Facilitating Development and Deployment of High-Efficiency Coal Technologies
- Addressing Climate Change -

Fumiyoshi MATSUOKA
Electric Power Development Co., Ltd. (J-POWER)

April 14, 2011
Clean coal technologies (CCTs) are key to addressing both climate change and energy issues.

Without coal, we cannot meet future energy demand; and without reducing CO$_2$ emissions from coal-fired power plants, we cannot solve the climate change issue.

Developed and developing countries should cooperate closely to promote aggressive R&D and worldwide deployment of CCTs.
J-POWER’s Thermal Efficiency Improvements

- Japan has continuously improved thermal efficiency (reduced CO₂ emissions) because of strict environmental regulations and fuel economics.

Steam Condition (primary/reheat steam temperature & pressure)

- Sub-Critical (Drum type)
- Super-Critical (SC)
- Ultra-Super-Critical (USC)

Improving energy efficiency through:
- Upgrading steam condition
- Scale-up

Transition of single unit capacity
Energy Efficiency in World’s Coal-Fired Power Plants

- Japan’s coal-fired power plants are world leaders in energy efficiency.
- Energy efficiency in China, USA and India, the world’s major CO₂ emitters, is relatively low.

Sources: Ecofys “International Comparison of Fossil Power Efficiency and CO2 Intensity 2009”
Many power plants in the world still do not address major pollutants (SOx & NOx)
SOx and NOx emission levels in Japan are much lower than other countries, almost equivalent to gas-fired levels.

SOx and NOx Emissions from Coal-Fired Power Generation

Source: Federation of Electric Power Companies, Japan (and actual data for Isogo)

J-POWER's Isogo Power Station
Replacement of Old Coal-Fired Power Plant with “USC”

**Isogo Coal-Fired Power Plant**
opened in 1967

**New Isogo Coal-Fired Power Plant**
Unit 1 opened in 2002, Unit 2 in 2009

17% CO₂ intensity improvement

<table>
<thead>
<tr>
<th>Capacity</th>
<th>530 MW (265 MW x 2)</th>
<th>1200 MW (600 MW x 2)</th>
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</thead>
<tbody>
<tr>
<td>SOₓ</td>
<td>60 ppm</td>
<td>10 ppm (20)</td>
</tr>
<tr>
<td>NOₓ</td>
<td>159 ppm</td>
<td>13 ppm (10)</td>
</tr>
<tr>
<td>PM</td>
<td>50 mg/m³</td>
<td>5 mg/m³ (10)</td>
</tr>
<tr>
<td>Steam</td>
<td>Subcritical</td>
<td>Ultra-Supercritical</td>
</tr>
<tr>
<td>Efficiency</td>
<td>38%</td>
<td>43%</td>
</tr>
<tr>
<td>CO₂ intensity</td>
<td>100 (base)</td>
<td>83</td>
</tr>
</tbody>
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Numbers in ( ) are for Unit #1.
Contribute to Worldwide CO₂ Emission Reduction through CCTs

- Japan could effectively contribute to rapid growth in infrastructure building and climate change mitigation in Asia through its CCTs and financial support.

Japan

Further development of CCTs ➔ Commercialization of CCTs

Support ➔ Investment return, CO₂ credits, etc.

Proven CCTs with preferred finance, technical transfer, joint venture, etc.

Coal saving and CO₂ emissions reduction ➔ Widespread deployment of latest CCTs

Deploy latest proven CCTs when building new plants and replacing old/low-efficiency power plants to achieve energy savings and CO₂ reductions.
### High Efficiency Technologies - Barriers and Required Actions

#### Barriers

- **Financial barriers**
- **Technical application barriers**
- **Political/regulatory barriers**
- **Business barriers** *(in some countries)*

#### Actions required

- **Financial support for increased costs of SC/USC**
- **Packaged technical support**
- **Suitable policy and regulatory structure**
- **Business environment to attract private investment**
Support for Capital Cost Increase

Total cost/benefit balance varies according to coal price, CO₂ cost, discount rate, plant specification, etc.

For USC deployment in developing countries, financial support is necessary to cover such capital cost increases.

- **Developed Country**
  - Preferred loan, export insurance, ODA, etc.

- **International Bank**
  - Set higher environmental criteria for finance and preferred finance programs for CCTs (e.g. IBRD, CTF)

- **Developing Country**
  - Preferred electricity tariff, longer power purchase period, tax incentives, other special support

- **Carbon Market**
  - Carbon credits (CDM, etc.)

- Fuel Cost: Around 10% savings
- BTG Equipment Cost: Increases 5-10%

Sub-Critical Plant
- Efficiency 38% (Gross, HHV)
- CO₂ down 12%

Latest USC Plant
- Efficiency up 5%
- Efficiency 43% (Gross, HHV)

Other plant costs are unchanged.
Effective Technical Transfer of O&M Know-How

- SC/USC requires sophisticated plant operation and maintenance.
- When deploying USC plants, developing countries require comprehensive technical support, not only for plant construction, but also for O&M.
- Reliable O&M contributes to stable supply of electricity.

**Thermal efficiency (%)**

- **A Power Station Unit #1 & Unit #2 in Japan**
- **Designed efficiency**
- **Efficiency degradation**

**Coal-fired plant in country X**

**Maintain designed thermal efficiency under suitable O/M management**

(Source: Federation of Electric Power Companies, Japan)
Promoting CCT development with a view to future zero-emissions plants.

After 2020, a series of innovative CCTs could be introduced in new plants, including replacement of existing old coal-fired power plants.

In the short term, USC and biomass fuel co-firing are the best options. In the 2020s, we expect that IGCC, IGFC and A-USC will become proven and commercially available. Widespread deployment of CCS may take longer.
How Can CCTs Help Reduce Worldwide CO₂ Emissions?

- R&D of a series of innovative CCTs including IGCC, A-USC, Oxy-fuel and CCS is undoubtedly an important step towards achieving a final zero-emissions target. Developed countries need to further accelerate such efforts with possible multilateral and/or bilateral cooperation.

- However, commercializing such innovative CCTs takes time, especially for developing countries.

- In parallel with such R&D efforts, we should facilitate widespread deployment of present state-of-the-art CCTs (especially USC) in all major coal-using countries.

We hope to help reduce worldwide CO₂ emissions through aggressive development and deployment of CCTs.