INTERACTION BETWEEN ETS AND POWER SECTOR

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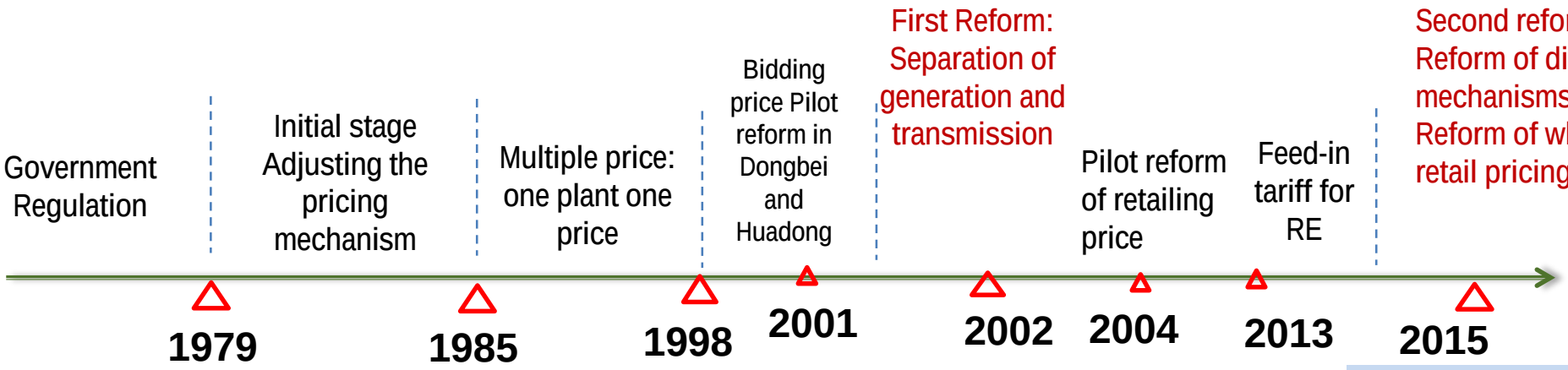
16 Years Evolution of Electricity Market Reform in China

- **What we have done and what we are going to do**



Centrally planned economy

National wide supply shortage of supply due to backward Electricity generation industry

Chaotic prices and ever rising price level

- *Rapid expansion of electricity demand*
- *Vertical integration and entry barriers deterred investment*
- *Lagged development of transmission network*

- *Lack of trading system lead to low efficiency of resource allocation*
- *Mixed pricing system lead to cross subsidy & abnormally high transmission and distribution costs*
- *Dispatch system lead to curtailment of RE and hamper their integration into network*

- **Three main policy objectives:**

  (a) Improving competition (reduce electricity prices)

  (b) Ensuring system security (establish ancillary service market)

  (c) Promoting green and low-carbon transition(full procurement , renewable quota system)

Power Sector Reform： Prominent Motivations

- **Severe over capacity throughout the whole country**

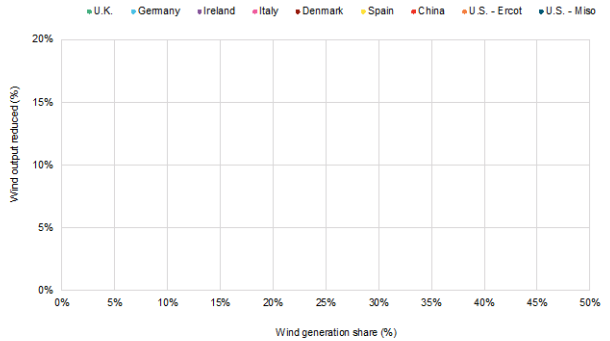
Available capacity versus peak demand by province, 2016 (GW)

Source: Bloomberg New Energy Finance, CEC. Note: Based on the global standard, we assumed available load factor of hydropower =50%, pumped hydro =100%, coal 90%, gas 90%, nuclear 80%, wind 10%, solar 30%, biomass 70%.

By the end of 2016, the national electricity supply surplus rate was 35%.In 2016, only four coastal provinces and cities in Guangdong and Shanghai were in short supply

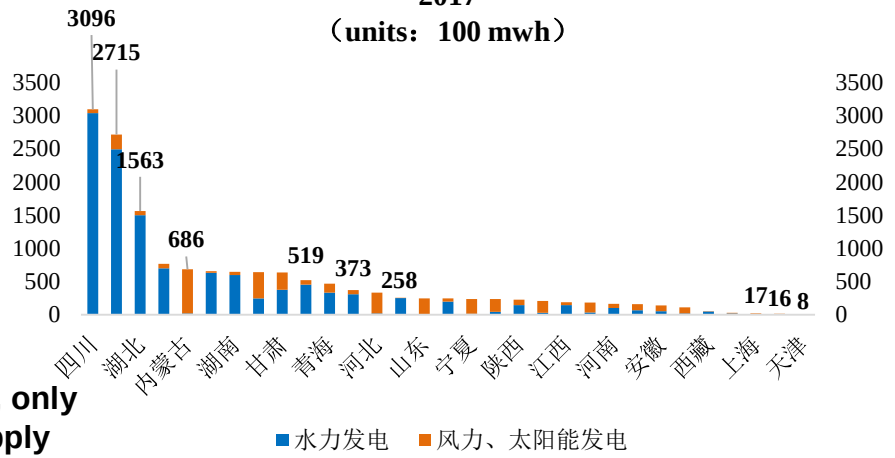
- **Lack of compatible policy and market scheme supporting renewable energy**

China's renewables curtailment



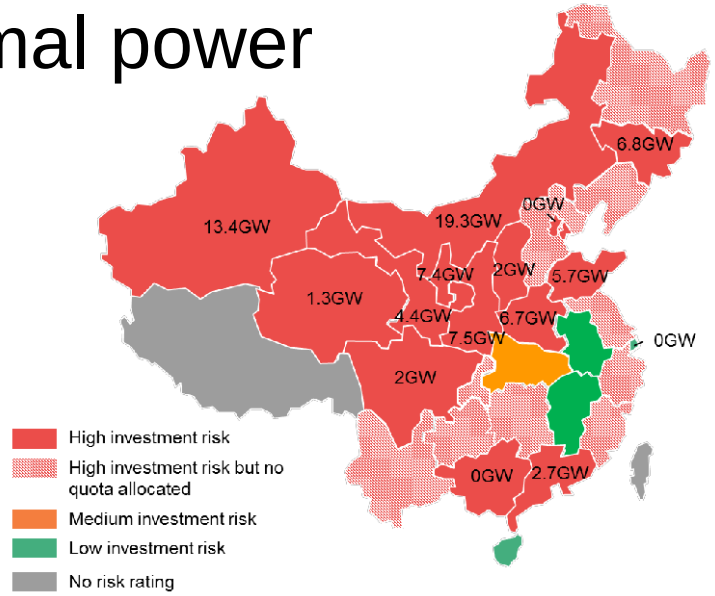
- Curtailment – wind farms and solar plants are forced to reduce their output.
- Even though variable renewable electricity penetration is still at a low level (less than 5% of the total electricity generation) in China, the country's wind and solar curtailment is the worst in the world. China's annual average wind curtailment exceeded 17% in 2016 largely due to the record number (30GW) of wind projects built in 2015.
- As curtailment goes uncompensated, China's renewable energy asset owners bear big financial uncertainties.

Provincial hydro, wind and solar power generation in 2017
（units：100 mwh）

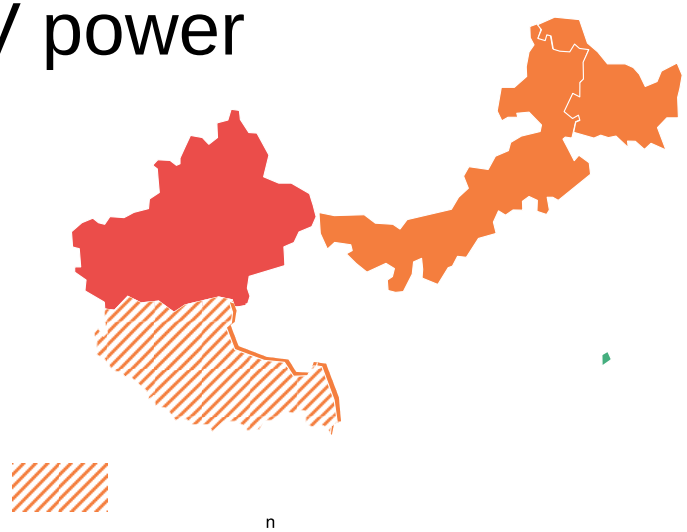


Investment risks of thermal power, wind power and PV

Thermal power

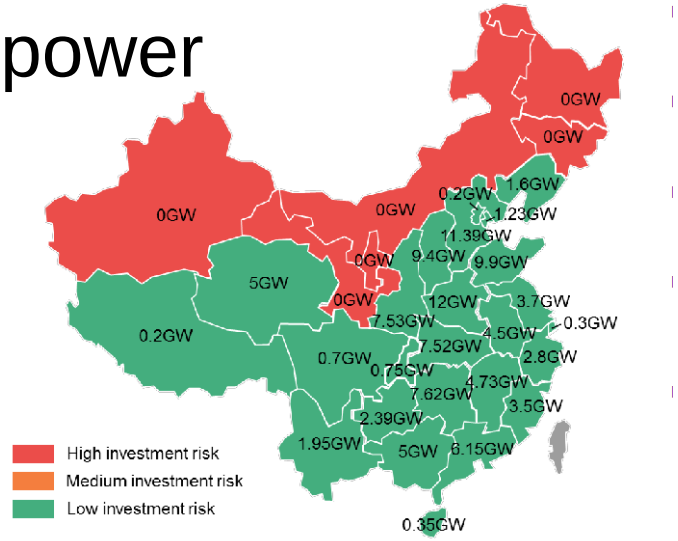


PV power



Source: NEA, Bloomberg New Energy Finance

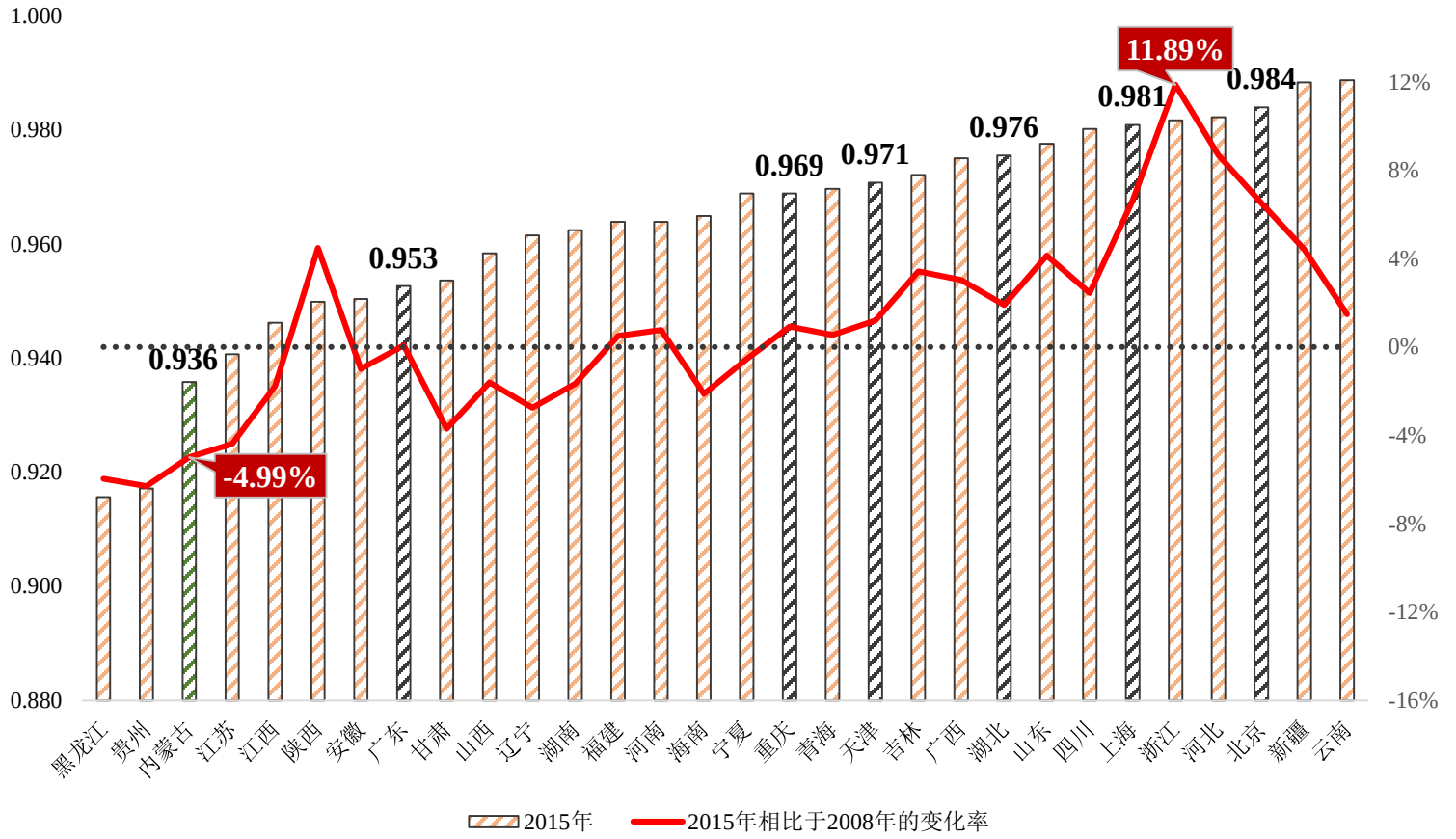
Wind power



Source: NEA, Bloomberg New Energy Finance

More free trading is required to reduce over capacity and investment risks

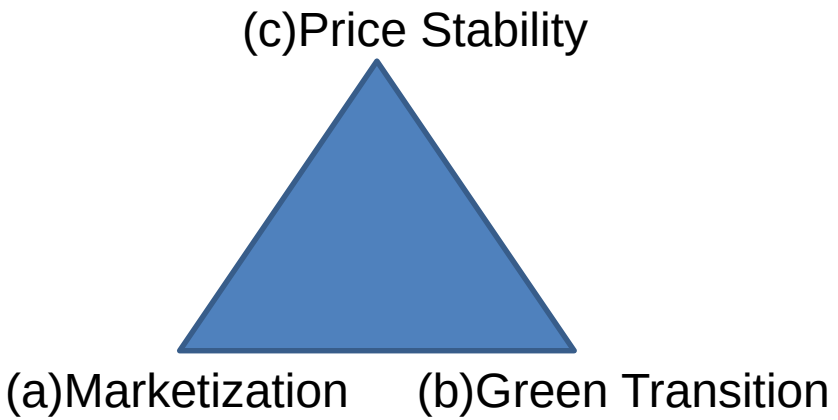
Great Diversity of Production efficiency across provinces



数据来源： CEESS计算所得，西藏因数据缺失剔除

Paradox within the Policy Targets

- **Without additional financial subsidies, the power industry faces direct trade-offs between different policy objectives in short-term. We use an "impossible triangle" to represent the problem:**
  - **(a) Marketization.** Market is a kind of decentralization mechanism (Aoki, 2001). Market participants will be able to determine prices, especially for oligopoly power generation companies.
  - **(b) Green transition**. Higher ratio of unstable renewable energy brings a higher proportion of capacity redundancy and operating costs. There is no price competitiveness of renewable energy except hydro power at this stage..
  - **(c) Price stability**. Low electricity prices are seen as an institutional advantage.



What can we expect in a liberalized electricity market ?

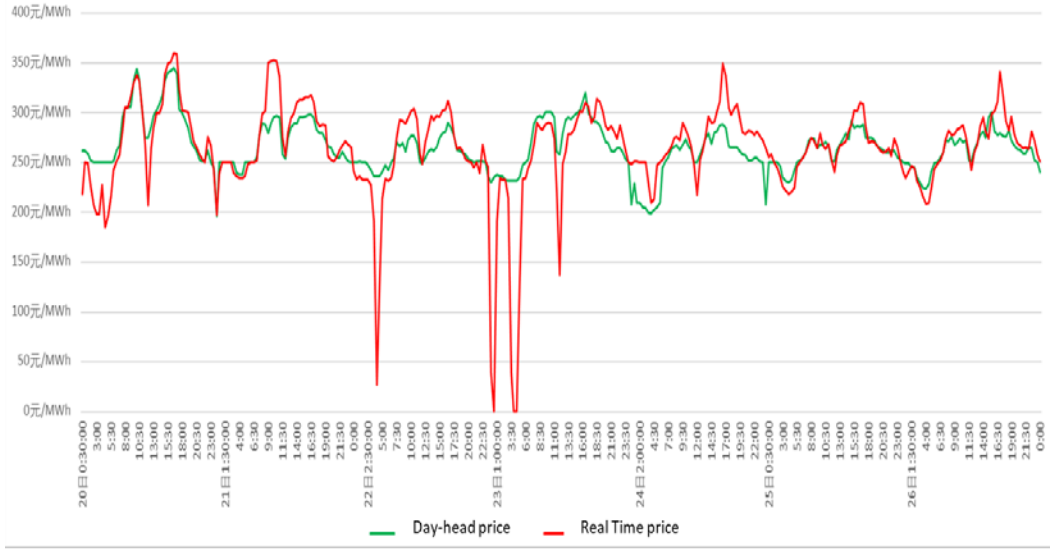
- **Lower electricity price.** Slowdown of demand and excess generating capacity(especially thermal)
- **Crowding out of low efficiency generating units .** Excessive capacity of coal-fired power plant
- **Revealed demand signal for green energy.** Rising public awareness about the environmental impacts of fossil fuel consumption
- **Favorable competition condition for RE.** Low marginal cost strengthen the competitiveness of RE in spot market(especially for the curtailment)
- **Removal of cross subsidy.** production side: removal of subsidies among fossil-fuels and RE; consumption side:gradual removal of subsidies from industrial users to residential users

Interaction between ETS and Power Sector

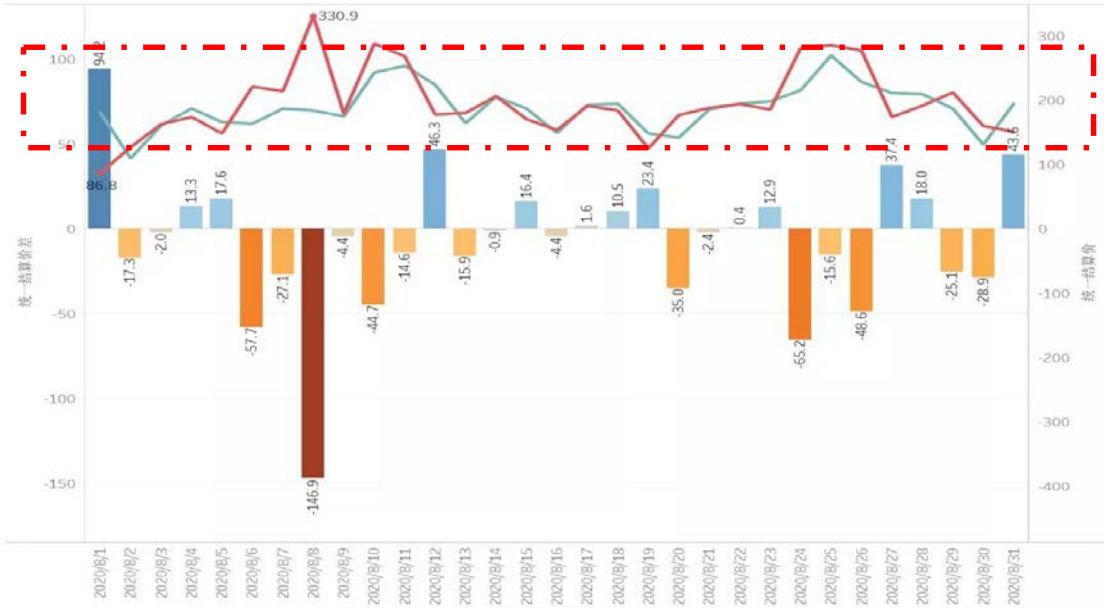
- **Production channel**: The policy raises the costs and product prices of regulated sources (s.t. Coal fired power generation) which causes production to shift to less stringently regulated sources and reinforce the development of high efficiency units.
  - **UK plants increased gas use by 19 to 24% and reduced coal consumption by 16 to 18% (McGuiness and Ellerman 2008).**
  - **Delarue et al (2008) likewise observe switching from coal to gas across the European electric power sector during the first phase of the ETS.**
- **Consumption channel:** Regulated sources reduce their fossil fuel use, which lowers fossil fuel prices and increases consumption by unregulated users.
- **Competitiveness channel:** provinces with low production efficiencies will suffer from loss in both markets
- **Intertemporal channel:** Capital stocks of all sources are fixed initially but change over time. Under the condition of low electricity price, ETS will reduce the ability of enterprises to recover the investment cost and improve the risk of capacity adequacy of power industry.
- **Technology channel:** Mitigation policy induces low carbon innovation, which reduces emissions by unregulated sources that adopt the innovations (s.t. Renewable energy power generation and energy storage technology).

Uncertainties

- **Eight representative provinces or regions are selected as the spot market reform pilot.**
  - Southern China (starting from Guangdong), Western Mongolia, Zhejiang, Shanxi, Shandong, Fujian, Sichuan, Gansu;
  - Spot prices in those pilots are very low (**0.2-0.3 yuan/kWh**), lower than the long-term price, and close to the variable cost of coal-fired units.
  - In addition to the **general oversupply**, local governments' **pursuit of reform performance** has depressed spot prices.



2019 Zhejiang Trial Operating



Daily Average price：0.1-0.2 yuan/kWh

2020.08 Guangdong Trial Operating

Source: https://mp.weixin.qq.com/s/LY7U36ppwLwMF6SzvZlavA

Uncertainties

- **In summary, the impact of electricity reform on ETS and carbon peak:**
  - **Political constraints.**
    - Marketization increases the uncertainty of electricity prices, and local governments will take a more cautious attitude towards the carbon market.
  - **Competiveness effects**.
    - Competition among power generation companies may rise or fall, depending on whether there is market collusion and the ability of regulators.
    - If the reform goes smoothly, the market competition will be improved and the excess capacity of thermal power industry will be gradually eliminated or solved. This helps to improve efficiency and reduce emissions.
  - **Technology innovation.**
    - Power system reform will promote the development of renewable energy quota trading system and energy storage technology, reduce the cost of power system and carbon emissions in the long term.