

JICA-Knowledge Forum

Energy Crisis and Carbon Neutrality

June 21st, 2023

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'S+3E'

- * The Japanese Government emphasized the significance of securing “S Plus 3E” in the determination of these mixes. “S Plus 3E” stands for Safety, Economic Efficiency, Environment and Energy Security.
- * “S plus 3E” are the basic principles of Japan’s energy policy.

G7 Dependence on Russian Energy

(% for FY2020)

| Country | Petroleum | Natural gas | Coal | Energy self-sufficiency rate |
|---------|-----------|-------------|------|------------------------------|
| Japan | 4 | 9 | 11 | 11 |
| U.S. | 1 | 0 | 0 | 106 |
| Canada | 0 | 0 | 0 | 179 |
| UK | 11 | 5 | 36 | 75 |
| France | 0 | 27 | 29 | 55 |
| Germany | 34 | 43 | 48 | 35 |
| Italy | 11 | 31 | 56 | 25 |

The Ukraine Crisis and Japan's Energy

■ Japan's Dependence on Russia (2021)

Coal 11%, petroleum 4%, natural gas 9%

■ Coal: Relatively easy to secure alternative suppliers despite soaring coal prices

*Coal-fired power will be utilized for the time being: Five ultra-supercritical (USC) boilers to start operation by 2024

*Need to show a roadmap for ammonia conversion in the long term

*Significant impact on the cement industry due to small-scale procurement

■ Petroleum: Middle East is the main alternative due to soaring oil prices.

*The OPEC Plus framework includes Russia.

*Sakhalin 1: Minister of Economy, Trade and Industry, ITOCHU Corporation, JAPEX, and INPEX Corporation

■ Natural gas: Difficult to deal with because it changes the nature of contracts ←

*Hiroshima Gas (50% dependence), Toho Gas (20% dependence), Saibu Gas (Arctic Ocean)

*Changing long-term contracts to spot contracts significantly increases import costs

*Sakhalin 2: Mitsui & Co., Mitsubishi Corporation

*Arctic Ocean and Kamchatka: Mitsui & Co., JOGMEC

Renewable Energy

■ The most important lesson from the Ukraine Crisis is to increase energy self-sufficiency.

*The key is to promote renewable energy, the ultimate domestically sourced energy.”

*It would be a fallacy to say the Ukraine crisis will reverse decarbonization.

*However, it will take time because self-sufficiency involves the construction of new facilities.

The lead time for offshore wind, which has the most potential for growth, is eight years.

■ Focusing on future cost reductions

*Government target: “commercial solar power at 7 yen/kWh by FY2025, onshore wind power at 8-9 yen/kWh by FY2030, and offshore wind power at 8 to 9 yen/kWh by FY2030 to FY2035.

*The lower limits of the costs of new construction and power generation set forth by the Cost Verification WG in July 2021 are, at least: 8 yen for solar power, 9 yen for onshore wind power, and 26 yen for offshore wind power.

* Problematic offshore wind power was compounded by the Mitsubishi Corp. crisis in December 2021.

The bids of all three locations were won in the 11 to 16 yen/kWh range

*The emergence of a game changer and the ensuing backlash

Nuclear Power Plants

- Has the Kishida Administration **shifted its policy** on nuclear energy?
: It's too **early to tell**.

- The test depends on whether the policy to **avoid replacement and new construction** will be reversed.

- *As much as there is optimism among proponents, there is also great potential for being left at the altar.
 - *Structural problems that cannot be changed even with "three years of stability" after the Upper House elections.

- The LDP-Komeito coalition framework — a vote reducing structure whether pro or con...

- **Lack of quick action:**

- Restarting will not happen in time for the power supply crisis in 2023.**

- *In addition to Kashiwazaki-Kariwa #6 and #7 and Tokai No. 2, also includes Onagawa #2, Takahama #1 and #2, and Shimane #2.

- *Next summer: No concrete measures for Kashiwazaki-Kariwa #6 and #7, and Tokai No. 2.

- **While the development of new nuclear power reactors has its merits, it is still a pie in the sky.**

- *Small module reactors: Locating new sites is difficult + declining economies of scale make it less meaningful.

- *High-temperature gas furnaces: Heat utilization may pave the way for domestic production of green hydrogen.

- *Sodium-cooled fast reactors: Could lead to nuclide conversion that would solve back-end problems.

Current Status of Nuclear Power Plant Reactors

*As of March 11, 2011: 54 existing units + 3 under construction = 57 units

*Current state

10 units in operation: Mihama #3, Ooi #3 and #4, Takahama #3 and #4, Ikata #3, Genkai #3 and #4, Sendai #1 and #2

7 units authorized but not in operation: Onagawa #2, Tokai No. 2, Kashiwazaki Kariwa #6 and #7, Takahama #1 and #2, Shimane #2

10 units pending application for permission: Tomari #1, #2, and #3, Oma and Higashidori (Tohoku), Hamaoka #3 and #4, Shiga #2, Tsuruga #2, Shimane #3

9 units not yet applied for: Onagawa #3, Higashidori (Tokyo), Kashiwazaki Kariwa #1, #2, #3, #4, and #5, Hamaoka #5, Shiga #1

21 units to be decommissioned

[Total 57 units]

*Achieving "20 to 22% nuclear power by FY2030" is difficult.

*New risk of becoming a military target

Coal-fired Power Plants

■ Construction boom of Ultra-supercritical pressure (USC) reactors: Coal is key measure for mitigating power crisis

- JERA / Taketoyo 5 (Aichi Prefecture) / 1.07 M kW / Operation started in August 2022
- Chugoku Electric Power Company / Misumi 2 (Shimane Prefecture) / 1 M kW / Operation started in November 2022
- Kobe Steel / Kobe 4 (Hyogo Prefecture) / 0.65 M kW / Operation started in February 2023
- JERA / Yokosuka 1 (Kanagawa Prefecture) / 0.65 M kW / Operation to start in June 2023
- JERA / Yokosuka 2 (Kanagawa Prefecture) / 0.65 M kW / Operation to start in February 2024
- Note, the power crisis this summer and next winter is serious for areas served by Tokyo Electric and Tohoku Electric.

■ Meanwhile, deadline for discontinuing coal-fired power must be clarified.

- Isolation in the G7
- False accusations of using ammonia as an excuse to prolong the life of coal.
- Declaring the discontinuation of coal-fired power in FY2040 is not a problem.
Shift from coal boilers to gas turbines using ammonia co-firing rate of more than 60%.

Newly built USC reactors should be used for 15 years (2024 + 15 = 2039).

New Vision: Carbon Neutrality

■ October 26, 2020

1st Diet Speech by Prime Minister Suga “2050 Carbon Neutrality”

← October 13, 2020/ JERA “2050 Zero Emission” by ammonia and hydrogen

■ April 22, 2021

Prime Minister Suga announced at the “Leaders Summit on Climate”

“46% GHG Reduction by 2030 compared with 2013”

→NDC(Nationally Determined Contribution)

Upwardly revised at large extent from “26% GHG reduction by 2030 compared with 2013”

■ Power Mix 2050 [reference case] (December 21, 2020)

*Renewable energy: 50 ~ 60%

*Thermal power by Hydrogen & Ammonia: 10%

*Carbon free thermal power other than hydrogen and ammonia (with CCUS)

+ Nuclear power: 30 ~ 40%

⇒ Real figure/ nuclear power 10% (conversion to secondary power supply)

CCUS=Carbon dioxide Capture, Utilization and Storage

Pathway to Carbon Neutrality

■ Power: Zero Emission Power Supply

- *Renewable energy, Nuclear power
- *Carbon-free thermal power (hydrogen, ammonia, CCUS)

■ Non-power: Heat Utilization, etc.

- *Electrification
[Total power demand of 1.3 ~1.5 trillion kWh, Electrification rate of 38%]
- *Hydrogen (Hydrogen reduction steel making, Fuel cell vehicle)
- *Methanation (e-gas), Synthetic fuel (e-fuel)
- *Biomass

■ Carbon Removal: Offset the final CO₂ emissions

- *Planting
- *DACCS (Direct Air Capture + Carbon dioxide Capture and Storage)

GX (Green Transformation) Investments 1

- * 150 trillion yen investment in GX over the next 10 years
 - 20 trillion yen government subsidy through GX Bonds
 - + 130 trillion yen private investment
- * Breakdown of ¥150 trillion investment (METI) (1)
 - Automobile industry: approx. 34 trillion yen
 - Renewable energy: approx. 20 trillion yen
 - Housing and buildings: approx. 14 trillion yen
 - Digital investment for decarbonization: approx. 12 trillion yen
 - Next-generation networks (grid and coordination): approx. 11 trillion yen
 - Hydrogen and ammonia: approx. 7 trillion yen
 - Storage batteries: approx. 7 trillion yen

GX (Green Transformation) Investments 2

* Breakdown of ¥150 trillion investment (METI) (2)

Aircraft industry: approx. 5 trillion yen

CCS (Carbon dioxide Capture and Storage): approx. 4 trillion yen

Chemical industry: approx. 3 trillion yen

Zero-emission ships (maritime industry): approx. 3 trillion yen

Bio manufacturing: approx. 3 trillion yen

Carbon-recycling fuel (SAF, synthetic fuel, synthetic methane): approx. 3 trillion yen

Iron and steel industry: 3 trillion yen

Resource recycling industry: approx. 2 trillion yen

Cement industry: approx. 1 trillion yen

Paper and pulp industry: approx. 1 trillion yen

Next-generation innovative nuclear furnace: approx. 1 trillion yen

Power Generation Cost (2050)

■ RITE (Research Institute of Innovative Technology for the Earth) May 13, 2021

*Scenario / Power Mix: Renewable energy • nuclear power • hydrogen/ammonia • CCUS thermal power)
/ Total power generation / Power generation cost (marginal cost)

- (1) Reference case = Basic index / 54%, 10%, 13%, 23% / 1.35 trillion kWh / 24.9 yen/kWh
- (2) Renewable energy 100% / 100%, 0%, 0%, 0% / 1.05 trillion kWh / 53.4 yen/kWh
- (3) Renewable energy Cost Reduction / 63%, 10%, 2%, 25% / 1.5 trillion kWh / 22.4 yen/kWh
- (4) Utilization of Nuclear power / 53%, 20%, 4%, 23% / 1.35 trillion kWh / 24.1 yen/kWh
- (5) Hydrogen and Ammonia Cost Reduction
/ 47%, 10%, 23%, 20% / 1.35 trillion kWh / 23.5 yen/kWh
- (6) CCUS Increase / 44%, 10%, 10%, 35% / 1.35 trillion kWh / 22.7 yen/kWh
- (7) Car Sharing / 51%, 10%, 15%, 24% / 1.35 trillion kWh / 24.6 yen/kWh

■ In any scenarios,

***Power generation cost of 2050 significantly exceeds the current cost (13 yen/kWh).**

Cost Reduction is the Biggest Challenge

- **The realization of Carbon Neutrality raises the energy cost**
⇒ **Cost reduction is the biggest challenge**
- **Innovation as well as thorough Utilization of existing infrastructures are the keys**
 - * **Japanese unique pathway to Carbon Neutrality**
 - **Ammonia: Utilization of the existing coal-fired power plants**
 - * **Applicable to Asian countries and Emerging countries**
Big Key to Carbon Neutrality for Non-OECD countries
Based by Japanese leadership basis
- **The Utilization of Biomass is also important**
 - * **Focused on Sorghum and Black Pellets**

Thank you for your attention