The Outlook of Chinese Coal-fired Electricity Generation Technologies to 2020

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1. Policy of Chinese Coal-fired Generation
2. Higher Efficiency Technology
3. Energy-saving Technology for Retrofit
4. CO₂ Reduction Technology
5. Water-saving Technology
6. Environmental Protection Technology
1 Policy of Chinese Coal-fired Generation

- Coal-fired generators will have its seat in the next 30 years in China, due to the Chinese energy resource.
- To develop High Efficiency Low Emission (HELE) technology is the key research field for coal-fire unit.
- Less coal-consumption of electricity power
- Less CO₂ emission
1 Policy of Chinese Coal-fired Generation

It is required by the government that the average coal consumption rate (net) shall be no less than 300g/kWh (41%) for new-built unit, and no less than 310g/kWh (39.7%) for as-built unit.
1 Policy of Chinese Coal-fired Generation

Electricity infrastructure blueprint in the Chinese 13th 5-year plan

![Power Generation Diagram]

- **Coal-fired Power**
  - 2016: 943 GW
  - 2020: 1100 GW
  - Increment: 157 GW
  - Und. Construction: 210 GW

- **Wind Power**
  - 2016: 149 GW
  - 2020: 61 GW
  - Increment: 88 GW

- **Solar Power**
  - 2016: 77 GW
  - 2020: 33 GW
  - Increment: 44 GW

- **Nuclear Power**
  - 2016: 34 GW
  - 2020: 24 GW
  - Increment: 10 GW
  - Und. Construction: 30 GW
## 1 Policy of Chinese Coal-fired Generation

<table>
<thead>
<tr>
<th></th>
<th>Market Scale 2016-2020</th>
<th>Increment 2016-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Power</td>
<td>61GW</td>
<td>40%+</td>
</tr>
<tr>
<td>Solar Power</td>
<td>33GW</td>
<td>40%+</td>
</tr>
<tr>
<td>Nuclear Power</td>
<td>30GW, in-depth feasibility study on inland nuclear unit</td>
<td>50%+</td>
</tr>
<tr>
<td>Coal-fired Power</td>
<td>10GW, newly installed 420GW, ultra-low emission retrofit 340GW, efficiency upgrade retrofit</td>
<td>0.5~1%</td>
</tr>
<tr>
<td>Coal-fired unit flexibility retrofit</td>
<td>133GW, CHP unit 82GW, unit without large-scale area-heating</td>
<td>New field</td>
</tr>
</tbody>
</table>
1 Policy of Chinese Coal-fired Generation

Roadmap of coal-fire technology upgrade

- Higher Eff. New Unit
- Lower Emission
- CO$_2$ Reduction
- Water-saving
- Flexibility
- Energy-saving Retrofit
2 Higher Efficiency technology

(1) 600°C Class USC technology

Some pioneer projects are under construction

- Higher parameter (35MPa/610 °C/630 °C/630 °C)
- State-of-the-art double-reheat boiler and turbine
- Deliberated thermal system
- New Arrangement
- Efficiency up-to 48%

Fig. from Shanghai Electric Group Co. Ltd
2 Higher Efficiency technology

(2) 650°C class AUSC technology

- New material will be used for boiler and pipe, such as Sanictro25, SP2215, HR6W
- Nickle-based material will be used for welded turbine rotator
- Much Less cost v.s. 700 AUSC unit
- Efficiency up-to 48% of SRH unit
3 Energy-saving Technology for Retrofit

- Parameter upgrade for sub-SC unit
- Switch to CHP unit
- System and equipment improvement
- Flue gas heat recovery
- Streamline Duct
3 Energy-saving Technology for Retrofit

Case: Streamline duct

With CFD the duct can be designed as a streamline shape with aero foil type guide plate, which could considerably reduce the pressure loss.
### A 1000MW Unit Case

<table>
<thead>
<tr>
<th>System</th>
<th>Pressure Loss reduction</th>
<th>Power Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.A. System</td>
<td>1kPa</td>
<td>400kW</td>
</tr>
<tr>
<td>S.A. System</td>
<td>1.2kPa</td>
<td>700kW</td>
</tr>
<tr>
<td>Duct System</td>
<td>1.5kPa</td>
<td>1800kW</td>
</tr>
<tr>
<td>Total</td>
<td>3.73kPa</td>
<td>2900kW</td>
</tr>
</tbody>
</table>
4 CO$_2$ Reduction Technology

(1) Hybrid combustion with coal and biomass

- Biomass fuel is a kind of renewable resource, regarded as CO$_2$ neutralizing fuel.
- Biomass fuel is a kind of commercial fuel with low NOx and SOx emission.
- The potential biomass fuel is in equivalent heat about 4 billion tons standard coal in China.
4 CO$_2$ Reduction Technology

**Biomass Gasification Firing**

- **Biomass**: 350 GWh/a -15% biomass input
- **Hybrid firing Benson boiler**
- **Coal**: 1850 GWh/a -80%
4 CO$_2$ Reduction Technology

**FURNACE HYBRID-FIRING**

- Common biomass mill and common burner: 5% ~ 15% biomass fuel firing
- Individual biomass mill and common burner: 5% ~ 40% biomass fuel firing
- Individual biomass mill and individual burner: 5% ~ 40% biomass fuel firing
(2) Other CO₂ reduction aspects

- Higher unit efficiency
- USC + Area Heating
5 Water-saving Technology

- Air-cooling unit up to 1000MW USC unit
- Condensate water in flue gas recovery

Water consumption rate reaches less than 0.03 m³/s.GW
6 Environmental Protection Technology

Ultra-low emission for firing inferior coal boiler