成立了新项目组,在大容量新能源并网及大规模储能接入电网领域开展研究。
- Specialist from SGCC chairs the working group *Grid integration of large-capacity renewable energy (RE) and large-capacity electric energy storage (EES)* under IEC MSB Technology & Market Watch strategic Working Group

4 智能电网国际合作情况

International cooperation of Smart Grid



- 经授权同意，IEC应对能源挑战2010-2030年白皮书中文版于2011年1月出版。
 - After being authorized and approved by IEC, the Chinese version of Coping with the Energy Challenge- The IEC's role from 2010 to 2030 was published in January 2011.
 - 经授权同意，美国国家标准化研究院智能电网互操作标准框架和路线图1.0版本已翻译完成，即将正式出版。
 - After being authorized and approved by NIST, *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0* has been translated into Chinese and will be published soon.
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- 2011年9月27-29日，国家电网公司与IEEE将在北京共同举办智能电网国际论坛。
 - SGCC/IEEE Smart Grid World Forum will be held in Beijing from 27 to 29 September.
 - IEC TC115高压直流标委会全体会议将于11月15-18日在德国柏林召开。
 - The third plenary meeting and WG meetings of IEC TC115 will be held from 15 to 18 November.
 - 高压直流用户会议将于2011年10月在中国上海召开。
 - *HVDC International conference* will be held in Shanghai in October.

建设智能电网是国际电力工业的共同选择。国家电网公司将加强与国际组织、企业、高校等各界的交流与合作，探索制定国际标准及规范，引导并支持能源及相关产业技术和装备升级，共同推动坚强智能电网建设。



Construction of Smart Grid is a common choice of the international power industry. State Grid will enhance communication and cooperation with international organizations, enterprises and universities, establish international standards and specifications, support and lead the technology and equipment upgrading, and jointly promote the construction of smart grid.



Thank you!