Grid Operation Businesses in China and the Integration of RES-electricity

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2016.03

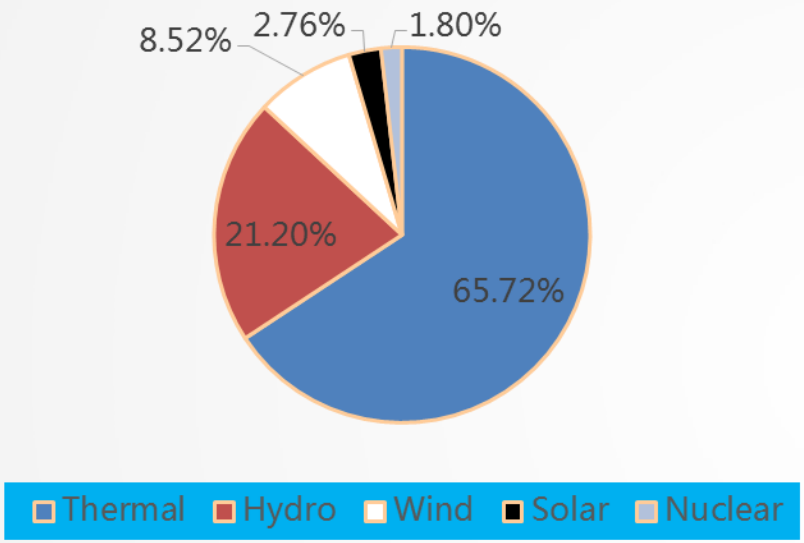
ELECTTRICITY SECTOR IN CHINA

RENEWALBES TRADING

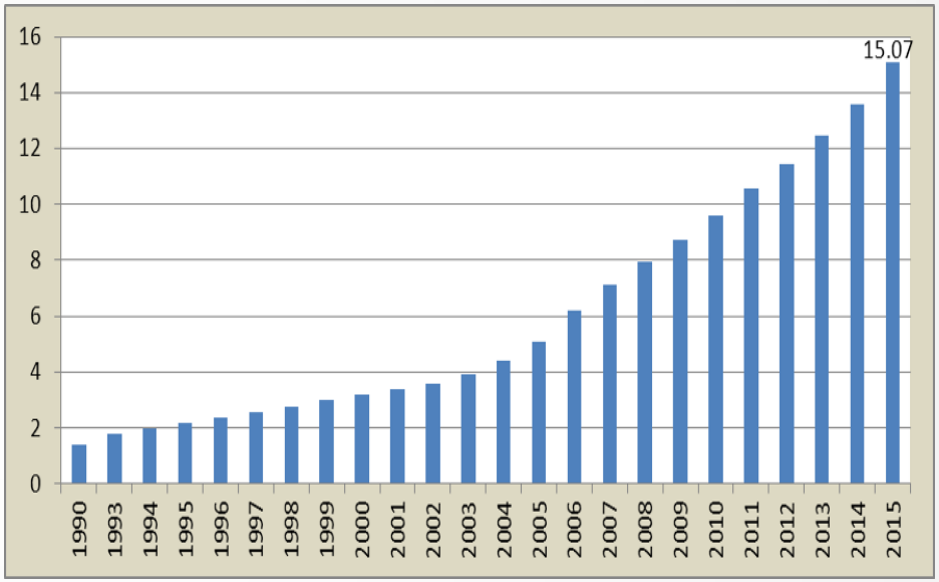
WIND PWER OPERATION & CHANLENGES

GLOBAL ENERGY INTERCONNECTION

Generation Mix & Growth Rate 2015



Generation Mix



Growth Rate

Total generation capacity in 2015 are 1507GW, with annual growth of 15.07%. Among which, Thermal 990GW, Hydro 319GW, Wind 128GW, Solar 42GW, Nuclear 27GW.

Electricity Sector-Current Status Since 2002

GENERATION

- Huaneng
- Datang
- Huadian
- Guodian
- China Power Investment
- Others

GRID

- State Grid
- China Southern Grid

CONSUMER

- Big Industrial
- Industrial & Commercial
- Rural
- Households

WHOLESALE

- Regulated
- Limited Competition

TRANSIMISSION & DISTRIBUTION

- Regulated
- Monopoly

RETAIL

- Grid Company as Sole Retailer
- Regulated
- Limited Competition

Grid Companies in China

State Grid:

Geographic Coverage
26 out of 32 provinces in China; 88% of China' s territory, 6 out of 7 regional girds.

Customers
Serving over 1.1 billion people, 83% of China' s population

Employee
1.8 million

Core business:
Power grid construction and operation, retail, R&D, Finance, equipment manufacturing

-Ranked 7th Fortune Global 500

Electricity Market Reform-Undergoing, Started in 2015

Three Liberalizations

New built power distribution & sales market

Electricity tariff other than transmission and distribution tariff

Power generation

One Independence

Electricity Exchange

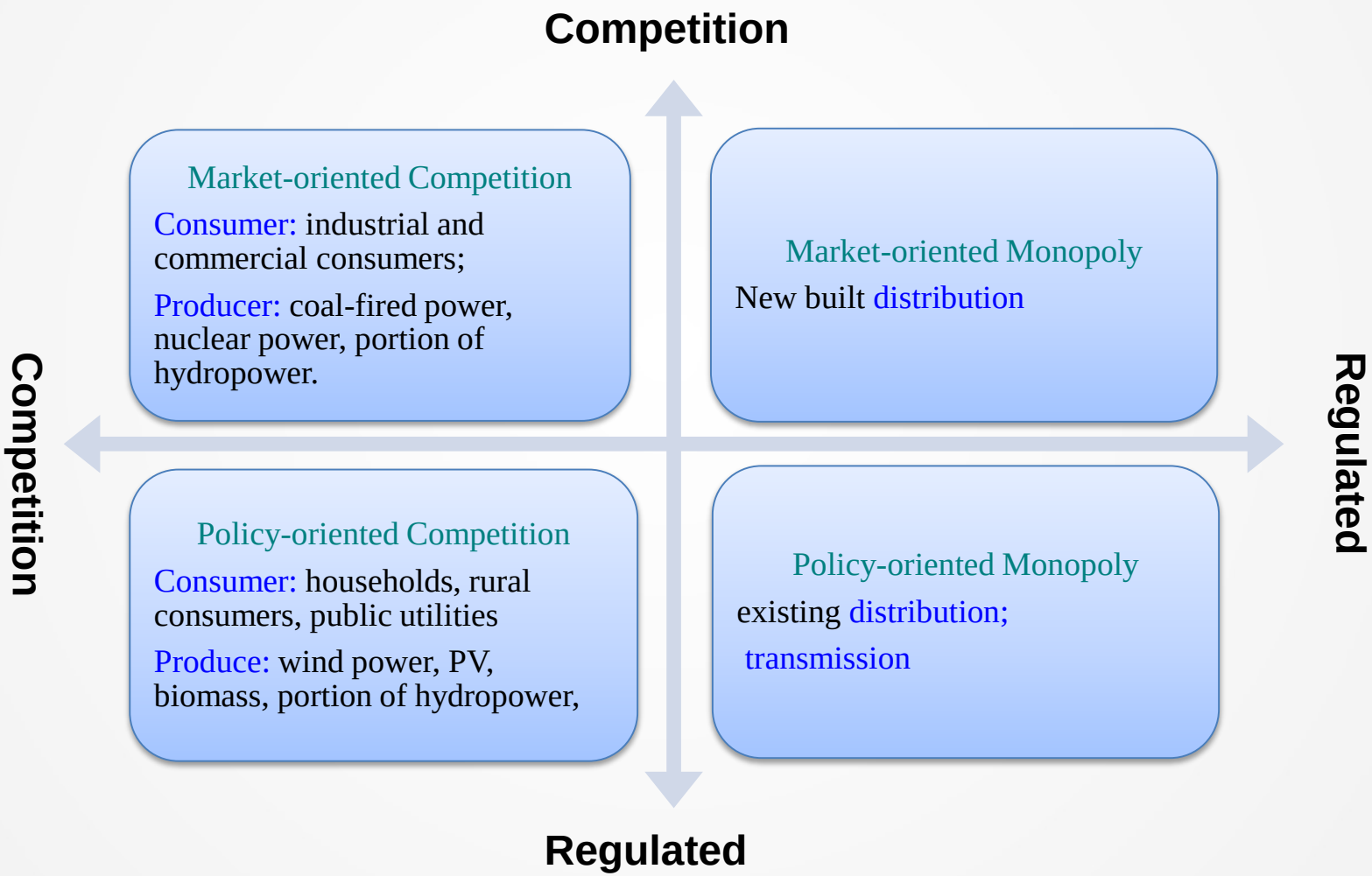
Three Enhancements

Government regulation

Overall planning

Security, efficiency and reliability

Electricity Market Reform-Undergoing, Started in 2015



Electricity Market Reform-Undergoing, Started in 2015

Master Policy

- Several comments on further deepening of electric power institutional reform

Policies

- Pushing forward with electric power reform
- Market-based power exchange
- Mechanism of power exchange
- Verification of power transmission and distribution tariff
- Reform at power sales side
- ……

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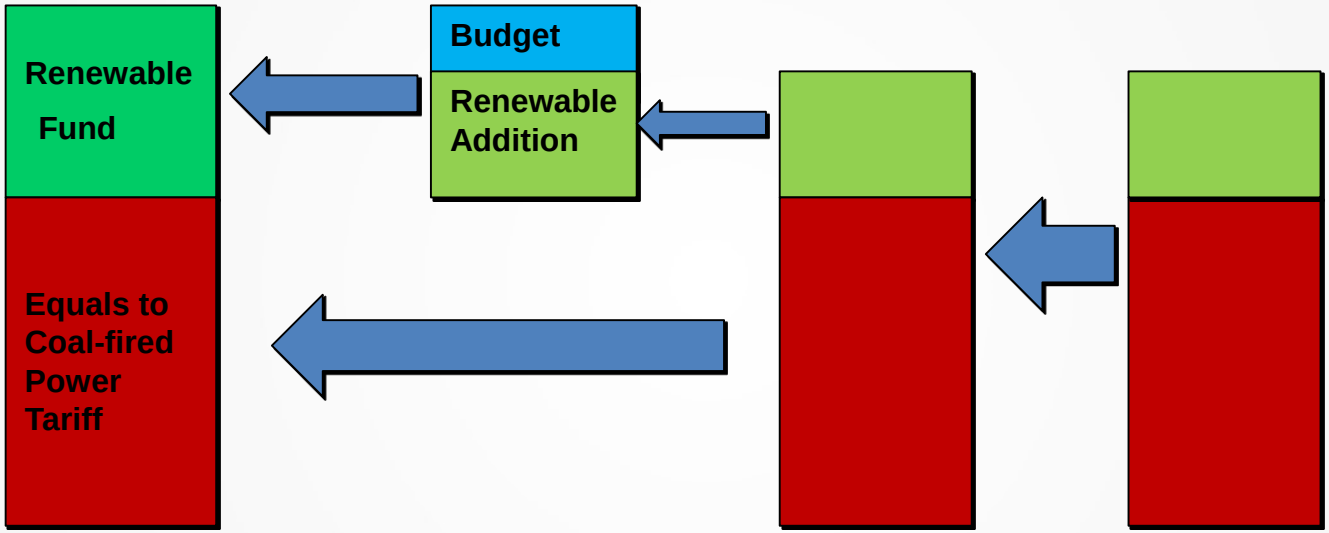
Renewable Energy Cost Share



Renewable Producer

Government

Grid Company

Consumer

Benchmark Tariff for Renewables

RMB Yuan/kWh

Resource Area	Benchmark Tariff for Wind Power	
	2016	2018
Category I	0.47	0.44
category II	0.50	0.47
category III	0.54	0.51
category IV	0.60	0.58

Resource Area	Benchmark Tariff for PV
	2016
category I	0.80
category II	0.88
category III	0.98

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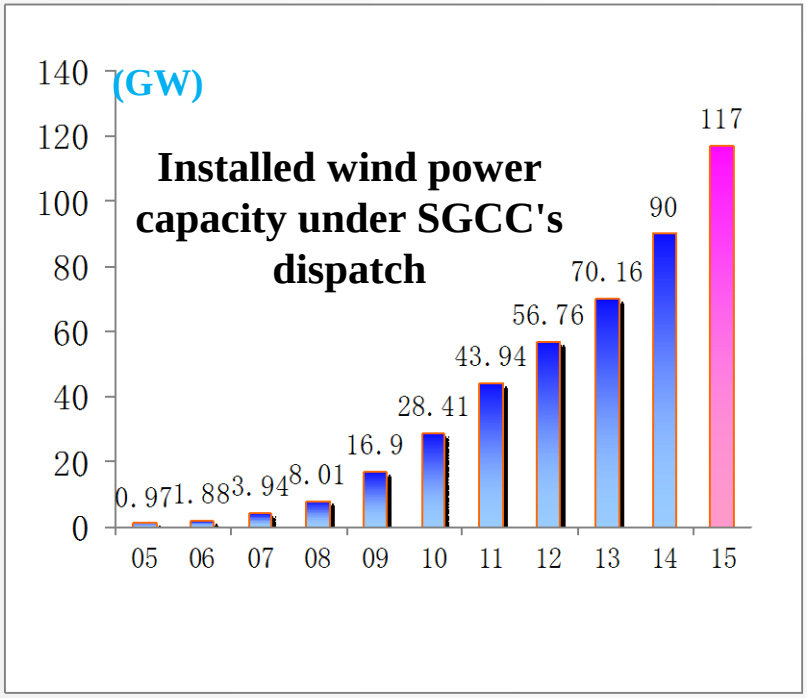
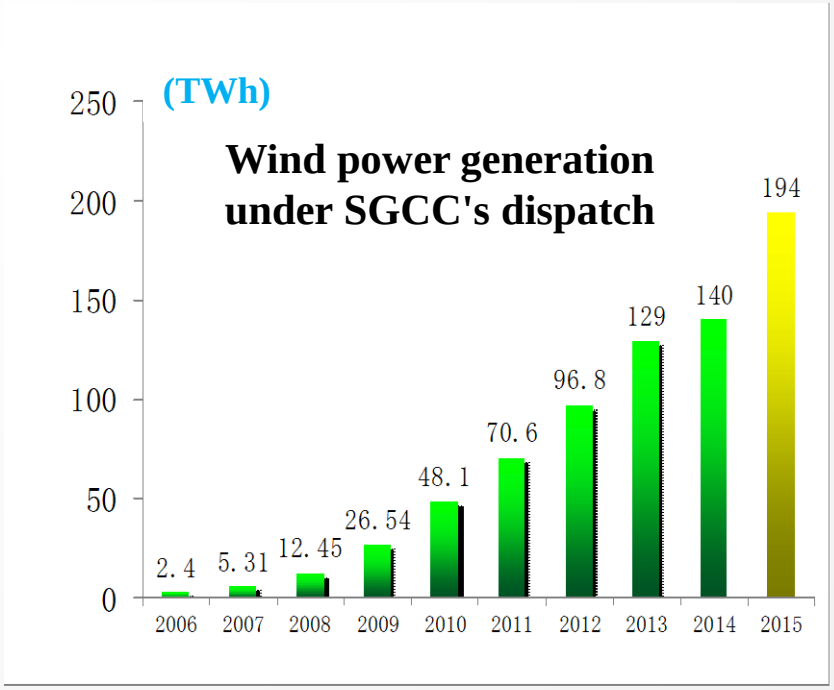
Installed Capacity and Rapid Growth of Wind Power

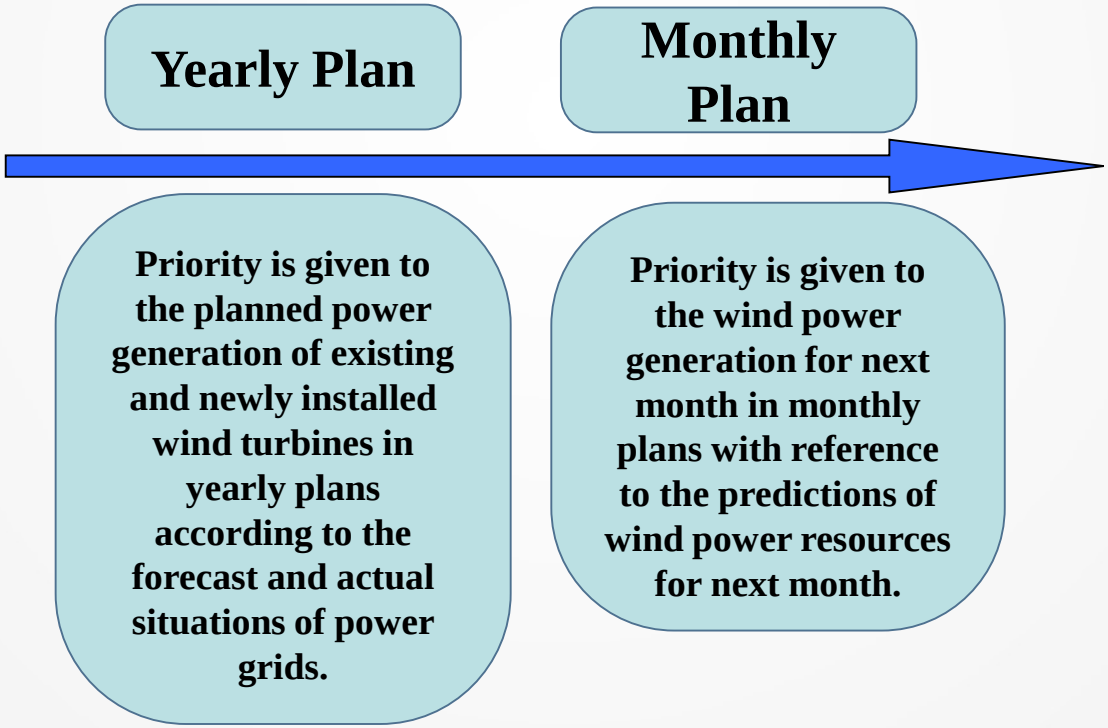
The average annual growth of installed capacity reached 60% from 2005 to 2015. As of the end of 2015， the total installed capacity of wind power in State grid service area are 117GW. In 2015 the wind power generation are 194TWh.





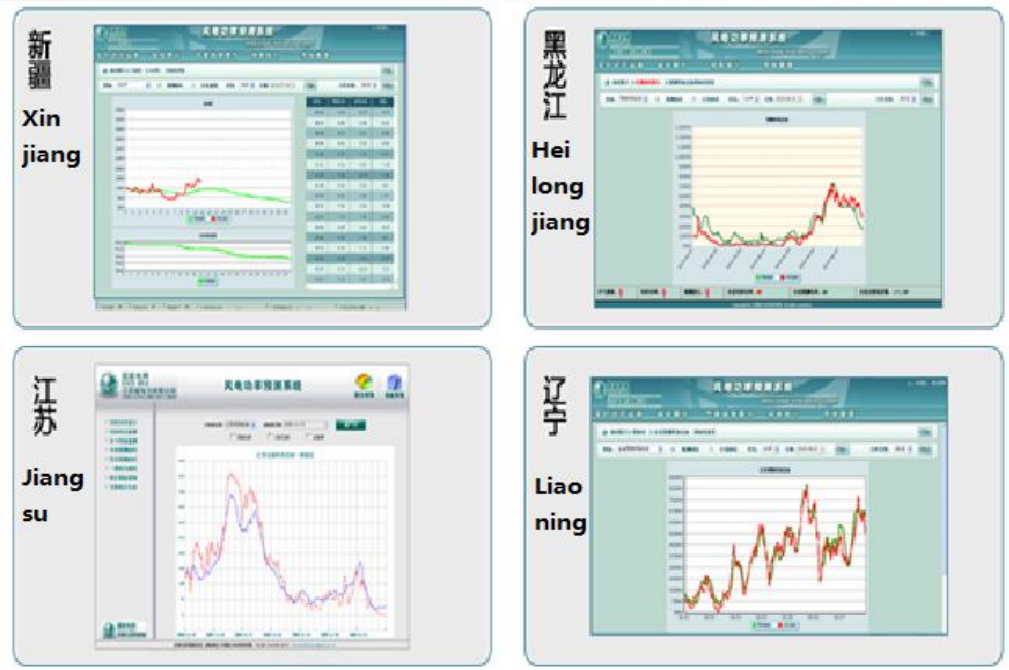
Priority of Wind Power Dispatching

Priority is given to wind power in yearly and monthly generation plans.



Establishment of Wind Power Prediction System

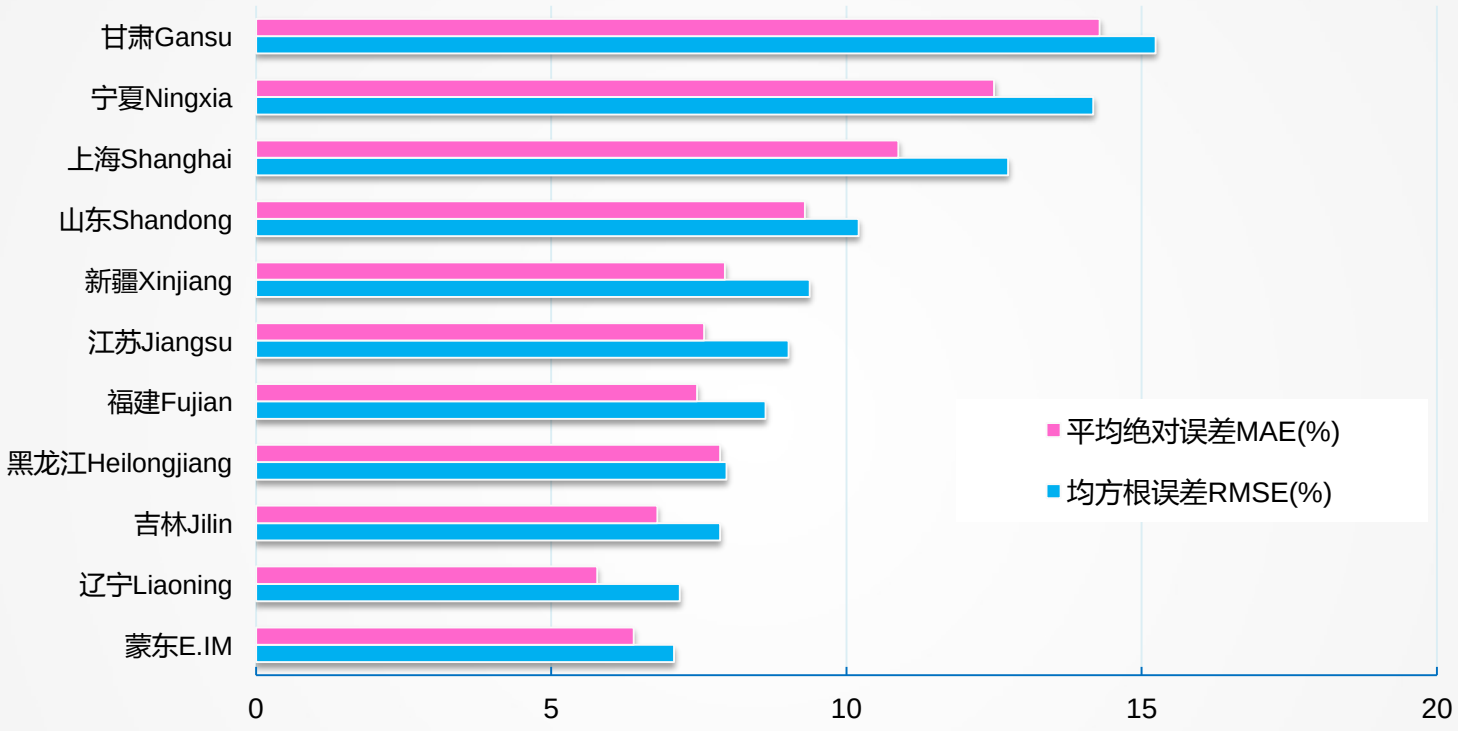
Wind power prediction system: Applicable to all geographical and climate conditions: plains, hills, mountains and other terrains; alpine climate, temperate marine climate, temperate continental climate, subtropical monsoon climate and others



Wind Power Prediction System

Numerical Weather Prediction Center

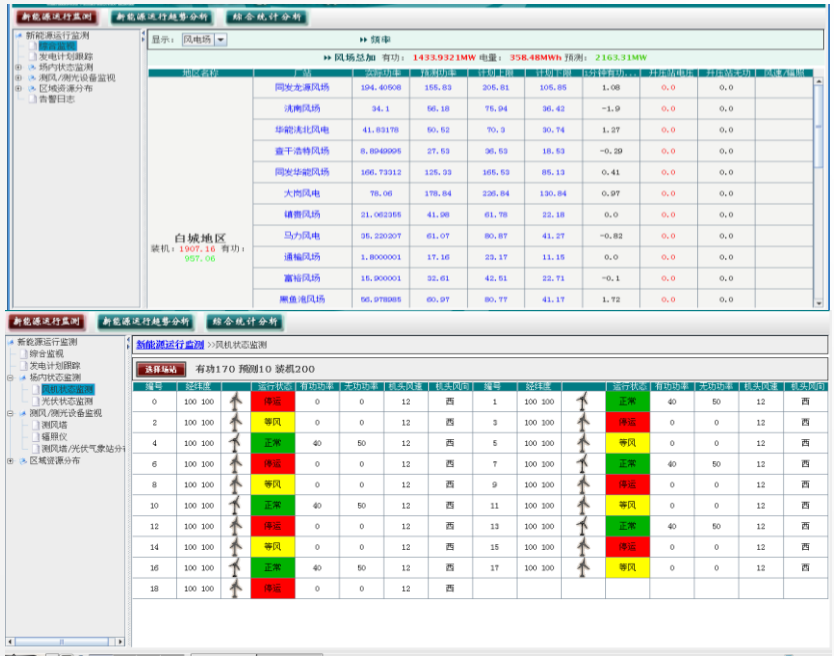
Establishment of Wind Power Prediction System



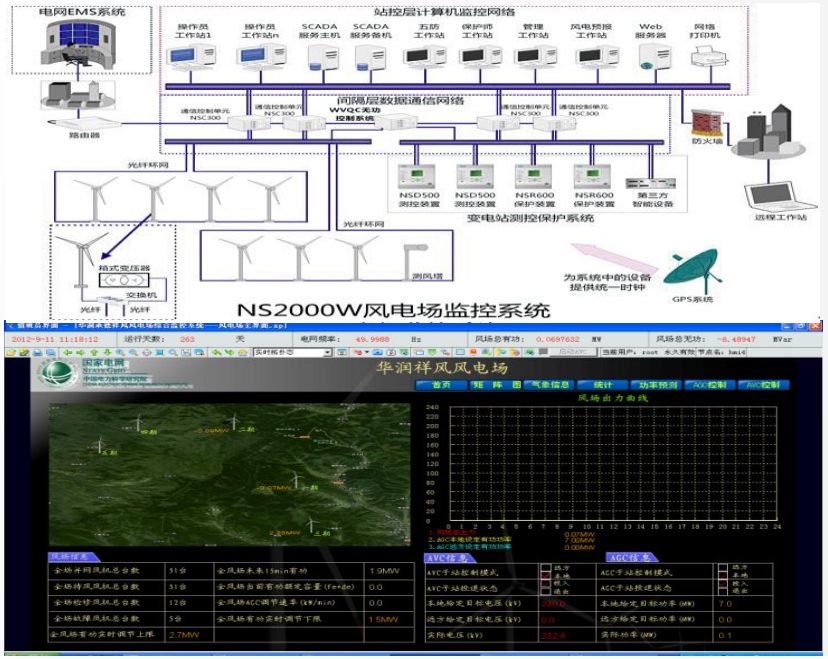
Wind power prediction system: with its precision above 90% in wind-rich areas.

Control of Wind Power Generation

- **On-line wind farm monitoring system: to monitor wind farm resources and operation information;**
- **Integrated wind farm monitoring system, active and reactive power control system and integrated automation system: to control wind farms.**



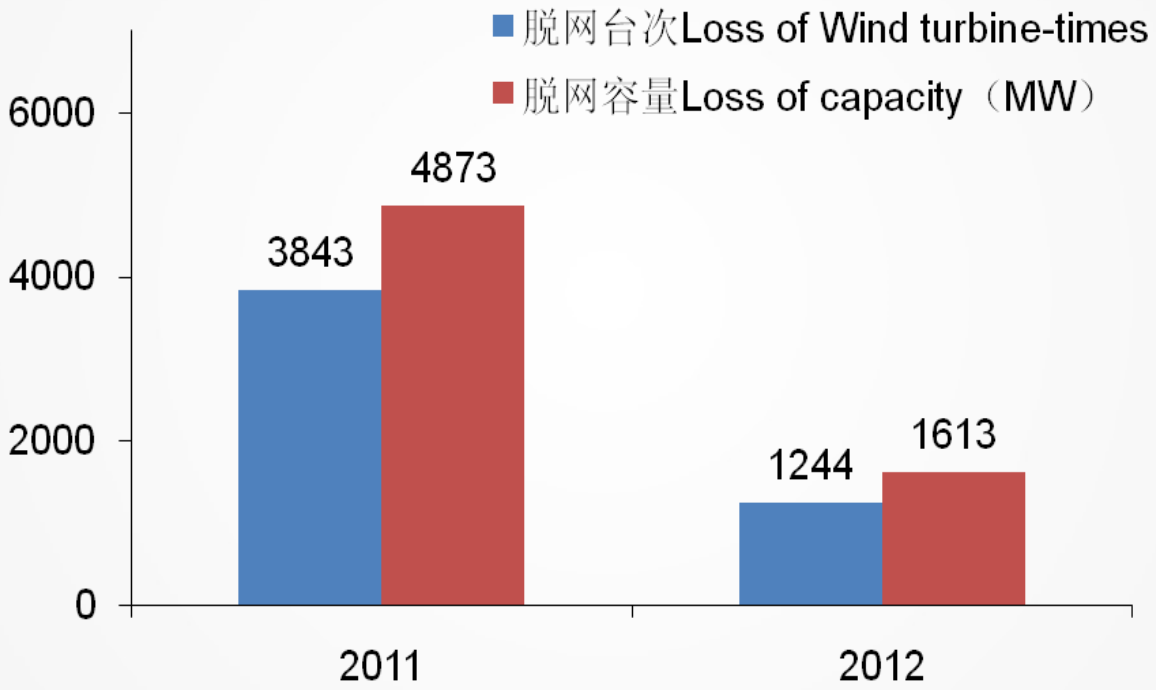
Real-time Wind Farm Monitoring System



Integrated Wind Farm Monitoring System

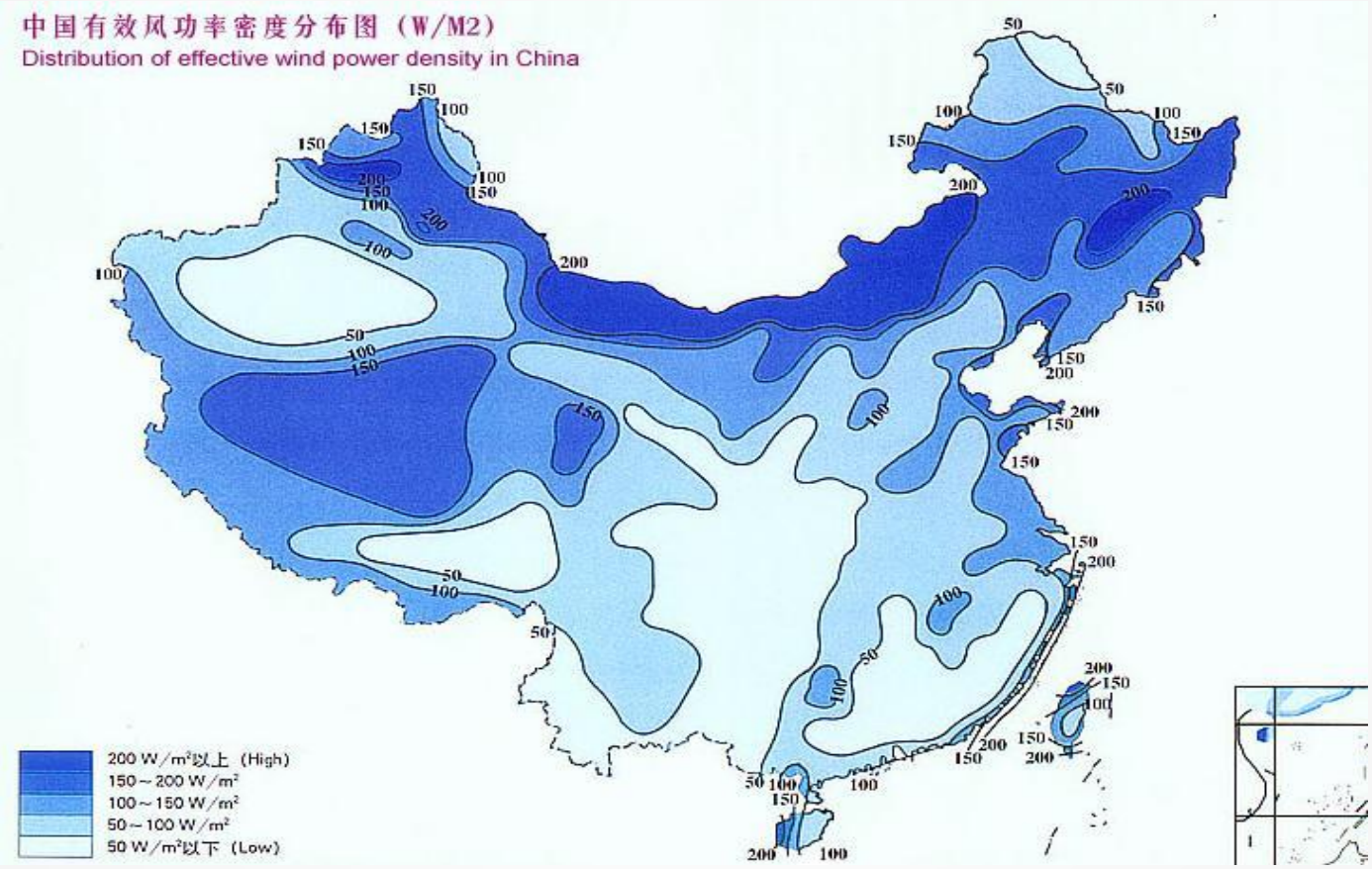
Development and Implementation of Anti-accident Measures for Large-scale Wind Turbine Loss

Wind Turbine Loss in Northwest China, North China and Northeast China in 2011 and 2012



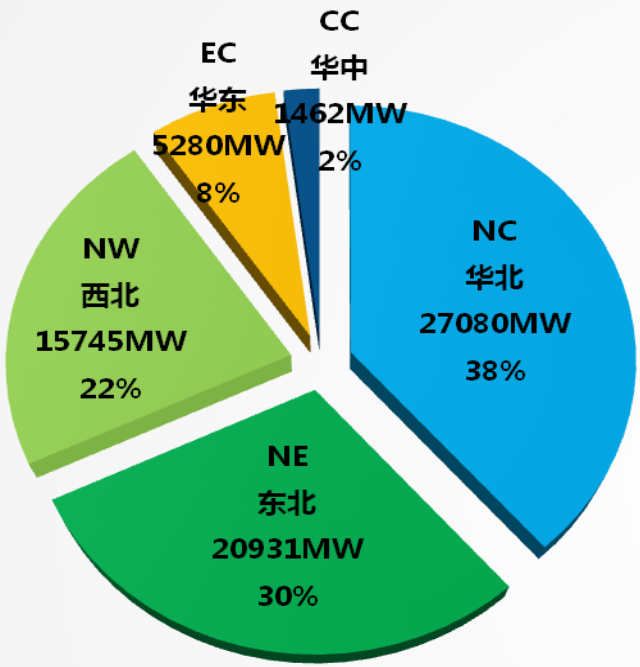
In response to many wind turbine loss accidents in recent years, State Grid has developed the anti-accident measures for wind power to ensure the safe operation of wind power. No large-scale wind turbine loss has occurred since June 2012.

Challenges:Wind Energy Resource Distribution

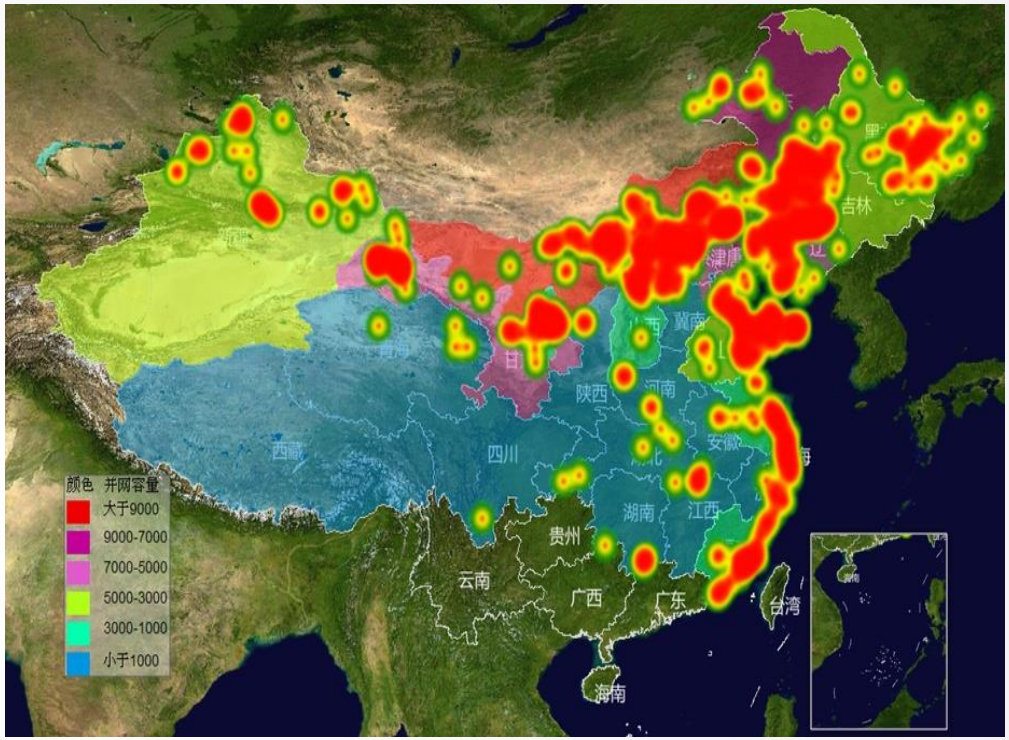


Resources: **80% plus located in in Northwest China, North China， Northeast China and the Tibetan Plateau;**
Load Center: **East China**
Distance: **Thousands of kilometers**

Challenges: Wind Power Distribution



(unit MW)



Wind Power Generation: As of the end of 2014, 90% plus in Northwest China, North China and Northeast China.

Challenges: Wind Power Operation

Lag of Trans-regional Power Transmission Line Construction

Local demand: weak

Regional interconnection: weak

Solutions: UHV Long Distance Transmission

Transmission Capacity: **up to 12GW**
Distance: **up to 5000 kilometers**

- **Completed:**

  3 AC and 4 DC
- **Under Construcion**

  4 AC and 3 DC
- **Under Planning & Study**

  Dozens

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Proposal of Global Energy Interconnection

During Summit of Global Sustainable Electricity Partnership (G-SEP) in May, 2014 (Moscow, Russia), the concept was first put forward.

The chairman of State Grid, Mr. Liu Zhenya proposed a strategic concept of building a global energy Interconnection.

Definition of GEI

Global energy interconnection is a globally interconnected strong and smart grid with UHV grid as the backbone, which will serve as a platform for extensive development, deployment and utilization of clean energy globally.

Its essence is UHV Grid + Smart Grid+ Clean Energy.

- **UHV grid is the key**
- **Smart grid is the foundation**
- **Clean energy is the priority**

Prospects

By 2050 clean energy will take up 80% of global primary energy	
Annually replace	fossil energy equal to 24 billion tons of standard coal
Annually cut emission	67 billion tons of CO_2,
Global carbon emission	within 11.5 billion tons， merely ½ of that of 1990

By 2050, The target of limiting global temperature rise within 2° C proposed by UNFCC can be realized.

United Nations
Framework Convention on
Climate Change

Roadmap

- The construction of global energy interconnection can be divided into three phases：

now — 2020 — 2030 — 2050

Phase1 Domestic Interconnection

- Develop clean energy within each country.
- Enhance domestirc grids interconnection.
- Promote smart grid construction.

Phase 2 Intercontinental Interconnection

- Cross-border grid interconnection.
- Clean energy base development within continents.

Phase 3 Intercontinental Interconnection

- Realize intercontinental interconnection.
- Energy Base development at the North Pole and the Equatorial region.
- Primary shape-up of global energy interconnection.

Propositions

Establish a collaborative research mechanism

Integrate various innovative resources, with key R&D projects as a link, to share avant-garde information, R&D facilities, and S&T achievements.
Combine efforts across sectors of production, education, research and application together to conduct collaborative research among institutes and meanwhile involving upstream and downstream industries.

Carry out cooperation on key projects

Based on China's Belt and Road strategy, join hands with relevant countries to promote key projects such as Asia-Europe interconnection, European Super grid, transmission from wind power bases at North Sea and the North Pole, and solar power bases at North Africa and Middle East etc.

Strengthen talent pool

Global energy interconnection will require input from many experts and talents with global visions, professional knowledge and practical experiences.

Build a high-level collaboration platform

To fully tap the potential of international organizations, research institutes, universities and energy companies, we should establish an international exchange and collaboration platform across different countries, sectors, and fields, centering around global energy interconnection.

Thank you!