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# Electricity Markets Evolution and Renewable Energy Integration in China

State Grid Energy Research Institute

2018.3.15

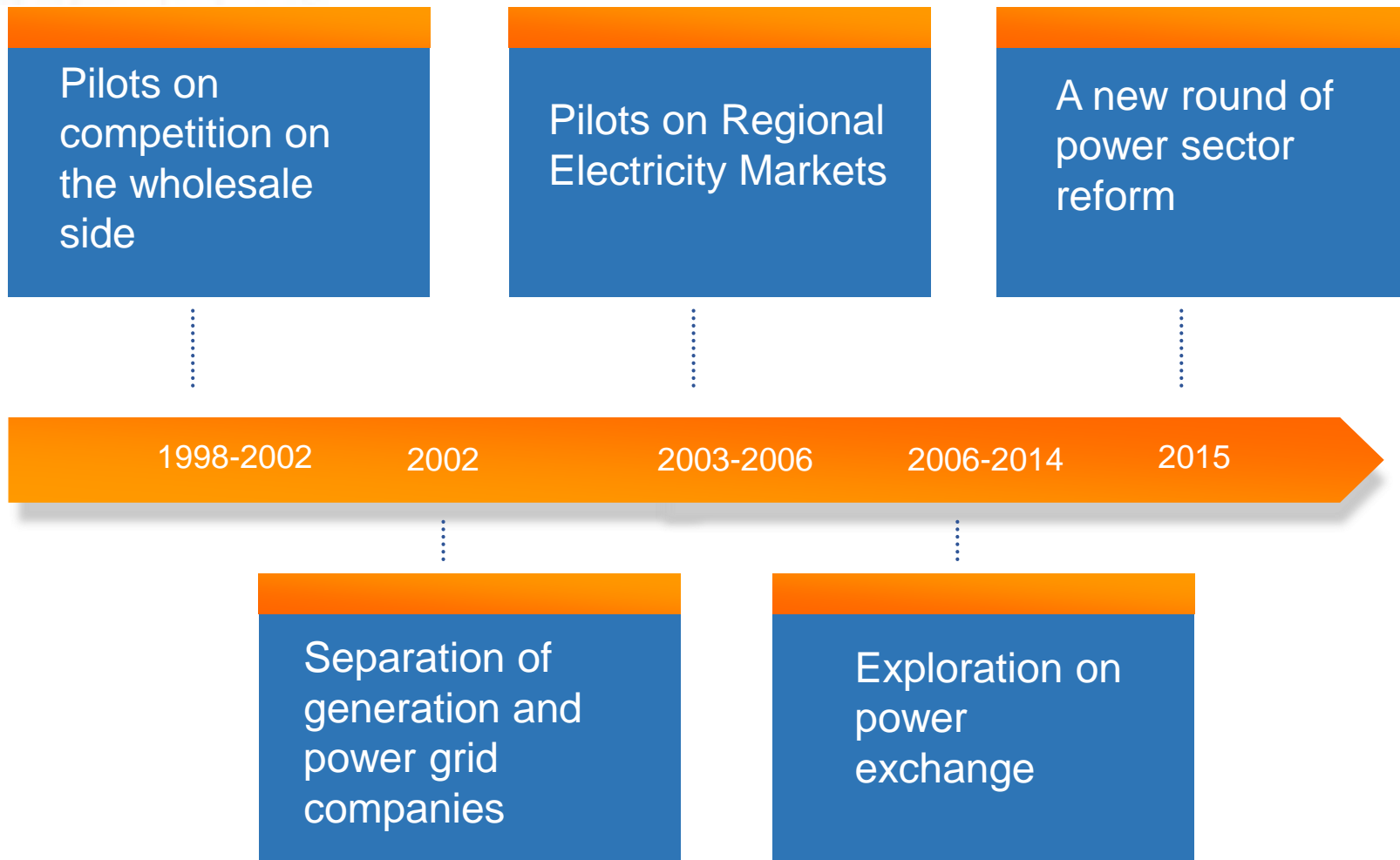


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# Outline

- 1. Electricity Market Revolution in China**
- 2. RE Integration with Market Mechanisms**
- 3. Thoughts on the Next Steps**

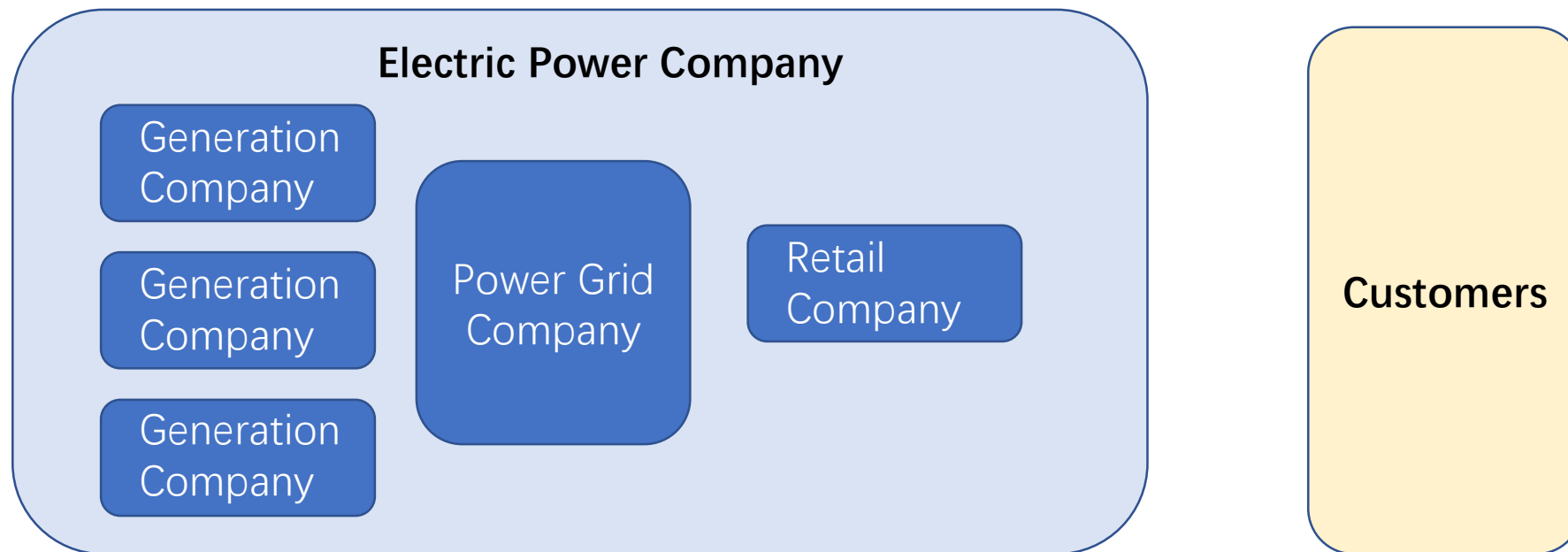




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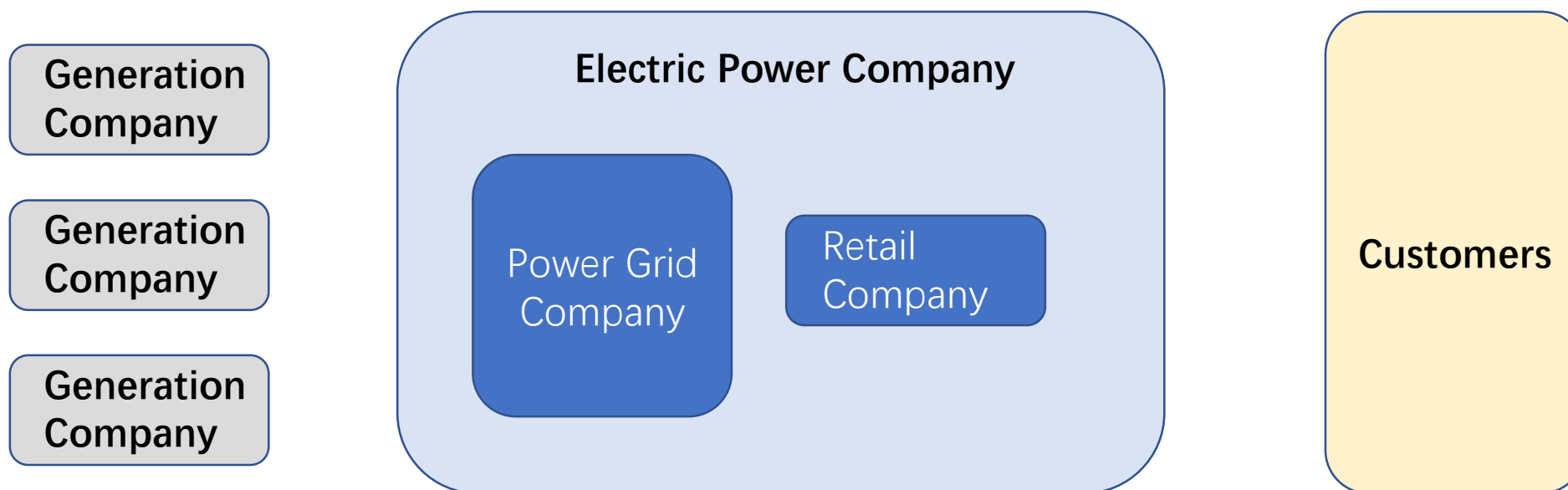
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- 1997: State Electric Power Company established
- 1998: Provincial markets pilots in Shanghai, Zhejiang, Shandong, Liaoning, Jilin and Heilongjiang
- 2000: operation of provincial electricity markets



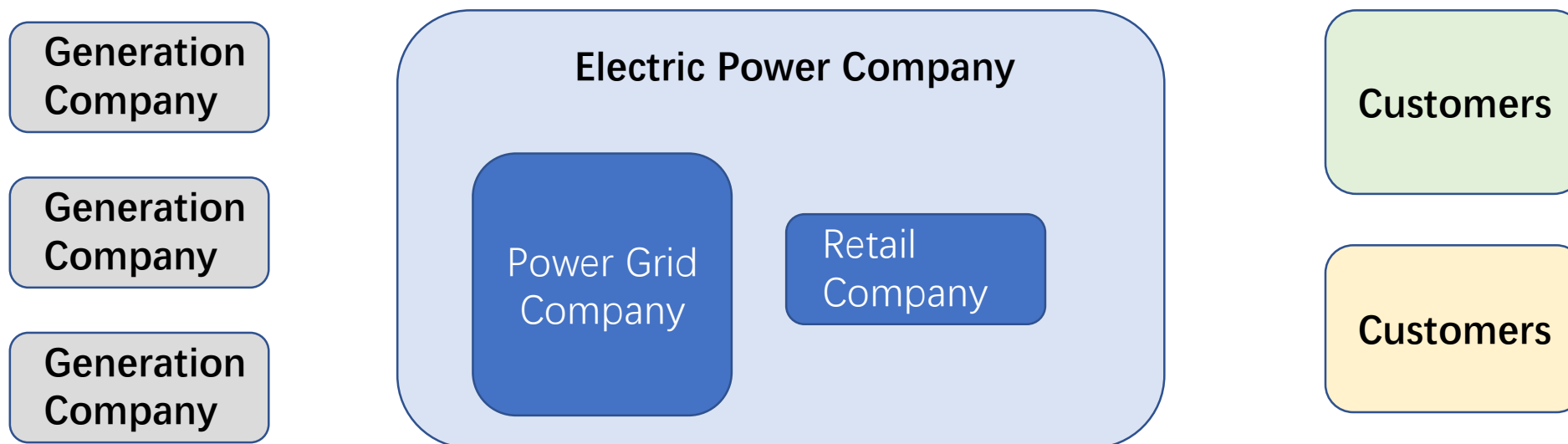


- 2002: Paper #5. Separation of power grid companies and power generation companies. Two power grid companies, five power generation companies. Competition on the generation side.
- 2002: Establishment of State Electricity Regulatory Commission (SERC)
- 2003: Regional electricity markets pilots in Northeast China, East China, etc.



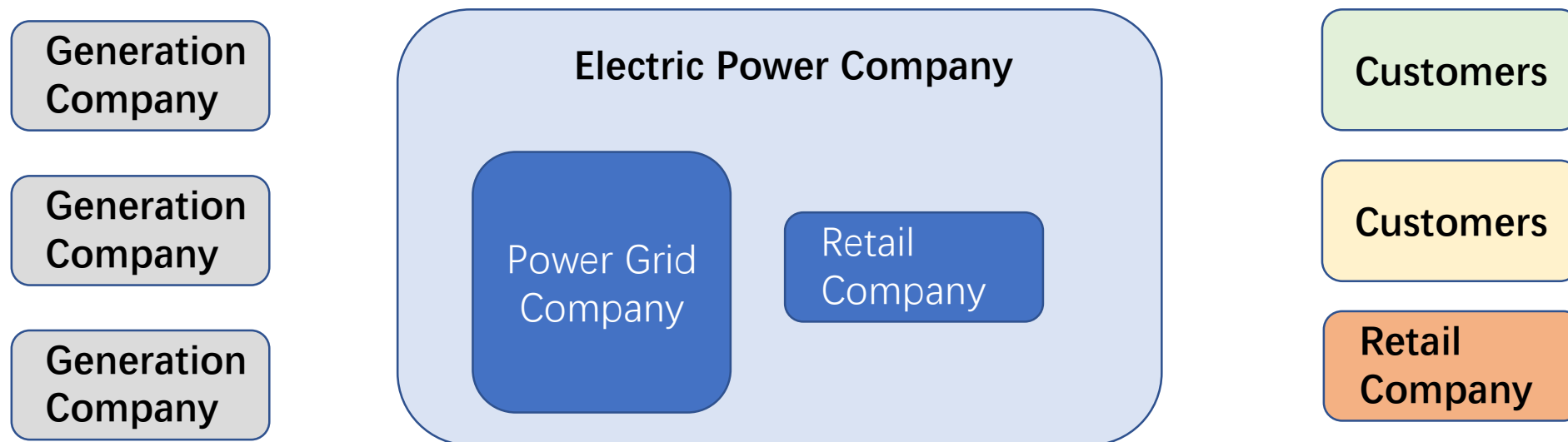


- 2006: Three tiers of power exchange centers established in State Grid Operation areas – National, regional, provincial. 2014-2015, power exchange centers established in Southern Power Grid.
- Annual, monthly power exchange in power exchange centers. Main type were generation rights trading and trans-regional, trans-provincial power exchange
- 2006-, bilateral trading between power generation companies in some provinces



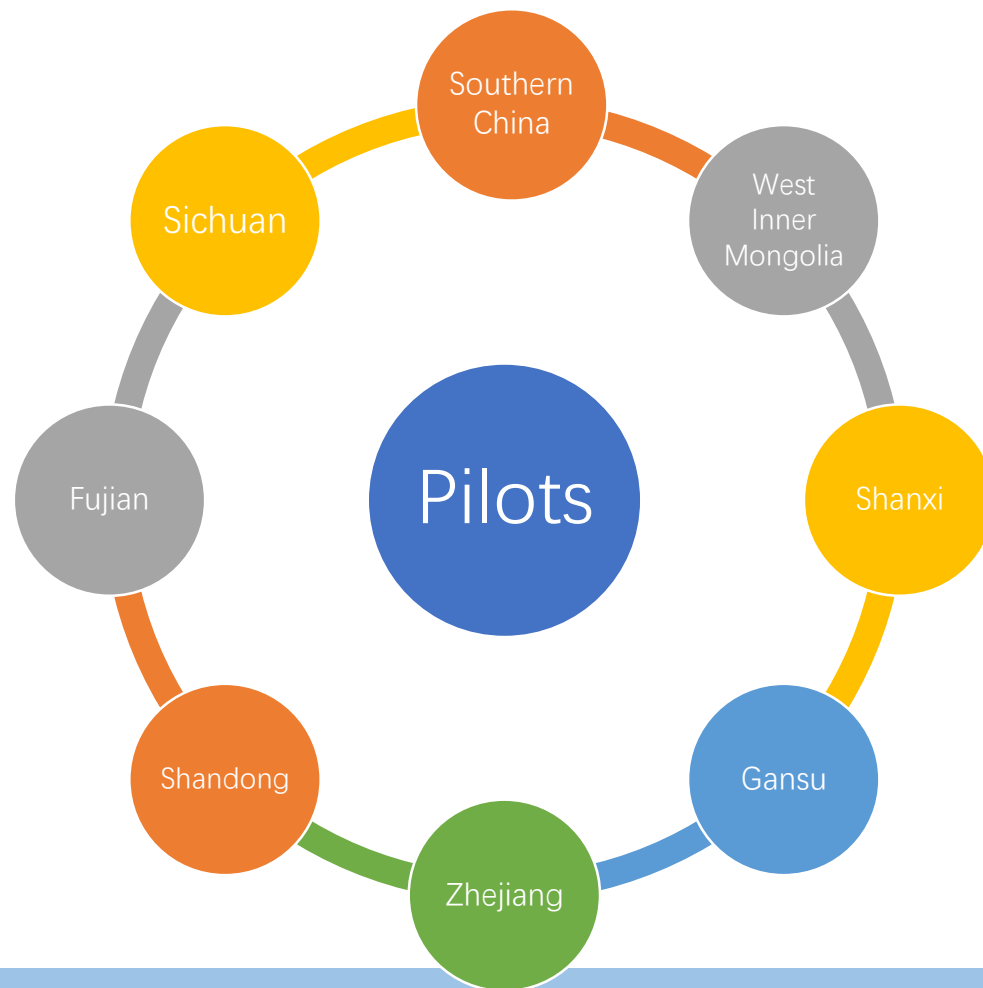


- 2015: CPC Central Committee and the State Council released Opinions Regarding the Deepening of the Power Sector's Reform (Paper #9), marking the official launch of the new-round power sector reform.
- “*three deregulations, one independent, and three strengthening*”
- deregulation of electricity prices; the deregulation of electricity retail services and opening for private capital; the deregulation of generation schedules except ones related to public welfare and power regulation.
- one independent refers to promoting the independence of power trading organization.





- 2017: 8 spot market pilots was selected in China.







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**1. Electricity Market Revolution in China**

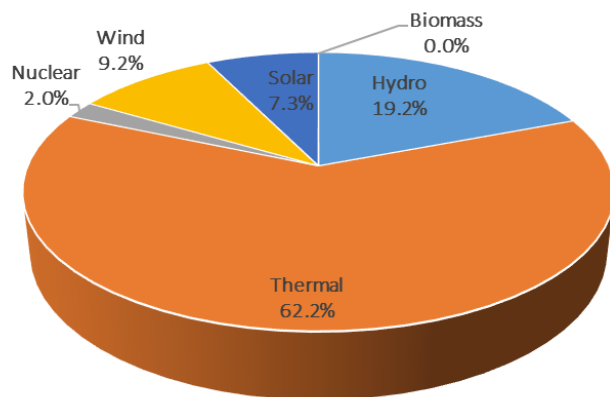
**2. RE Integration with Market Mechanisms**

**3. Thoughts on the Next Steps**

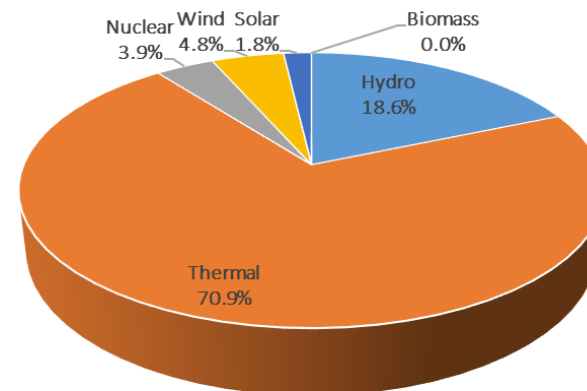


# RE Development: Capacity and Energy

- Installed capacity of wind and solar generation: 293.93 GW (by the end of 2017)
- Capacity share: 16.5%
- Energy from wind and solar: 423.8TWh (2017)
- Energy share:6.6%



*Generation Capacity Structure in China in 2017*

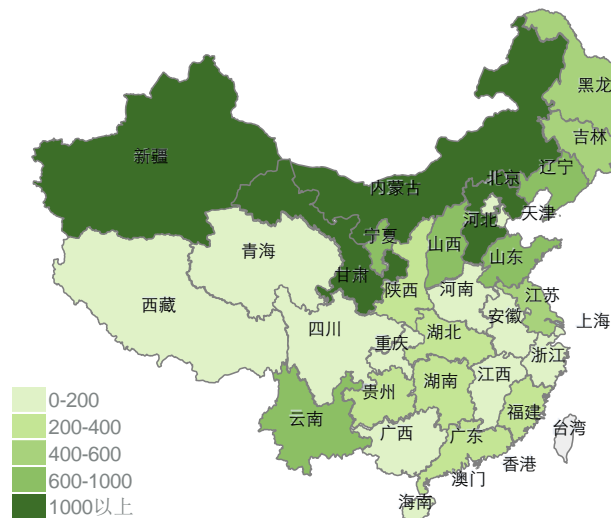


*Generated Energy from each type of generation in 2017*

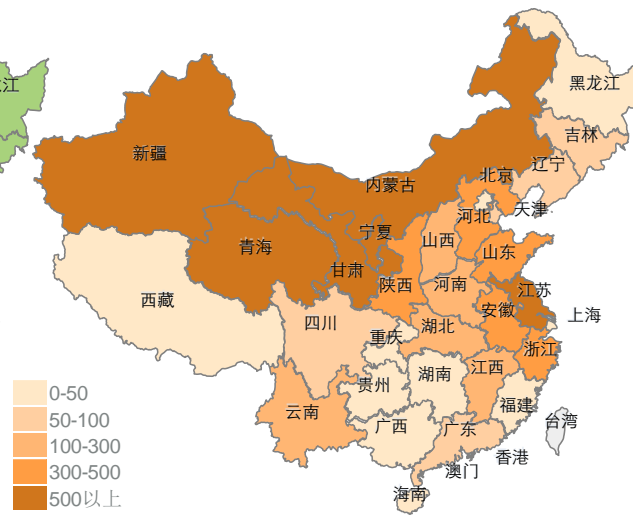


## RE Development: Characteristic

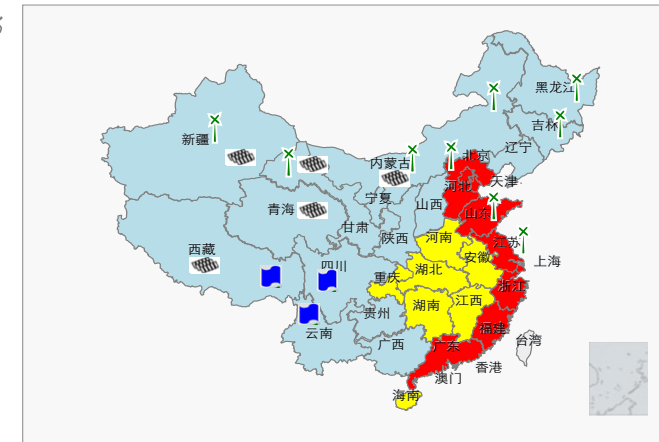
- Concentrated in the “Three North” regions: North China, Northeast China, and Northwest China, ~70% of the total capacity.
- Far from the load centers: Mainly in the central and eastern regions, ~65% of the total electricity consumption in China.



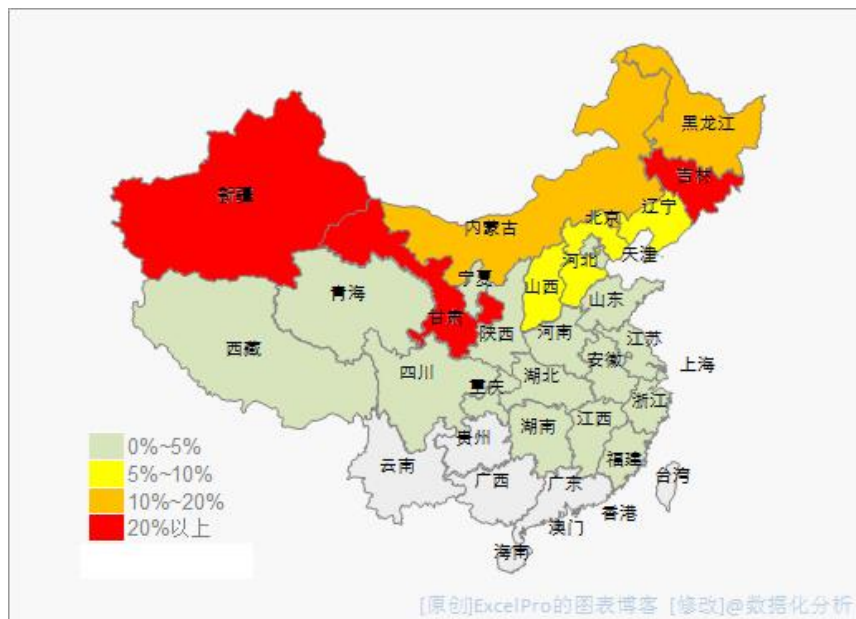
*Distribution of Wind Resource in China*



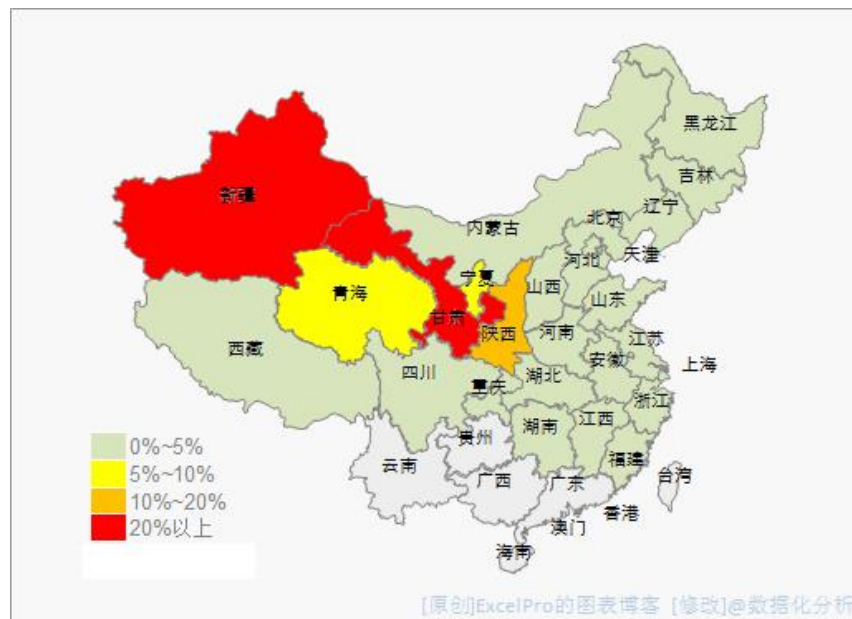
*Distribution of Solar Resource in China*



*Distribution of Electric Load in China*



*Distribution of Wind Curtailment in China*



*Distribution of Solar Curtailment in China*



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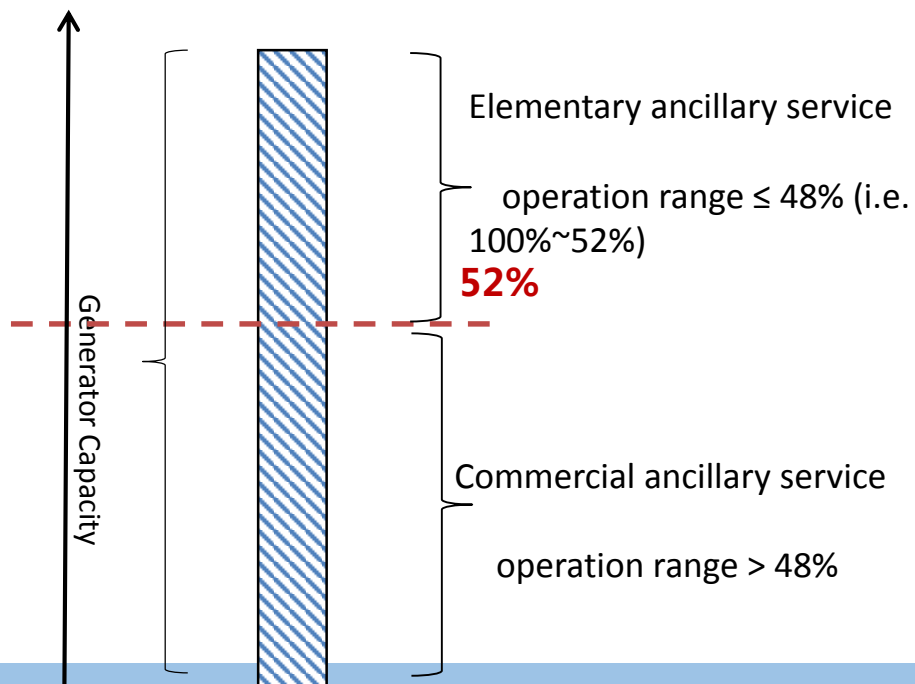
## Barriers to RE Integration in China

- Lack of flexibility from conventional generation
  - CHP
  - Self generation
  - Nuclear
- Limited trans-regional and trans-provincial interconnection
- Institutional barriers
  - Lack of ancillary service market
  - Inflexible price mechanism
  - Lack of demand side participation in renewable energy integration
  - ...

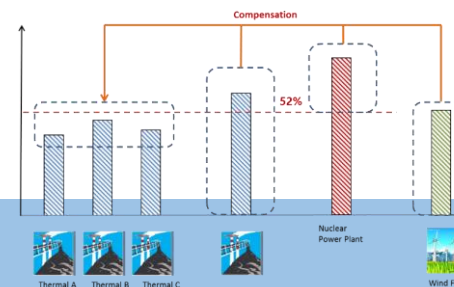


# (1) Ancillary service scheme in Northeast China

**Basic Idea:** The market price mechanism is introduced. Thermal generators can bid for their capabilities to be dispatched down and they will be compensated based on the clearing price. The more they can be dispatched down, the higher compensation rate they will get. The cost initiated will be borne by coal-fired generators, wind, nuclear, etc.



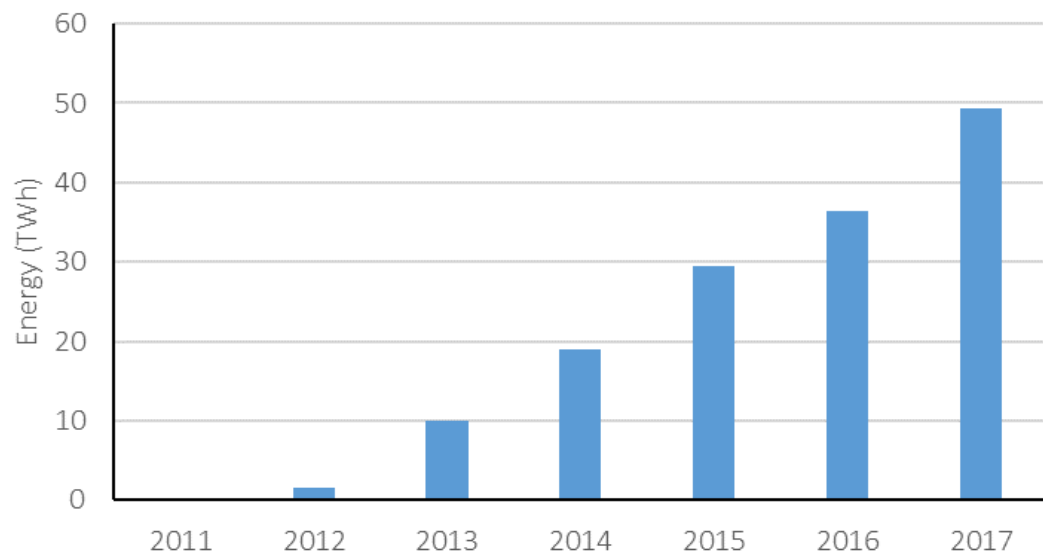
| Period      | Type    | Loading rate         | Bid Floor (RMB/kWh) | Bid Cap (RMB/kWh) |
|-------------|---------|----------------------|---------------------|-------------------|
| Non-heating | Non-CHP | $40\% < R \leq 50\%$ | 0                   | 0.4               |
|             | CHP     | $40\% < R \leq 48\%$ |                     |                   |
|             | All     | $R < 40\%$           | 0.4                 | 1                 |
| Heating     | Non-CHP | $40\% < R \leq 48\%$ | 0                   | 0.4               |
|             | CHP     | $40\% < R \leq 50\%$ |                     |                   |
|             | All     | $R < 40\%$           | 0.4                 | 1                 |



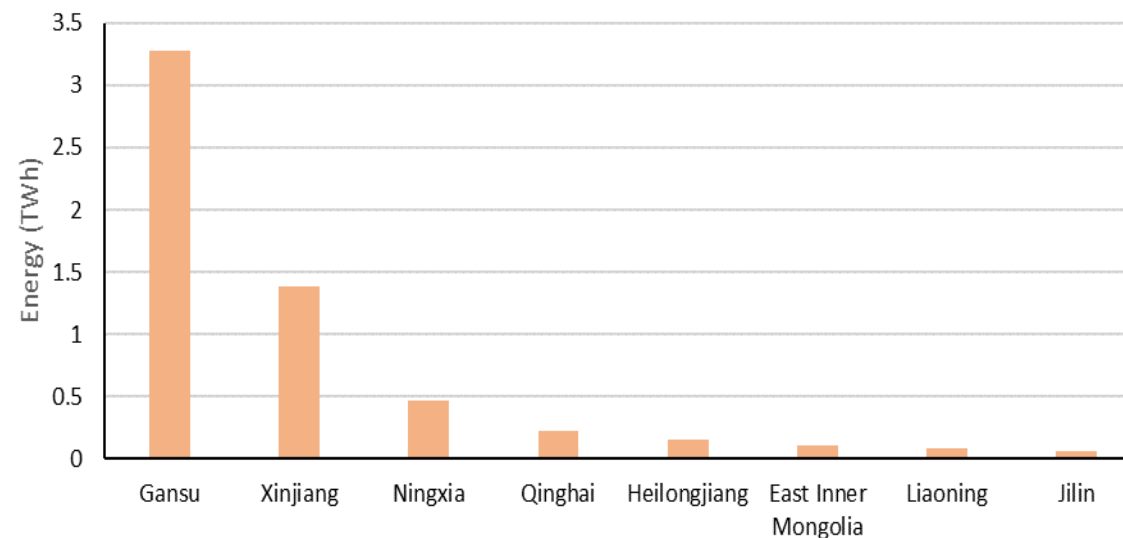


## (2) Encouraging trans-regional RE power exchange

### Trans-regional RE power exchange



### Trans-Regional RE Exchange via Spot Market





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- Electricity Market Design
  - Coordination of long term market and spot market
  - Coordination of provincial electricity market and trans-provincial electricity market
  - Facilitation of renewable energy integration
- Renewable Energy Integration
  - How to participate in the electricity market
  - What policy changes are needed
  - ...



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# Thank you!

**If you have further questions, please contact**

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