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

Shouhe Zhao
State Grid Corporation of China
Japan Representative Office
2016.03
RENEWABLES TRADING

WIND POWER OPERATION & CHALLENGES

GLOBAL ENERGY INTERCONNECTION
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

**TRANSMISSION & DISTRIBUTION**
- Regulated
- Monopoly

**RETAIL**
- Grid Company as Sole Retailer
- Regulated
- Limited Competition
Grid Companies in China

State Grid Corporation of China

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

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

Market-oriented Competition
Consumer: industrial and commercial consumers;
Producer: coal-fired power, nuclear power, portion of hydropower.

Policy-oriented Competition
Consumer: households, rural consumers, public utilities
Producer: wind power, PV, biomass, portion of hydropower,

Market-oriented Monopoly
New built distribution

Policy-oriented Monopoly
existing distribution; transmission

Competition
Regulated
Electricity Market Reform—Undergoing, Started in 2015

- Several comments on further deepening of electric power institutional reform

Master Policy

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
- ……
ELECTRICITY SECTOR IN CHINA

RENEWALBES TRADING

WIND POWER OPERATION & CHALLENGES

GLOBAL ENERGY INTERCONNECTION
Renewable Energy Cost Share

- Renewable Fund
  - Equals to Coal-fired Power Tariff

- Budget
  - Renewable Addition

- Government
- Grid Company
- Consumer
# Benchmark Tariff for Renewables

## Benchmark Tariff for Wind Power

<table>
<thead>
<tr>
<th>Resource Area</th>
<th>Benchmark Tariff for Wind Power</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>Category I</td>
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</tr>
<tr>
<td>category II</td>
<td>0.50</td>
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<tr>
<td>category III</td>
<td>0.54</td>
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<tr>
<td>category IV</td>
<td>0.60</td>
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## Benchmark Tariff for PV

<table>
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<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>category I</td>
<td>0.80</td>
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<tr>
<td>category II</td>
<td>0.88</td>
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<tr>
<td>category III</td>
<td>0.98</td>
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</table>
RENEWABLE TRADING

WIND POWER OPERATION & CHALLENGES

GLOBAL ENERGY INTERCONNECTION
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.

**Yearly Plan**
Priority is given to the planned power generation of existing and newly installed wind turbines in yearly plans according to the forecast and actual situations of power grids.

**Monthly Plan**
Priority is given to the wind power generation for next month in monthly plans with reference to the predictions of wind power resources for next month.
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.
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
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
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 Construction
  - 4 AC and 3 DC
- Under Planning & Study
  - Dozens
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.
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.

<table>
<thead>
<tr>
<th>Annual Activity</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Annually replace fossil energy</td>
<td>equal to <strong>24 billion</strong> tons of standard coal</td>
</tr>
<tr>
<td>Annually cut emission</td>
<td><strong>67 billion</strong> tons of CO₂,</td>
</tr>
<tr>
<td>Global carbon emission</td>
<td>within <strong>11.5 billion</strong> tons, merely ½ of that of 1990</td>
</tr>
</tbody>
</table>

By 2050, the target of limiting global temperature rise within 2°C proposed by UNFCC can be realized.
The construction of global energy interconnection can be divided into three phases:

**Phase 1: Domestic Interconnection**
- Develop clean energy within each country.
- Enhance domestic 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!