Promotion of Investment for Highly Efficient Coal Power Generation

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Resources Development

Research, Development and Demonstration

Exchanging Information

Planning and Coordination

International Activities

Business Promotion

- Exploration for coal resources
- Coal production and safety technology
- Technology for CO2 storage
- ECBM/GMM and resources development

- CCT/CCS with monitoring and development
- Coal and coal-bed methane utilization
- Technology for coal utilization
- Communication and cooperation for technical development

- Coal Information data bank creation
- Coal Information network development
- Policy proposal
- Public relations

- Project coordination and management
- Planning work

- Transfer of coal-mining technology to other countries
- Human resource development

- Coal-fired power station renovation project
- Low rank coal upgrading technology
- Low rank coal utilization technology
- Quality control for coal cleaning
CONTENTS

1. Coal and Electricity Demand
2. Clean Coal Technology
3. Expect for Future Coal Power Generation
4. Life Cycle Cost of USC
5. Conclusion
1. Coal and Electricity Demand


IEA World Energy Outlook 2014
2. Clean Coal Technology

Coal Preparation
- Washing

Clean Coal Technology
- Environmental Protection
  - Low NOx Combustion
  - Flue-gas Treatment
- Dust Removal
  - De-SOx
  - De-NOx

High Efficiency
- PF Combustion
  - SC, USC, A-USC

Global Warming
- CO$_2$ Capture
- Biomass Co-combustion

Gasification
- IGCC, IGFC

Ash utilization
- CCS
Installation of USC in the World

- First Ultra Super Critical Unit (USC) was installed in Japan in 1993. Since then, USC is increasing RAPIDLY and Super-Critical and Sub-Critical units are decreasing.
- 60% of recent installation is USC in the world. SC is less than 10% and Sub-Critical is small number.
  - Countries where USC were already operated:- Japan, Germany, Italy, Poland, Czech Republic, Netherland, Slovenia, USA, China, Korea, Taiwan, Malaysia,
  - Countries where USC is planned:- Greece, Indonesia, India, Philippines, Morocco, Vietnam

![Annual installed capacity of coal fired power generation in the world](image-url)
Efficiency of Coal Power Generation in Various Countries (HHV, gross heating value basis)

Hard Coal

Lignite

IEA Electricity Information 2015:
Calculated by JCOAL
World Highest Efficient Coal fired Power Station
---Isogo No.2 600MW  600/620C  USC (Japan)---

Efficiency :
Gross 44%
Net 41%
(HHV Basis)
Electricity Generation Mix of Japan

- July 2015, Japan’s New Energy Mix towards 2030 was decided.
- The basic policy of “Energy Mix” is to realize a balanced power source composition, while achieving 3E+S (Safety, Energy Security, Economic efficiency and Environment).
- Coal is positioned as the important energy source to be used while the environmental burden.

**Electricity generation mix**

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>2013</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>12%</td>
<td>3%</td>
</tr>
<tr>
<td>Coal</td>
<td>30%</td>
<td>26%</td>
</tr>
<tr>
<td>LNG</td>
<td>43%</td>
<td>27%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>11%</td>
<td>22-24%</td>
</tr>
<tr>
<td>Renewable</td>
<td>1%</td>
<td>7.9%</td>
</tr>
</tbody>
</table>

**Renewable Energy**

- Geothermal: 8.8-9.2%
- Bioenergy: 7.9%
- Wind: 1.7%
- Solar: 3.7-4.6%
- Hydro: 1.0-1.1%

METI Website
3. Expect for Future Coal Power Generation

Competing plants are:-
- Super critical unit (SC)
- Ultra supercritical unit (USC)
- Advanced ultra supercritical unit (A-USC)
- Integrated gasification combined cycle (IGCC)
- Natural gas combined cycle (NGCC)
Cumulative Installed Capacity of Plants when CCS is equipped

The graph shows the cumulative installed capacity of plants over time, categorized by different types of plants such as NGCC, SC, IGCC, and USC. The graph also indicates the timeline from 2005 to 2050, with projected capacities at various time points.
Breakdown of LCOE (Base case at 2030)

- Capital cost is biggest for coal fired power plants, but fuel cost is biggest for NGCC.
- LCOE of plants with CCS is higher than without CCS case (when carbon tax is not applied).
- LCOE of IGCC is lowest among all the plants when CCS is equipped, but highest without CCS.
Effect of coal and gas price change for the share of coal and gas

Change of Coal Ratio(%) at 2030 (without CCS)

Coal Price: Base

Coal Price: +1.0%/y

Change of Gas Price(%/y)

Coal Ratio(%)

Effect of coal and gas price change for the share of coal and gas
Share of plants when CCS is equipped (at 2030) when natural gas price is changed (Coal price is constant)

- Share is not changed when gas price goes down, but share is changed much for higher gas price.
4. Life Cycle Cost of USC

- **Total cost of USC is smaller when compared with Sub-Critical unit, when studied about the case in developing country.**
- **Conditions of estimation:**

<table>
<thead>
<tr>
<th></th>
<th>Net thermal efficiency</th>
<th>Load factor</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>USC</td>
<td>0.4</td>
<td>0.8</td>
<td>CRIEPI</td>
</tr>
<tr>
<td>Sub-Critical</td>
<td>0.26</td>
<td>0.73</td>
<td>ECOFYS 2013</td>
</tr>
</tbody>
</table>

Comparison of Cost

- Total cost of USC is smaller when compared with Sub-Critical unit, when studied about the case in developing country.
- Conditions of estimation:

CCT Workshop 2015
5. Conclusion

- Coal is the essential fuel in many countries.
- However, coal should be used by installing Clean Coal Technologies.
- High efficient USC (or HELE) will play a major role for coal power generation.
- Life cycle cost of USC is smaller than Sub-critical units. USC is already commercially used widely in the world.
- Investment for USC should be considered for the next project.
- Japanese government will contribute by USC technology for reducing global warming gas in the world.