Japan Long-term Energy Policy after Fukushima Accident

IESR Webinar "Post 11 years of Fukushima"

March 11, 2022

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Summary

- The Fukushima nuclear accidents completely changed the energy sector in Japan. Nuclear energy is no longer most reliable, least expensive, "main" power source in Japan.
- 2. Fukushima accident is not over. Technological challenges for decommissioning of Fukushima are unprecedented. Economic, social, and humanitarian impacts are also just enormous.
- **3. Long term energy policy is self-inconsistent**, stating "Japan will reduce its dependence on nuclear power as much as possible," but maintain it as an important option for carbon neutral policy. Role of nuclear power in carbon neutral policy could be limited.
- Lessons learned from the Fukushima accidents are: 1) Think unthinkable 2) Engineering risk assessment is not enough 3) Need for independent scientific advice/policy review organization 4) Public trust is essential.



Big shifts in energy structure and public opinion

• Nuclear Power:

- Operating: **54 units [48.9GWe]**(2011/3)→ **10 units [10.0GWe]** (2021/12)
- Share of nuclear power: **25.9%** (2010) \rightarrow **3.9%** (2020)
 - Coal (29%→31%). Natural Gas (28% →39%). Renewable (9% →20%)(2020)
 - <u>https://www.enecho.meti.go.jp/statistics/total_energy/pdf/gaiyou2020fyr.pdf</u>

• Public Opinion:

- "Nuclear power is necessary": **87.4%** (2010/9) → **24.9%** (2013/12)
- "Nuclear power should be maintained: 8.0% or expanded: 2.2% (2020/10)= 10.2%
- "Nuclear energy should be phased out: 48.0% or shutdown immediately:8.4% (2020/10)= 56.4%
- Source: Japan Atomic Energy Relations Organization (JAERO), "Public Opinion on Nuclear Power: 2020 edition", February 2021. <u>https://www.jaero.or.jp/data/01jigyou/pdf/tyousakenkyu2020/results_2020.pdf</u>



Status of Reactors Officially Operational in Japan vs. WNISR Assessment

in Units, as of year end 2005-2020 and mid-2021



Officially Operating

Sendai-1 & -2. Takahama-3 & -4, Ohi-3 & -4, Genkai-3 & -4. Mihama-3. 24 in LTO of which

Kashiwasaki-Kariwa 2-4



* To be decomissioned, but not officially closed yet

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Source: Mycle Schneider et.al., "World Nuclear Industry Status Report: 2021", September 2021, https://www.worldnuclearreport.org/-World-Nuclear-Industry-Status-Report-2021-.html Nagasaki University Research Center for Nuclear Weapons Abolition

Nuclear power is no longer the cheapest power source in Japan (2021)



Source: METI, Cost Verification Working Group Report, August 2021.

https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/mitoshi/cost_wg/2021/data/07_05.pdf

Fukushima accident is not over yet: Current Status of Unit 1-4 (METI, 2021)



<Dismantling of Unit 1/2 exhaust stack >



Local company joins as a prime contractor. [Completed in May 2020]

<Fuel debris retrieval>



Confirmed that the deposit likely to be the fuel debris was able to be gripped and moved.(Unit 2) [Feb. 2019]



Lifting the last fuel assembly (2021/2/26)

Completed fuel removal from the spent fuel pool of Unit3 and transfer to the common pool, by remote control. [Apr. 2019-Feb.2021]

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Source: Ministry of Economy and Trade and Industry (METI), "The Update of Fukushima Daiichi NPS", March 4, 2021. https://www.meti.go.jp/english/earthguake/nuclear/decommissioning/pdf/20210304 FPCJ METI.pdf Nagasaki University

Contaminated Water Management(1)

- i) "Contaminated water" contains a large amount of radioactive materials, and have been generated in buildings every day since the accident.
- ii) "Treated water" is water in which most of radionuclides are removed by purification.
 - However, "tritium" cannot be removed by purification, and remains in the treated water at the level higher than its regulatory standards for discharge.



* C-14 also cannot be removed by ALPS, but its concentration is far lower than its regulatory standard for discharge

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Source: METI, "ALPS treated water", March 2021. https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/202103 Treated Water en.pdf Nagasaki University Research Center for Nuclear Weapons Abolition

Contaminated Water Management(2) -What is the problem?

- "Treated Water" is not the same "tritium water" released by other nuclear facilities. It may contain other radioactive materials.
- There are other alternatives and subcommittee's evaluation is not sufficient.
- Lack of public trust and transparency in decision making process
 - 55% of public opposed to the release of tritium water (by Asahi Shimbun, 21/01/04)

- ✓ Regarding about 30 % of the treated water stored in tanks, <u>the concentration of</u> <u>radionuclides other than tritium meets the regulatory standards for discharge</u>.
- Regarding about 70 % of the water, <u>concentration of radionuclides exceeds the</u> <u>regulatory standards</u>. It will be **re-purified** to meet the regulatory standards with an exception of tritium.

* In early years, the ALPS treatment has been carried out by prioritizing the volume of water treatment to quickly reduce the radiation impact to outside the site. There were also cross filter permeate troubles and other troubles.

- <u>Re-purification test</u> shows that the <u>ALPS has ability to remove the radionuclides</u> <u>sufficiently</u>.
- ✓ In the case of releasing it to the environment, the treated water will be <u>sufficiently</u> <u>diluted also to meet the regulatory standard for tritium.</u>

Sum of the ratios of actual concentrations to regulatory standards for 62 nuclides* (as of November, 2020)



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Evacuation Zones (METI, 2021)

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Source: Ministry of Economy and Trade and Industry (METI), "The Update of Fukushima Daiichi NPS", March 4, 2021. <u>https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/20210304_FPCJ_METI.pdf</u>

Fukushima accident is not over yet (off-site challenges)

- 35,500 Evacuees (as of April 2021): The government intends to continue lifting restriction orders for affected municipalities. However, according to a recent survey, only 2.5 percent of the people returned to Okuma Town and 9.2 percent to Tomioka Town.
- Food Contamination: Only 127 out of 54,412 samples (0.23%) taken (11 months of FY2020) were found contaminated beyond legal limits. Food import restrictions remain in 14 countries.
- Decontamination: As of April 2021, around 76 percent of the total amount of 14 million m³ of contaminated soil had been shipped. The soil is to be processed through various stages of volume reduction before being retransported to a final repository.

Source: Mycle Schneider et.al., "World Nuclear Industry Status Report: 2021", September 2021, <u>Research Center for Nuclear Weapons Abolition</u> Nagasaki University Research Center for Nuclear Weapons Abolition

Total Cost of Fukushima accident: Difficult to estimate but is increasing



- Government. Cost Estimates rose from US\$₂₀₂₁74.3 billion in 2012 to US\$223.1 billion in 2021.
- JCER (Japan Center for Economic Research). Cost Estimates range from US\$322 billion to US\$719 billion depending on the scenario:
 - Decontamination estimated at US\$186 billion and compensation at US\$96 billion while decommissioning costs vary from US\$40 billion (if delayed to 2050, not including post-2050 costs) to US\$476 billion.
- The biggest difference between the government and JCER estimates comes from the fact that the official estimate does not include final disposal costs for radioactive waste generated by decommissioning and decontamination.

Source: Mycle Schneider et.al., "World Nuclear Industry Status Report: 2021", September 2021, https://www.worldnuclearreport.org/-World-Nuclear-Industry-Status-Report-2021-.html

Legal cases against nuclear power (or TEPCO)-nuclear power can be shutdown by legal action

- Government Responsibility: Divided outcome, all cases appealed
 - Sendai High-Court decision (Sept. 2020) and the Tokyo High-Court decision (Feb. 2021) acknowledged government responsibility.
 - A separate Tokyo High-Court decision (Feb. 2021) rejected the responsibility of the state.

TEPCO Cases

- Criminal Case: Tokyo District Court acquitted three TEPCO executives from criminal responsibility (Sep. 2019).
- Civil Liability Case: Underway.

Lawsuits Against Reactor Operation and Restarts

- April 2015: Hiroshima High Court, provisional injunction against Ikata-3.
- Dec. 2017: Hiroshima High Court, injunction against Ikata.
- Dec. 2020: Osaka District Court revokes license for modification of installation of Ohi-3 and -4.
- March 2021: Mito District Court, injunction against Tokai Daini, because of missing credible evacuation plan.

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Japan's energy policy is self-inconsistent

Strategic Energy Plan (2021)

- "Japan, which has experienced the accident at TEPCO's Fukushima Daiichi Nuclear Power Station, is giving the top priority to safety regarding nuclear power when realizing the 2030 energy mix and making its energy choices for 2050 and is reducing its dependency on nuclear power as much as possible as it aims to expand renewable energy. "(p.4)
- Regarding TEPCO's Fukushima Daiichi Nuclear Power Station accident, the government and nuclear operators must continue their efforts to make sure not to let such accident happen again, not forgetting even for a moment that their falling into the so-called "myth of safety" invited the disastrous situation, sincerely reflecting on that fact." (p.56)

• But...

- "Nuclear power is an important base-load power source as a low carbon and quasi-domestic energy source, contributing to the stability of the energy supply-demand structure in the long term." (p.23)
- "Plan is to increase share of nuclear power up to 20~22% by 2030 almost impossible goal.

https://www.enecho.meti.go.jp/en/category/others/basic_plan/5th/pdf/strategic_energy_plan.pdf



Carbon neutral and role of nuclear power

• GOJ wants to maintain nuclear power as a base-load electricity source and promote it as a "growth sector" in its "Green Growth Strategy towards 2050 Carbon Neutrality".

METI, "Green Growth Strategy towards 2050 Carbon Neutrality", December 25, 2020, <u>https://www.meti.go.jp/english/press/2020/1225_001.html</u>

 According to an independent think tank, energy efficiency (industrial structural change), renewable energy and carbon tax are most important (role of nuclear power is limited, or CCS can be a good alternative). Figure 3: The carbon tax is an important measure in the 80% reduction.



(Sources) See Figure 2. The estimation performed with the computable general equilibrium (CGE) model.

Source: Japan Center for Economic Research(JCER), "60% reduction in Greenhouse Gas driven by Digital transformation of Economy: 10,000 yen Carbon Tax for an 80% Reduction by 2050", May 7th, 2019. <u>https://www.jcer.or.jp/jcer_download_log.php?f=eyJwb3N0X2lkljo0NzEyMiw</u> iZmlsZV9wb3N0X2lkljo0NzEyNH0=&post_id=47122&file_post_id=47124

Lessons learned from the Fukushima accident

"Think Unthinkable"

• Wishful thinking (or denying possible failure) would lead to "unpreparedness"

Engineering risk assessment is not good enough

• Social, economic, political and ethical issues must be included.

Need for independent scientific advice/review organization

- "Science without policy is science, but policy without science is gamble" -David Grey, International Institute for Applied Systems Analysis(IIASA)
- Lack of independent policy review organization is main reason for "polarized debate" and loss of public trust.

• Public Trust is essential for any public policy implementation.

 Transparency, public participation, accountability of policy making are keys to public trust.



What is "nuclear power"?

Nuclear power is "a medicine which has strong side effect".

- Please don't take it if you don't need. If you need to take it, please make sure that you are ready to accept its side effect.
- -Keep yourself healthy so that you don't need to take it.

