Grid Development and Integration of RE in China

State Grid Corporation of China
Frankfurt
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Outline

1. Overview SGCC
2. Development of Renewable Energy in China
3. Integration of Renewable Energy
4. Global Energy Interconnection
SGCC Overview

- **Geographic Coverage**
  88% of China’s territory

- **Customers**
  Serving over 1.1 billion customers

- **Employees**
  1.8 million

- **Key Figures (2016)**
  Assets: €464Bn  Revenue €285Bn

- **Core business**
  Power grid construction and operation, R&D

- **Overseas Business**
  Runs overseas business in the Philippines, Portugal, Brazil, Australia, Italy, etc.

- **R&D**
  4 Research institutes
  24,000 Researchers & Developers

- **Ranked 2nd Fortune Global 500**

Data Source: 2015
Distribution of overseas assets and offices

SGCC’s service areas in China
SGCC’s overseas service areas
SGCC’s overseas offices
Global Energy Interconnection Research Institute Europe
GEIRI Europe, Berlin
1. Overview SGCC
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- **Hydro power**: 330 GW, ranking **No.1** in the world;
- **Wind power**: 169 GW, ranking **No.1** in the world;
- **PV power**: 78 GW, ranking **No.1** in the world;
- **Wind power** has been the **third largest** power source in China.

Wind and PV power capacity growth from 2006 to 2014

Wind: Over 20% growth

PV: Over 350 times growth
9 large-scale wind power bases are in planning or under construction, each of them with a capacity of more than 10GW.

- Large-scale of Offshore wind-farms
- Large, distributed PV and wind turbines

Wind, Solar, Storage Pilot Project
- Wind: 600MW
- Solar: 60MW
- Storage: 50MW

Data Source: 2015
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UHV operation & construction:

- 13 UHV (6 AC and 7 DC) Projects in Operation
- 9 UHV (2 AC and 7 DC) Projects under Constr.

Commissioned UHV projects:

<table>
<thead>
<tr>
<th>Projects</th>
<th>Length of line</th>
<th>Conversion capacity</th>
<th>Annual CO2 emission reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000kV Jindongnan--Jimen</td>
<td>640km</td>
<td>18GVA</td>
<td>--</td>
</tr>
<tr>
<td>±800kV Xiangjiaba-Shanghai</td>
<td>1,907km</td>
<td>12.8GW</td>
<td>26.0 million tons</td>
</tr>
<tr>
<td>±800kV Jinping-Sunan</td>
<td>2,059km</td>
<td>14.4GW</td>
<td>32.4 million tons</td>
</tr>
<tr>
<td>1000kV Huainan-Zhebei-Shanghai</td>
<td>2×649km</td>
<td>21GVA</td>
<td>--</td>
</tr>
<tr>
<td>±800kV Haminan-Zhengzhou</td>
<td>2,210km</td>
<td>16GW</td>
<td>40 million tons</td>
</tr>
<tr>
<td>±800kV Xiluodu-Zhexi</td>
<td>1,669km</td>
<td>16GW</td>
<td>34.0 million tons</td>
</tr>
<tr>
<td>Total</td>
<td>9,782km</td>
<td>98.20G</td>
<td>132.4 million tons</td>
</tr>
</tbody>
</table>

Data Source: 2015
By 2020:
- More than 22 UHVDC lines
- Wind power: 250GW
- Solar power: 150GW
World Record 1: Multi-Terminal HVDC

<table>
<thead>
<tr>
<th>Launch of operation</th>
<th>4th July 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacity</td>
<td>400/300/100/100/100 MW</td>
</tr>
<tr>
<td>Rated DC voltage</td>
<td>±200 kV</td>
</tr>
</tbody>
</table>

Current status

- Power supply to islands
- Wind power integration

Upgrade plan

- Transform to HVDC grid
- Solution 1 – dashed blue line
- Solution 2 – dashed red line
- Solution 3 – dashed green line
- Redundancy
- Grid reliability and security
- DC CBs → DC side fault clearance
World Record 2: DC GRID

Winter Olympic 2020 – DC Grid Demo Project

Proposal 1

Proposal 2
Phase I: 100MW Wind, 40MW PV, 20MW storage
Phase II: 400MW Wind, 60MW PV, 50MW storage
In total: 500MW Wind, 100MW PV, 70MW storage

Data Source: 2015
Smart Grid for Distributed RE

- Pumping Storage (57 Plants): 65 GW
- Operation (29 Plants): 25 GW
- Construction (15 Plants): 21 GW
- Planned (13 Plants): 19 GW

- Smart Substations: 2700
- Smart Meters: 430 million
- EV Charging Stations/Poles: 1 million

Data Source: 2016
Since 2009

- 500 pilot projects completed so far
- 10 billion Euros invested in total

Data Source: 2015
Development of E-mobility

Growth of Charging Stations and E-Mobility

2017: 1 Million
2020: 5 Million
1. Fossil fuels must be replaced by clean energy sources, such as solar energy, wind power and hydropower.

2. Electric energy replaces coal, oil and gas. Clean electricity is transported over long distances, thus solving the problem of excessive dependency on fossil fuels and the emission of CO2.
Large-scale RE: Global Energy Distribution Platform

-Wind: North Pole, Northern and Northern Asia, Northern Europe, Central North America, Eastern Africa

-Solar: North Africa, East Africa, The Middle East, Central and South America and Equatorial Regions

-RE: Random & intermittent: only large power grids can fundamentally solve the integration & utilization of RE: Global Energy Interconnection

Distribution of global wind energy resources

Distribution of global solar energy resources
24 Hour Power Curves of China, Europe, North America respectively

24 Hour Power Curve stemming from the superposition of the curves of China, Europe, North America
1. If 80% of the Energy Consumption comes from Clean Energy by 2050, CO2 will be reduced to the half of its level in 1990.

2. By the end of 21 century, the increase of global temperature can be limited to 1.5°C, which will meet the target requirement (COP21).
Thank you for your attention!