

# Development and Prospect of Double Reheat Technology in China

A decorative blue wave graphic spans across the middle of the slide, starting with a dark blue outer layer and a lighter blue inner layer, creating a layered effect.

L I W e n k a i

Electric Power Planning & Engineering Institute

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## China's energy structure

- China is the largest energy consumer in the world.
- Coal is accounted for more than 60% of China's total energy consumption.
- In 2016, 65% of petroleum and 34.4% of natural gas was imported from abroad.

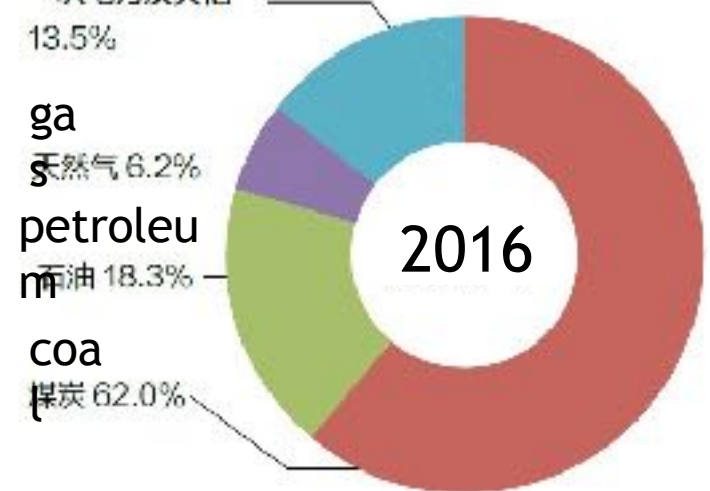
non-fossil

一次电力及其他  
13.5%

天然气  
6.2%

石油  
18.3%

煤炭  
62.0%



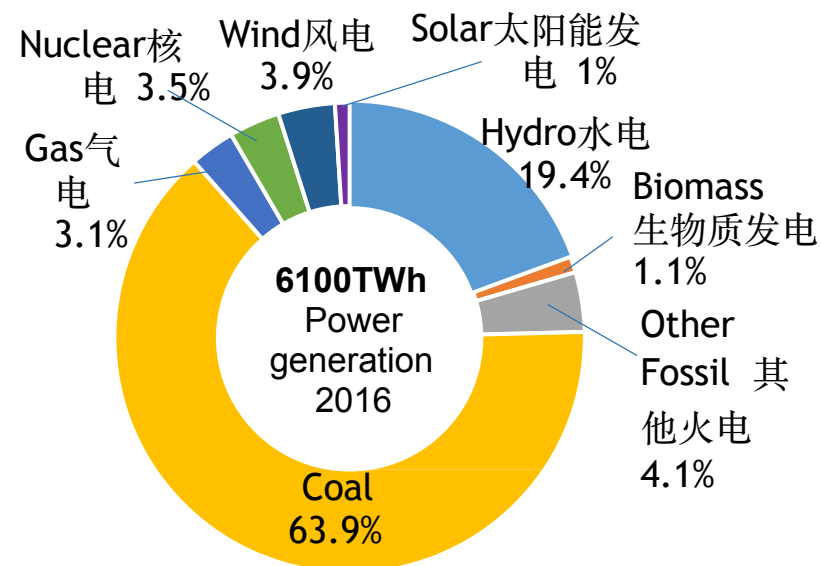
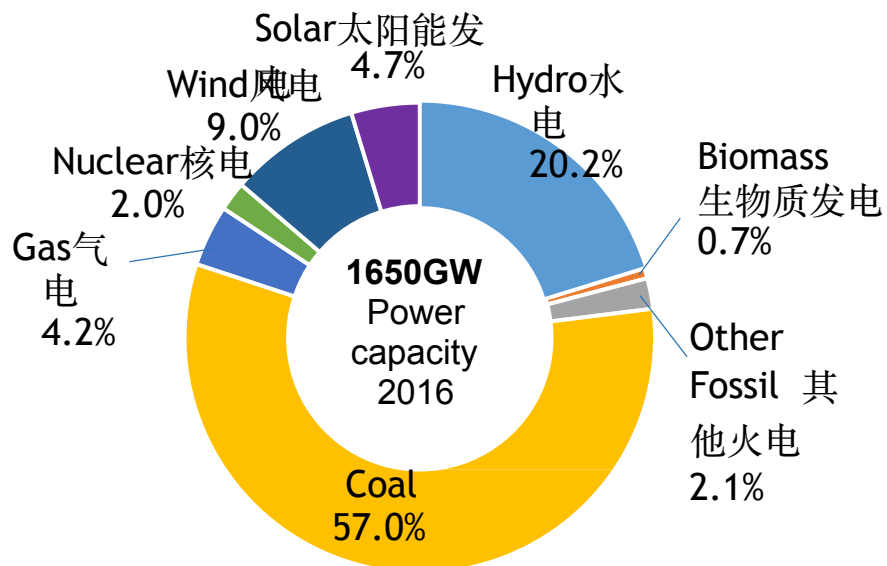
structure of China's energy consumption

**Coal plays an important role in China's energy supply, coal also is the important guarantee of China's energy security.**



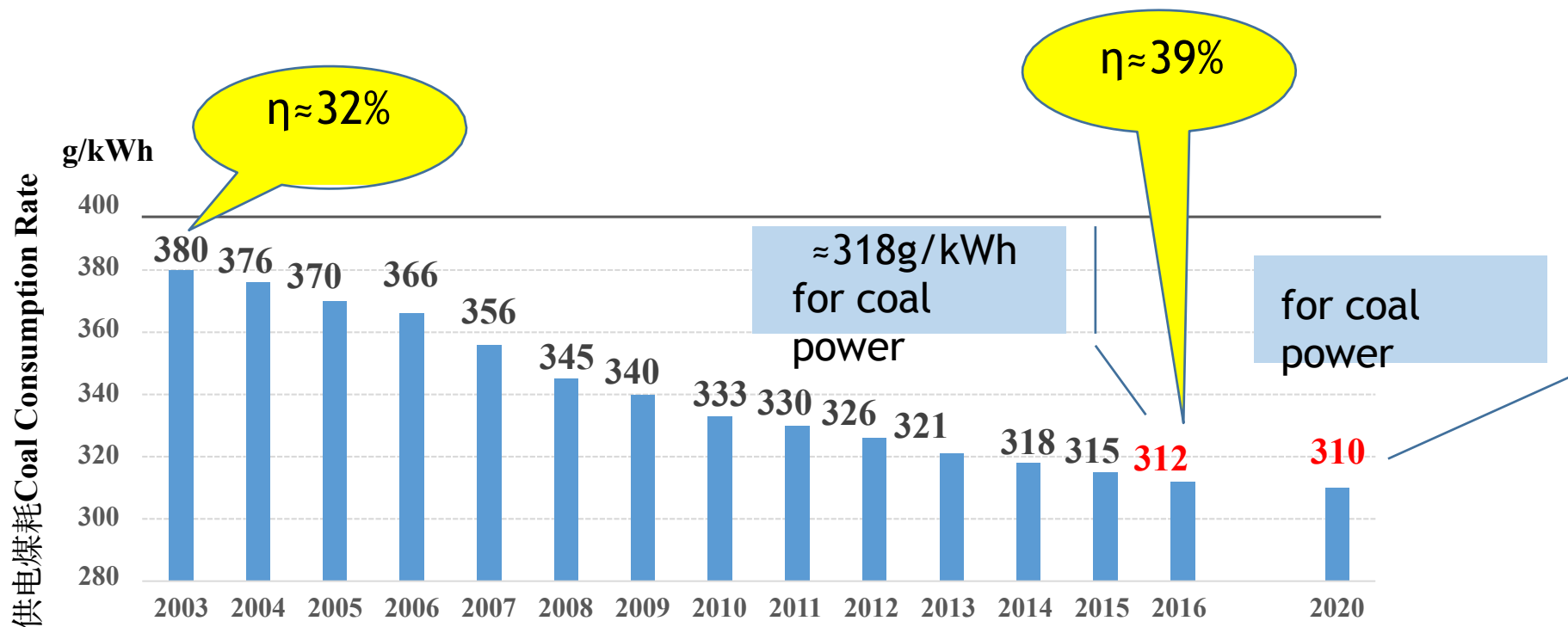
## Installed capacity and electricity generation of coal-fired power

- Coal power is foundational energy in China's power supply structure. In 2016, China's total installed power capacity is **1650 GW**, power generating **6100 TWh**. The proportion of coal power capacity and generation is **57.0%** and **63.9%**.



## Energy efficiency being improved continually

- Owing to optimization of coal-fired power structure, improvement of coal-fired power generation technology, and upgrading of existing coal-fired power plants, **the average coal consumption keeps decreasing.**

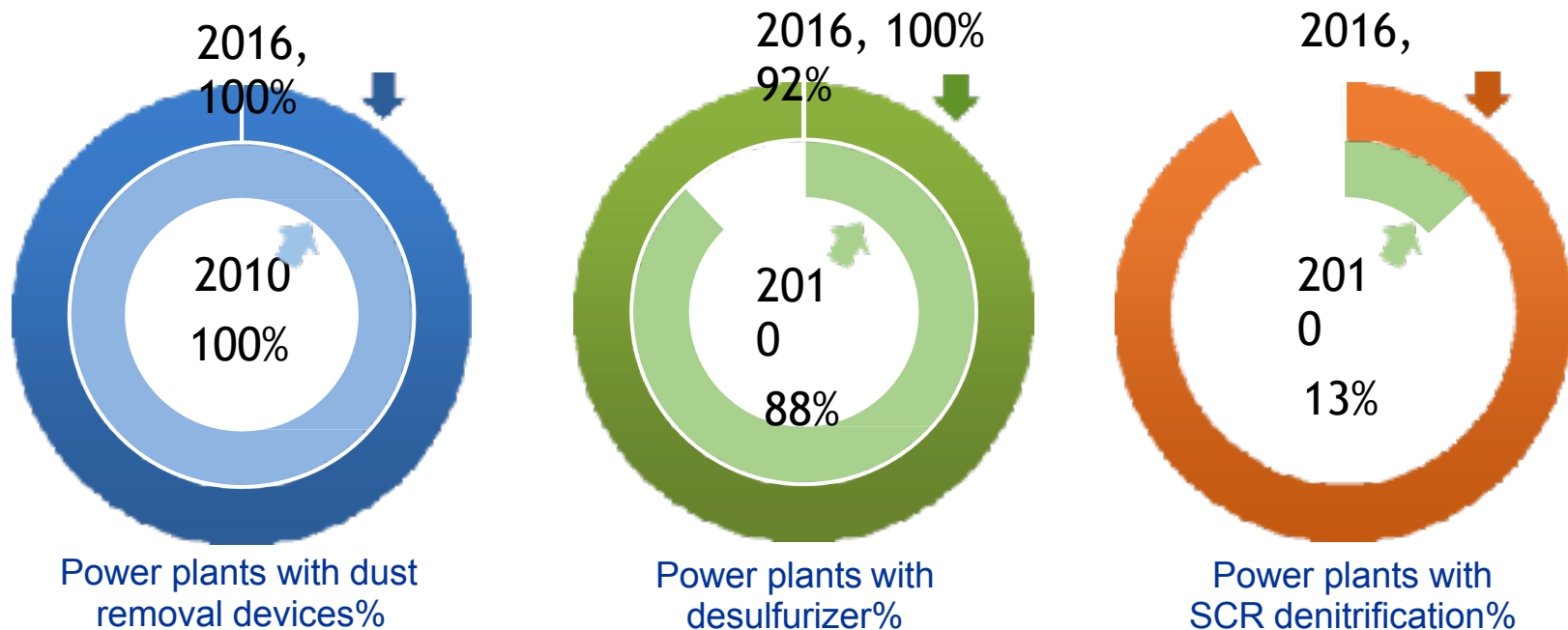


Annual average coal consumption for power supply by fossil-fired units nationwide [Unit: g/(kWh)]

## Pollutant emission being reduced continually

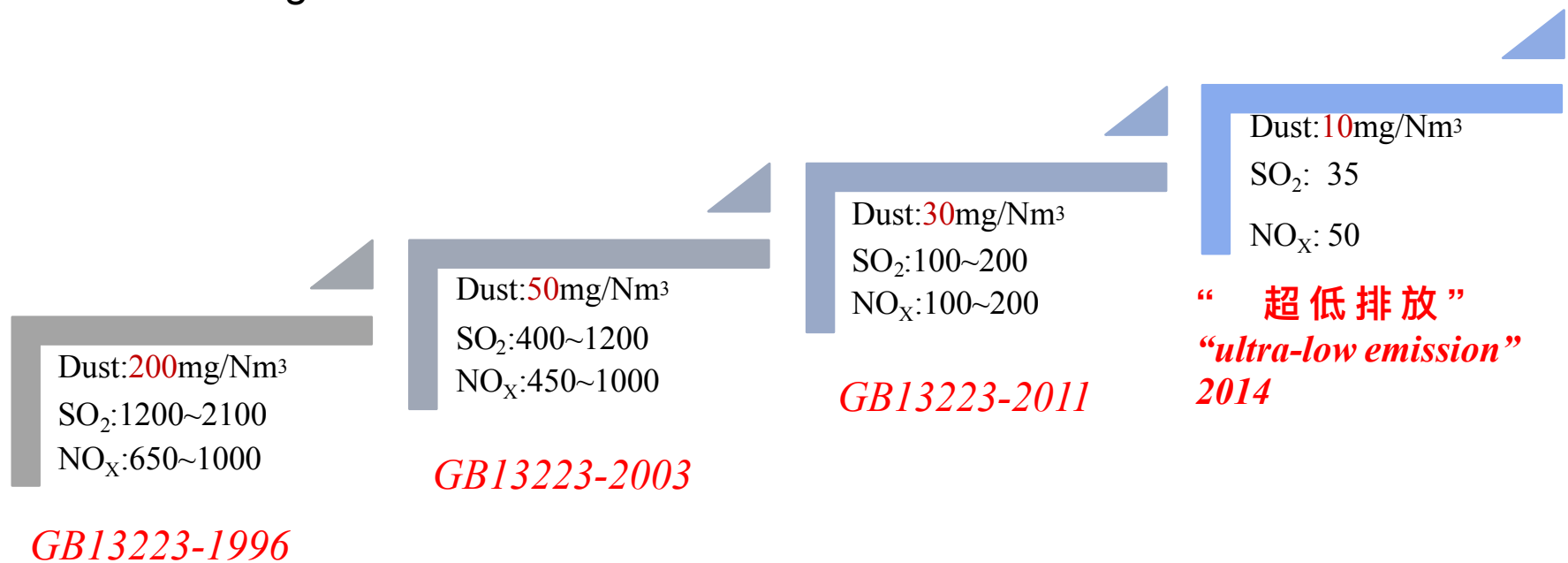
At present, air pollution is the focus for coal-power emission control.

- By the end of 2010, proportion of coal-power units that installed PM-removal devices(100%), SO<sub>2</sub>-removal devices(88%), and SCR devices (13%).
- By the end of 2016, proportion of coal-power units that installed PM-removal devices(100%), SO<sub>2</sub>-removal devices(100%), and SCR devices (92%).



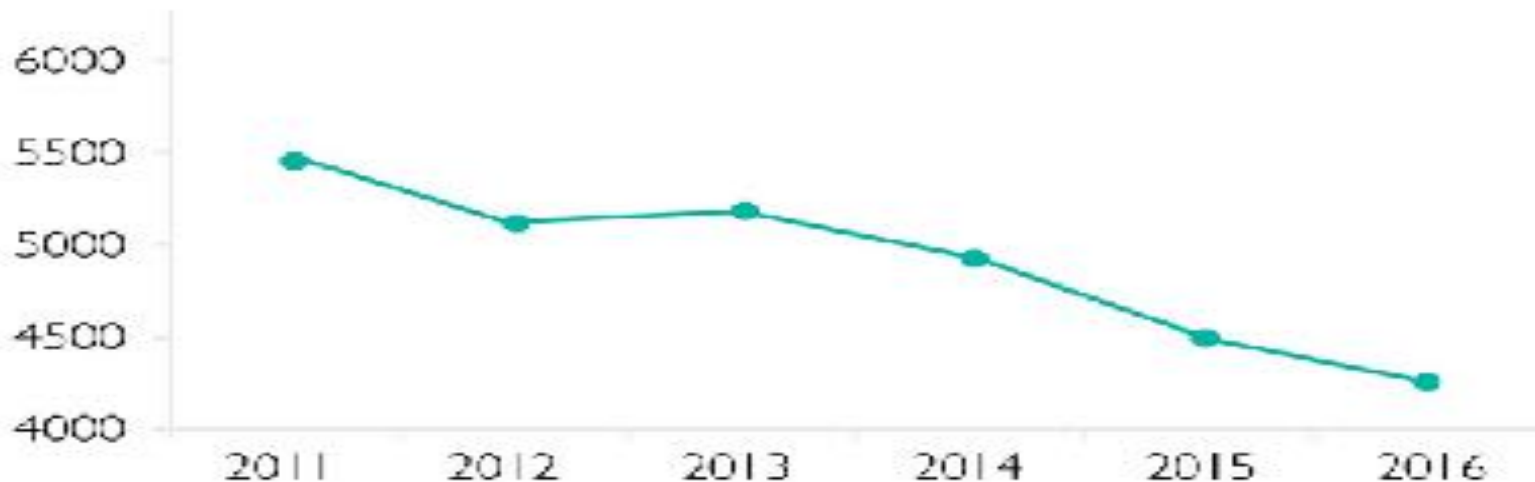
## Pollutant emission standards being improved continually

- Air pollutants emission standards for thermal power plants are becoming more stringent. China's ultra-low emission standards have been at the **leading level** in the world. However, local emission standards in some developed countries are still more stringent.



## Challenge 1: Annual utilization hours declining consecutively

- In recent years, China's annual utilization hours of coal power has been declining year by year. In 2016, the annual utilization hours of coal power was about **4240h**, which was less than the previous year by 240h, declining consecutively for three years.



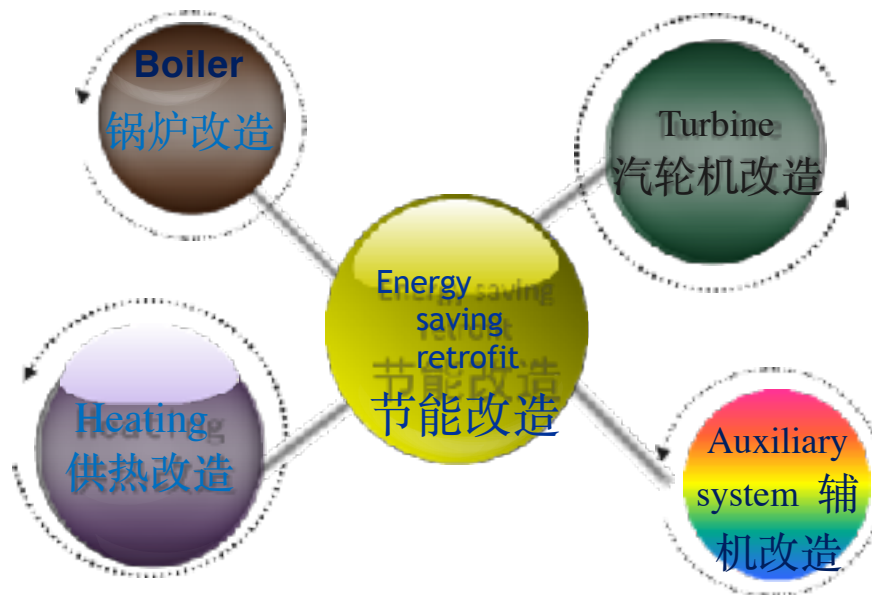
Annual Utilization Hours of Coal Power in China

Due to the less utilization hours, a lot of coal-fired power plants are facing financial difficulties.



## Challenge 2: Carry on energy saving and emission reducing

- China's coal power has experienced rapid growth, and has accumulated a very rich comprehensive upgrade experience in different unit types.
- Policies issued by NEA and MEP.
- It's necessary to carry on energy saving and emission reducing transformation.



## Challenge 3: Flexibility retrofit

- In recent years, China's renewable energy was developed rapidly, however, due to the insufficient consumptive ability of the grid, quite a lot of renewable energy is wasted.
- In 2016, average wind curtailment rate is 17.1%, overall wind curtailment was **49.7TWh**.
- In northeastern China, **80%** of the thermal power units are CHP units, of which the operational flexibility is weak. There are large surplus of generating capacity in heating period.

All these factors have prompted China to improve the flexibility of the steam power units.

## Challenge 4: Pressure from Climate Change



2014.1  
1

### <China-US Joint Statement on Climate Change>

#### 《中美气候变化联合声明》

- China sets a target for its greenhouse gas output to peak around **2030**
- China intends to increase the share of non-fossil fuels in primary energy consumption to around **20%** by 2030

2015.1  
1

### <Paris Climate Change Agreement>

#### 《巴黎气候变化协定》

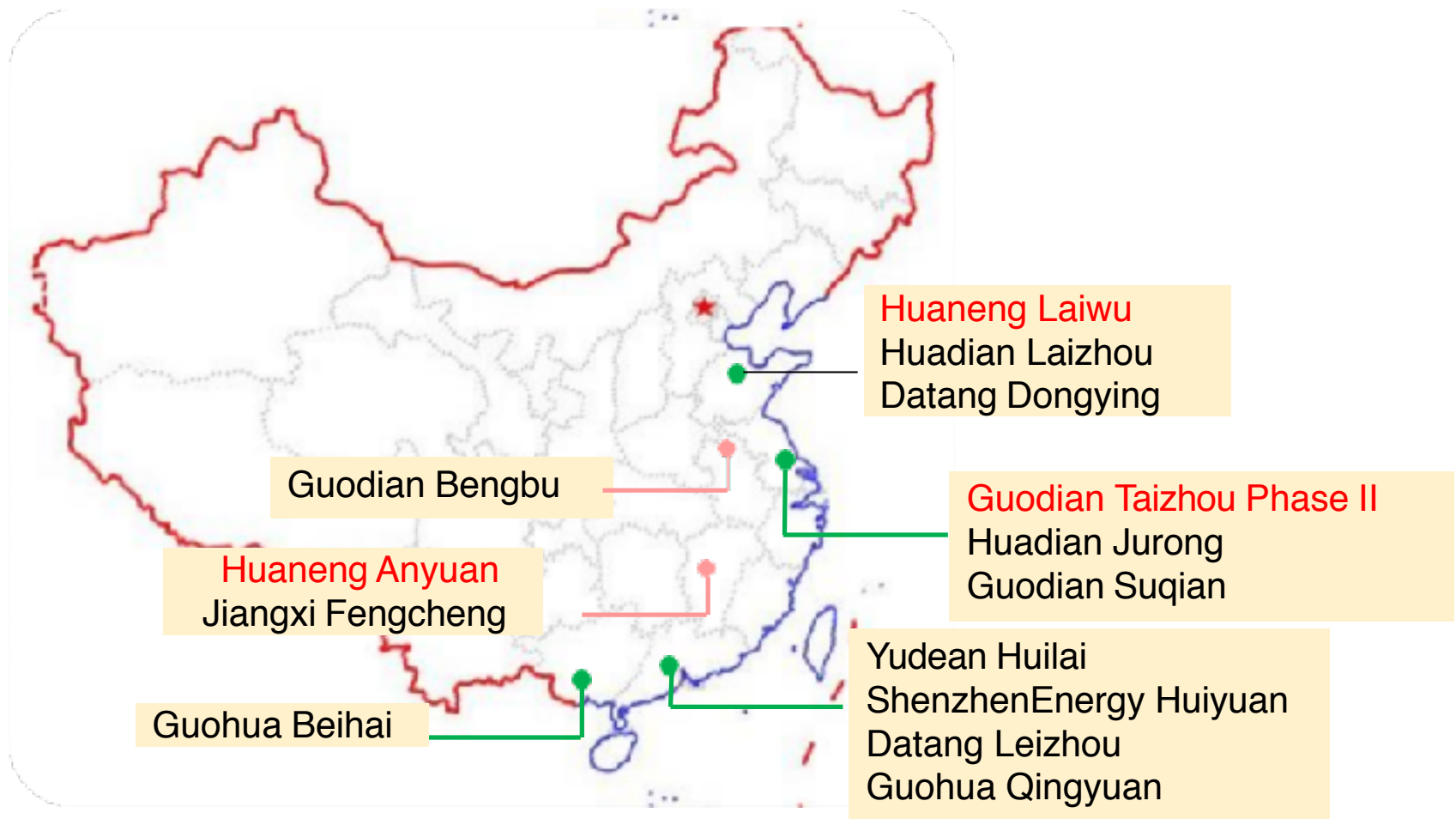
- China promises to cut its CO<sub>2</sub> emissions per unit of GDP by **60% to 65%** by 2030 from its 2005 level

In order to meet these commitments, China must reduce the share of coal-fired power units and reduce the intensity of CO<sub>2</sub> emissions from coal-fired power units.

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## DRH projects: operation / construction / planning



## Guodian Taizhou Phase II: 2×1000MW DRH units

- Guodian Taizhou Phase II:  
2×1000MW double reheat USC power  
plant Put into operation in Sep 2015  
and Jan 2016

31MPa/600°C/610°C/610°C 266 g/  
kWh



$\eta_{\text{net}} \approx 46.2$   
%

Boiler: Shanghai boiler  
plant Tower type furnace  
33.03MPa.g,  
605/623/623°C  $\eta \approx 94.5\%$

ST: Shanghai ST plant  
31MPa, 600°C/620°C/  
620°C Heat rate  $\approx 7072\text{kJ/}$



## Huaneng Laiwu: 2×1000MW DRH units

- Huaneng Laiwu:  
2×1000MW double reheat USC power plant Put into operation in Dec 2015 and Nov 2016

31MPa/600°C/620°C/620°C 266.18 g/kWh

Boiler: Harbin boiler plant

Tower type furnace

32.87MPa.a,

605/623/623°C  $\eta \approx 94.65\%$

ST: Shanghai ST plant

31MPa, 600°C/620°C/

620°C Heat rate  $\approx 7051$ kJ/

kWh

$\eta_{\text{net}} \approx 46.2\%$





## Huaneng Anyuan: 2x660MW DRH units

- Huaneng Anyuan:  
2x660MW double reheat USC power plant Put into operation in Jun 2015 and Aug 2015

31MPa/600°C/620°C/620°C 273 g/kWh



$\eta_{\text{net}} \approx 45.1\%$

Boiler: Harbin boiler plant  
Π type furnace

32.45MPa.a,

605/623/623°C  $\eta < 93.8\%$

ST: Dongfang ST plant

31MPa, /600°C/620°C/

620°C Heat rate  $\approx 7187\text{kJ/}$

kWh





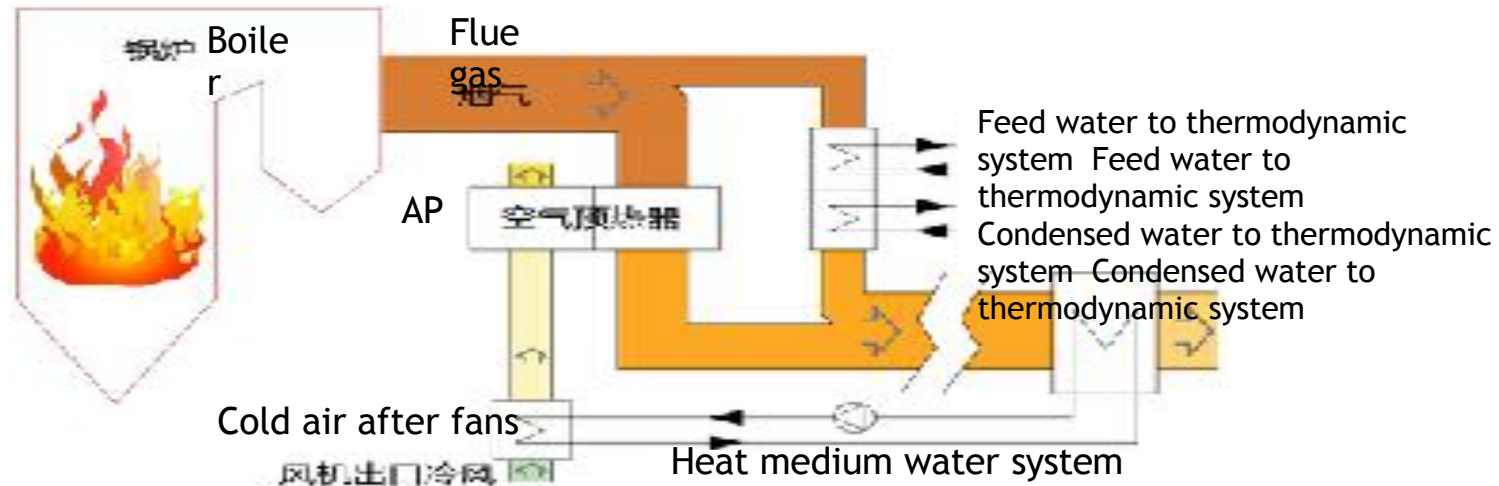
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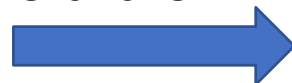
3. Prospect of DRH technology

## 1. Deeply coupling ST & boiler technology



- Power plant in Penglai of ZTE Electric Power Limited : 2×1000MW, double reheat, USC.

- Parameters : 31MPa/600°C/620°C/620°C



260 g/kWh

- By reducing the difference in temperature in heat exchangers, applying flue gas-water heater、 steam-air pre heater and low temperature ECO, the net efficiency can be increased to as high as 47.2%.

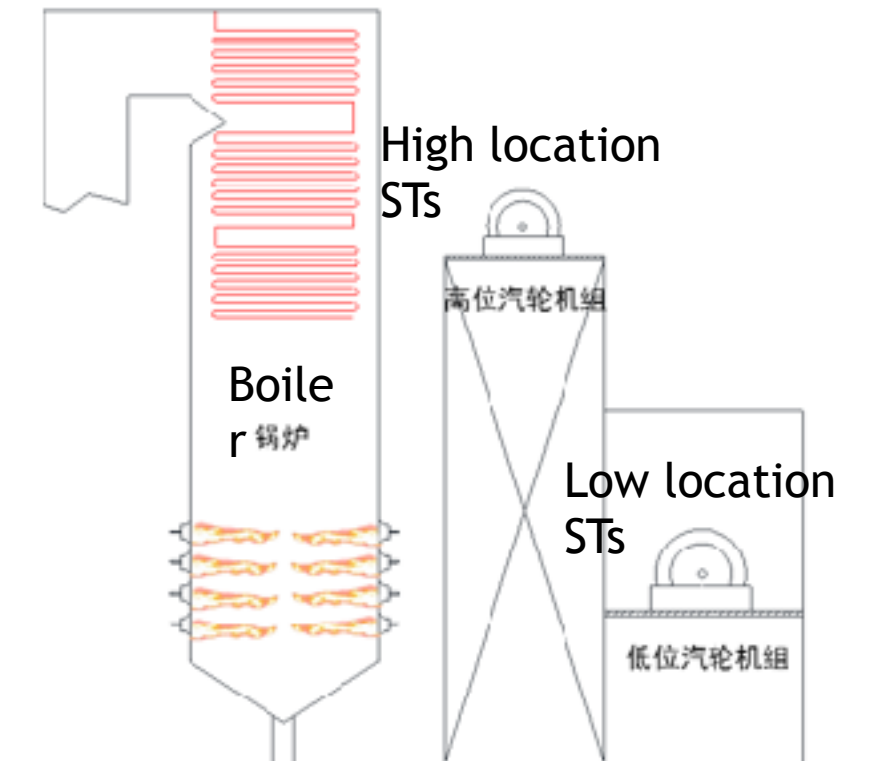
## 2. High-low location two axis STs arrangement technology

- Shenneng Pingshan Phase II:  
1×1350MW double reheat USC  
power plant.

- Parameters : 33MPa/  
600°C/620°C/630°C

➔ 246.7 g/kWh

- By reducing the length of steam pipe and applying a lot of other energy-saving technologies, the net efficiency can be increased to as high as 49.8%

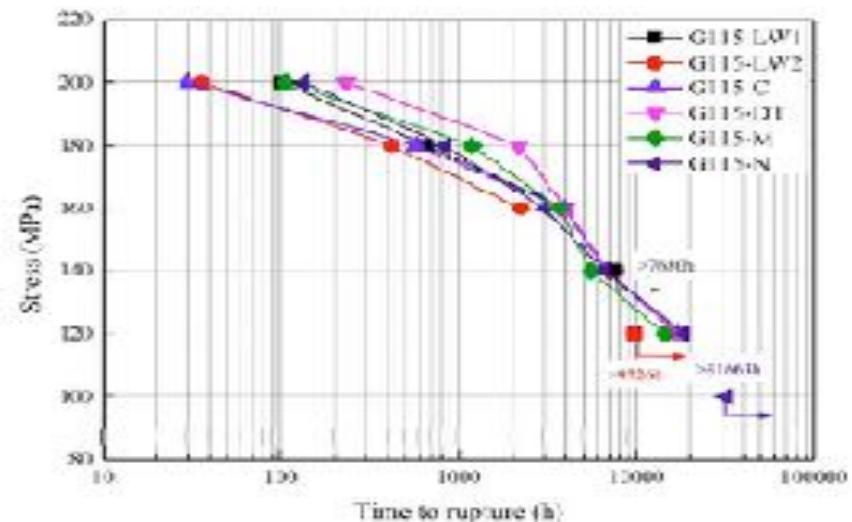


## 3. 630 °C USC coal-fired power generation technology

- Datang Yuncheng: 2×1000MW double reheat USC power plant.
- Steam turbine inlet main steam parameters: 35MPa / 615 °C / 630 °C / 630 °C 。
- Gross power generation efficiency can be increased to 50% or more, power generation standard coal consumption rate can be reduced to 246 g / kWh or less.



G115



lasting test data @ 650 °C

650°C持久试验数据



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Thanks for your attention!

谢谢！