Japan’s Coal Policy and International Contribution

Toshihiko FUJII
Director-General
Oil, Natural Gas and Mineral Resources
Agency for Natural Resources and Energy
Ministry of Economy, Trade and Industry
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1. **Principles of Japan’s Coal Policy in the future**

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In July 2015, Japan’s New Energy Mix (Long-term Prospect of Supply and Demand of Energy) 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 reducing the environmental burden.

Electricity generation mix:

- Renewable Energy: 11% (2013: 11%, 2030: 22~24%)
- LNG: 43% (2013: 43%, 2030: 27%)
- Nuclear: 1% (2013: 1%, 2030: 22~20%)
- Coal: 30% (2013: 30%, 2030: 26%)
- Oil: 12% (2013: 12%, 2030: 3%)
- Geothermal: 1.0~1.1%
- Bioenergy: 3.7~4.6%
- Solar: 7.9%
- Wind: 1.7%

(Total Electricity generation) 1,065TWh

Self-Sufficiency Rate: About 25%

Electricity cost: Lower the cost from the current level

Greenhouse Gas Emissions: Reduction target at the same level as in Europe and the US
Ensuring Coal Economically and Stably

- In order to ensure stable supply of coal, it is necessary to diversify supply sources to some extent and promote the use of low-grade coal in the future.

### Steam coal imports in 2014

- **Australia**: 62.0%
- **Indonesia**: 27.2%
- **Russia**: 7.4%
- **USA**: 1.6%
- **Others**: 0.7%

**Import steam coal**
- **Total**: 129.9 mil ton

### Coking coal imports in 2014

- **Australia**: 69.9%
- **Canada**: 14%
- **USA**: 7.5%
- **Russia**: 6.4%
- **Others**: 0.9%

**Import coking coal**
- **Total**: 53.36 mil ton

### Japan’s coal supply sources and evaluations

- **Russia**
  - Large coal reserves and short-distance source
  - Long-inland transportation

- **Indonesia**
  - Large coal reserves, but mainly low calorific coal

- **Mozambique (coking coal)**
  - Japanese companies acquired mining concessions and are aiming at earlier development.

- **Canada**
  - Increase of suspension of operation at high-cost coal mines
  - Weak price competitiveness

- **USA (East coast)**
  - Increase of suspension of operation at high-cost coal mines
  - Weak price competitiveness

- **USA (West coast)**
  - Lack of exporting ports

- **Australia**
  - Large coal reserves and the largest coal supplier to Japan
  - High-quality coal, stable source of coal for Japan
  - Increase of suspension of operation at high-cost coal mines

- **Colombia**
  - Weak price competitiveness
  - Lack of ports for large vessels

Source: Ministry of Finance trade statistics 2014

Source: METI
Principles of Japan’s Coal Policy in the Future

- Ensuring coal supply economically and stably
- Aiming at averaged power generation efficiency of total domestic coal-fired power plants equivalent to “USC level” by 2030, leading to CO2 emission reduction by efficiency improvement
- Establishing and introducing the next-generation coal-fired power technologies, such as A-USC and IGCC within 10 years

### Principles on Improvement of Efficiency of Coal-Fired Power Generation

- **USC**
  - Installed capacity: 15.3 GW
  - CO2 emissions: 900 g-CO2/kWh
  - About 50% increase in capacity factor

- **SC**
  - Installed capacity: 12.5 GW
  - CO2 emissions: 800 g-CO2/kWh
  - About 50% increase in capacity factor

- **Sub-C**
  - Installed capacity: 4.35 GW
  - CO2 emissions: 709 g-CO2/kWh
  - Increase in capacity factor equivalent to USC level

### Comparison of CO2 emissions among coal-fired power technologies (case of 1,000MW plant)

- **Sub-C**: Approximately 5.5 million tons/year
- **USC**: Approximately 5 million tons/year
- **A-USC/IGCC**: Approximately 4.4 million tons/year
- **IGFC**: Approximately 3.6 million tons/year

Note: The total of general and wholesale electricity utilities, excluding wholesale supply. The installed capacities are as of March 2015.
Aiming at establishing IGFC technology, ultimate high-efficiency coal-fired power technology, by 2025

Power generation efficiency

- **Integrated coal Gasification Combined Cycle (IGCC)**
  - Coal-fired thermal power generated through coal gasification, utilizing the combined cycle combining gas turbine and steam turbine
  - Power generation efficiency: Approximately 46 to 50%
  - CO2 emissions: Approximately 650 g/kWh (1700 deg. C class)
  - Technological establishment: Around 2020

- **Advanced Ultra Super Critical (A-USC)**
  - Pulverized coal thermal power utilizing high temperature and pressure steam turbine
  - Power generation efficiency: Approximately 46%
  - CO2 emissions: Approximately 820 g/kWh
  - Technological establishment: Around 2016

- **Integrated Coal Gasification Fuel Cell Combined Cycle (IGFC)**
  - Coal-fired thermal power utilizing the triple combined cycle combining IGCC with fuel cell
  - Power generation efficiency: Approximately 55%
  - CO2 emissions: Approximately 590 g/kWh
  - Technological establishment: Around 2025

Technology for capturing, storing and effectively utilizing CO2 emitted from thermal power plants (CCUS) can be a key to achieving "zero CO2 emissions" from power plants.

Technology development/demonstration and geological study are now promoted to reduce costs and secure storage-sites.

**CO2 Capture (Carbon dioxide Capture)**

- By placing CO2 separation/capture systems in thermal power plants, more than 90% of CO2 can be captured.

**CO2 Storage (CCS: Carbon dioxide Capture and Storage)**

- Technology for storing captured CO2 in the ground.
- Although large amounts of CO2 can possibly be stored, operating capability and storage capacity are the issues.
- The research and development as well as verification test are in the process toward the realization of CCS technology around 2020.

**CO2 Utilization (CCU: Carbon dioxide Capture and Utilization)**

- Technology for producing valuable materials such as alternative fuels or chemical materials from utilizing captured CO2.
- Development of more efficient technologies and expansion of application areas for utilizing a large amount of CO2 are the issues.
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Global Coal-Utilization Forecast and Japan’s Contributions

- Demand for coal-fired power generation will continue to increase in terms of energy security and energy access, especially in Asia.

- Promoting high efficient coal-fired power generation is critical to addressing the climate change.

- Disseminating Japanese Clean Coal Technology could contribute to the clean use of coal for meeting the growing energy demand in consistency with the reduction of the global environmental burden.

**Projection of power generation**

**CO₂ emission reduction achieved by introducing USC plants**

(Asian non-OECD countries)

Source: Created by the Ministry of Economy, Trade and Industry on the basis World Energy Outlook 2013, IEA

*Hypothesis: Facilities reconstructed within 40 years, 25% of plants existing in 2011 reconstructed every 10 years. New and reconstructed plants employ Ultra-Supercritical technology.
Operation & Maintenance Technology with the World’s Highest Level

- Operation & Maintenance technology is the key to maintaining high efficiency of coal-fired power plants.
- Capacity building and other technological cooperation are promoted.
- Using the “IOT” for remote operation from Japan could be a future issue.

Thermal efficiency change over time at coal-fired power plants

The keys to maintaining efficiency of coal-fired power plants

- Constant monitoring
- Periodic inspections / Overhaul inspections
- Fuel management
- Operator licensing system
- Education and training of O&M staff

Source: The Federation of Electric Power Companies
Promotion of the Utilization of Low-Grade Coal

- Utilizing low-grade coal is one of important measures in improving energy access.
- Low-grade coal can be used effectively with Japanese power generation technologies such as IGCC.
- Demonstration project of producing SNG or chemical products from lignite is being implemented.

**IGCC demonstration project**

- Nakoso IGCC demonstration project (1999–2009)
  - World’s first demonstration of air-blown IGCC in Fukushima.
  - After the completion of the demonstration, the IGCC plant was transferred and is now operated as a commercial plant since April 2013.

- Ofukushima IGCC project
  - 500MW-scale IGCC demonstration in Fukushima is planned.
  - Construction completion and operation start scheduled for 2020.

- Deploying overseas
  - FS aimed at introducing IGCC in Thailand and Chile

**Low-grade coal utilization technology demonstration**

- Demonstration to gasify low-grade coal
  - Long-period operational demonstration of a gasification furnace in Indonesia (50t/day experimental furnace)
  - Technological demonstration aimed at practical use by Indonesian national fertilizer company

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**Gasification furnace**

- **Construction of 500MW scale IGCC**
- **Hirono thermal power plants**
- **Nakoso thermal power plants**

- **Low-grade coal** (lignite)
  - **Biomass**
  - **Waste material**

- **Reforming**
  - **Shift reaction**

- **Product**
  - GT, GE **Fuel**
  - **Direct-reduced iron (DRI)**
  - **Ammonia** (fertilizer ingredient)
  - **Synthetic methane gas**

- **Direct coal liquefaction ingredient**

- **Fuel for transportation**
  - Chemical material
  - **(Catalysis)**

- **Gas**

- **Liquid**

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Japan’s Contribution to Sustainable Coal Use in the World

- Role of high efficiency coal-fired power technology in enhancing energy security
  - Support to the replacement of old and low efficiency coal-fired power plants in Ukraine

- Strong needs for expanding electricity infrastructure in developing countries
  - “High Quality Infrastructure Partnership”, “Enevolution Initiative”

- Maintaining the international circumstances for continuing utilization of coal-fired power generation.
  - Discussion in OECD about the rules for public financial support to coal-fired power generation
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Summary

1. Japan will establish the next-generation clean coal technologies as the top-runner in this field in order to realize clean coal use compatible with the reduction of the environmental burden.

2. Japan will contribute to reducing the global environmental burden from coal utilization through the dissemination of clean coal technologies in the world.

3. Japan will make utmost efforts to maintain the international circumstances for continuing utilization of coal, while contributing to the reduction of the global greenhouse gas emissions.
Thank you for your attention.