

White Paper on Nuclear Energy 2021 published in 2022 (Summary)

Japan Atomic Energy Commission (JAEC)



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Summary

Special Report

**Nuclear Energy Use to achieve
Carbon Neutrality in 2050 and Economic Growth**

1. Policy Objectives

- (1) Carbon neutrality:** UNFCCC COP26 held in November 2021 built a consensus on maintaining the effort to achieve the 1.5°C target.
- (2) Medium- to long-term economic growth:** It is essential to take the response to global warming as an opportunity for growth and to create a “virtuous cycle of the economy and the environment.”
- (3) Stable energy supply:** The unprecedented supply shortage of natural gas caused by Russia's invasion of Ukraine has made energy security be a common global issue.

→ One option that could be taken to achieve these policy objectives is nuclear power.



A scene from COP26

2. Trends in major countries and regions

Many countries have declared carbon neutrality as one of their policy objectives, and they intend to use nuclear energy continuously in the future as a means of ensuring energy security, etc.

(1) Countries promoting nuclear energy

U.S.: Has declared to achieve carbon neutrality by 2050.

Will increase nuclear power generation from the 2030s to the 2040s, while making use of existing reactors.

France: Has established new legislation to achieve carbon neutrality by 2050.

In February 2022, President Macron announced that the nation would construct six new reactors and consider building eight more.

U.K.: Has established new legislation to achieve carbon neutrality by 2050.

Will increase the ratio of nuclear power in its energy mix to a maximum of 25% by 2050 (app. 14.5% as of 2020).

(2) Countries and region restricting nuclear energy

Germany: Has established new legislation to achieve carbon neutrality by 2045.

Plans a full phase-out of nuclear power by the end of 2022.
Plans to ensure energy supply by transactions of electricity with neighboring countries via international power grids, depending on the outputs of fluctuating renewable energy supply at home.

China: Has declared to achieve carbon neutrality by 2060.

According to the IEA's analysis, the ratio of nuclear power in total power generation needs to be increased to about 15% by 2060 (app. 5% in 2020).

Russia: Has declared to achieve carbon neutrality by 2060.

Has included nuclear power in the definition of “green projects,” to which preferential financing is to be granted.

Taiwan: Has declared to achieve carbon neutrality by 2050.

Plans to close all nuclear power plants by 2025.
With no transnational power grid in place, it introduced planned power outages, etc. in 2021 due to supply shortages.

3. Advantages and challenges of nuclear energy

(1) Advantages of nuclear energy

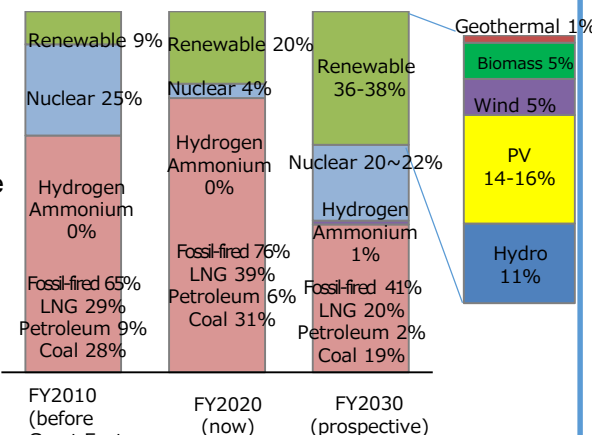
- ① No greenhouse gas emissions during the power generation process.
- ② Little fluctuation in the output due to weather conditions, etc.
- ③ Stable supply as a quasi-domestic energy source.
- ④ Low generation and integrated costs.
- ⑤ Carbon-free hydrogen production and prospects for heat utilization.

(2) Challenges associated with nuclear energy

- ① Rebuilding public trust.
- ② Solving fundamental issues culturally ingrained in the organizations concerned, such as the unique mindset to conform tacitly to the opinion of the majority and so on.
- ③ Enhancing safety and pursuing nuclear security
- ④ Addressing back-end issues such as decommissioning and radioactive waste disposal.
- ⑤ Sustaining and strengthening human resources, technology, and industrial infrastructure at higher levels for continued use of nuclear energy as an energy source .

4. Situation in Japan

- ① Carbon neutrality by 2050 has been declared.
- ② Nuclear power is expected to compose approx. 20-22% of the total generation mix in FY2030.
- ③ In March 2022, the government issued a power crunch warning in the service areas of Tokyo EPCO and Tohoku EPCO.



Toward the Use of Nuclear Energy in Light of Social Demands

- ① We need to understand that **the energy supply should not be taken for granted and that it is available through the efforts of various people.**
- ② **Each and every citizen needs to have a sense of ownership of and get involved in discussions on the future of energy in Japan** as it directly affects their daily lives.
- ③ We need to consider **the role of nuclear energy as one of the components in Japan's energy security.**

JAEC intends to actively disseminate information on the situation surrounding nuclear energy and its standing in order to facilitate deeper discussion on various options available based on a shared understanding.

Summary

Chapters 1 to 8

**Current status and efforts
related to the nuclear utilization in Japan**

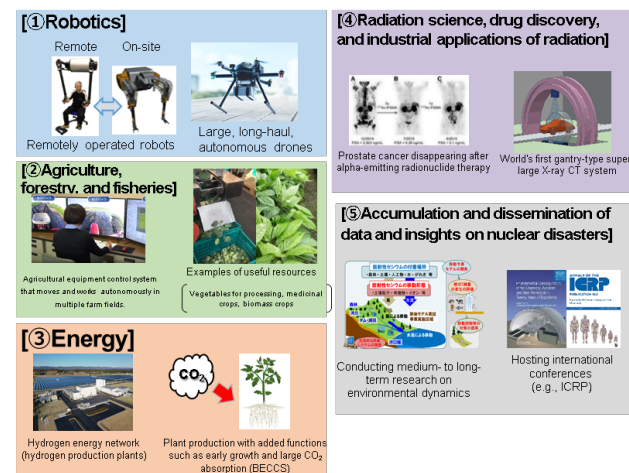
Chapter 1: Steady recovery and reconstruction of Fukushima, and constant safety improvement with lessons learned

1. Efforts toward the reconstruction and revitalization of Fukushima

- ① These include an August 2021 decision on the policy to lift evacuation orders in some Restricted Areas outside of Specified Restoration and Revitalization Bases, initiation of preparatory stays in the Specified Bases in November 2021, moves by other countries to remove or relax import restrictions, the use of foodstuffs and hydrogen produced in Fukushima in the Recovery Olympics, and a decision on the basic concept of the Fukushima International Research and Education Organization in March 2022.

2. Constant efforts to improve safety and countermeasures against nuclear disasters

- ① The Nuclear Regulation Authority (NRA) and the nuclear industry exchange opinions regarding the improvement of nuclear plant operations in view of the status of implementing the Nuclear Regulatory Inspection Program.
- ② In February 2022, the Integrated Nuclear Emergency Response Drill was conducted at the Onagawa Nuclear Power Plant (NPP).



Research projects carried out by Fukushima International Research and Education Organization

Chapter 2: Nuclear energy use addressing global warming issues and providing cost-effective electricity for the national economy

1. Positioning of nuclear energy use

- ① On the premise of ensuring safety, the use of nuclear energy is to be promoted by extending the operation period of existing reactors and taking other actions as a means to respond to global warming, to secure a stable energy supply, to ensure the economic-efficiency of the power supply, and serve other purposes.
- ② The Green Growth Strategy Through Achieving Carbon Neutrality in 2050 embodied in June 2021 provides goals and a processing schedule for small modular reactors (SMRs), high-temperature gas reactors, and nuclear fusion.
- ③ The "Sixth Basic Energy Plan" approved by the Cabinet in October 2021 positions nuclear energy, on the major premise of ensuring its safety, as an important low-carbon baseload power source that contributes to the stability of the energy supply-demand structure in the long term. The plan includes the prospects of nuclear power to compose approximately 20–22% of the total power generation mix by FY2030.

2. Status of nuclear power generation

- ① Mihama Nuclear Power Plant Unit 3 was restarted in July 2021, becoming the first to operate for more than 40 years in Japan.



Sixth Basic Energy Plan

Chapter 3: Efforts at home and abroad in the global context

1. Trends in international organizations and nuclear superpowers

- ① In February 2022, the IAEA launched the "Rays of Hope" project to support the establishment and expansion of the use of radiation in fighting cancer.
- ② In February 2022, French President Macron announced a policy to build six new nuclear reactors and consider building eight more.

2. Engagement in and collaboration with international organizations, and promotion of bilateral and multilateral collaboration

- ① At the IAEA General Conference held in September 2021, Shinji Inoue, then Minister of State for Science and Technology Policy, Cabinet Office, explained Japan's initiatives (including the basic policy on handling of ALPS-treated water) in the statement he made on behalf of the government.
- ② At the Forum for Nuclear Cooperation in Asia (FNCA) ministerial-level meeting held in December 2021, participants discussed the expansion of utilization of new reactors, accelerators, and associated technologies, and adopted a joint communiqué.



22nd FNCA ministerial-level meeting (Dec. 2021)

Chapter 4: Peaceful use of nuclear energy, nuclear non-proliferation, and nuclear security

1. Promoting the peaceful use of nuclear energy

- ① JAEC evaluates the plutonium utilization plans and the mid-term implementation plan for spent fuel reprocessing formulated by the operators and other stakeholders from the standpoint of peaceful use and plutonium balance.
- ② The total volume of separated plutonium held by Japan as of the end of 2021 is approximately 45.8 tons in aggregate both within and outside of Japan.

2. Ensuring nuclear security

- ① Japan carries out efforts to protect nuclear materials, foster a nuclear security culture, and strengthen nuclear security measures based on the Nuclear Reactor Regulation Act.
- ② The IAEA, G7, and other forums have expressed concern over the occupation of a nuclear power plant and other facilities in Ukraine by Russian forces since February 2022.

3. Maintaining and strengthening nuclear disarmament and non-proliferation frameworks

- ① As the only country to have experienced the use of atomic bombs in war, Japan has engaged actively in efforts toward nuclear disarmament and non-proliferation on the basis of the Nuclear Non-Proliferation Treaty, such as submission of a resolution on the elimination of nuclear weapons to the U.N. General Assembly.

| | | As of End of 2021 |
|------------------------|------------|-------------------|
| Total (Japan+Overseas) | | App. 45.8 t |
| Breakdown | Japan | App. 9.3 t |
| | (Subtotal) | App. 36.5 t |
| | U.K. | App. 21.8 t |
| | France | App. 14.8 t |

(Note) The total figures may not agree completely due to rounding.

Chapter 5: Rebuilding of public trust and confidence as a precondition in the use of nuclear energy

1. Efforts to enhance information sharing and communication by nuclear energy-related organizations

- ① Information provision initiatives have been taken, including hosting symposiums on energy policies, distributing timely articles on websites, and utilizing VR content.
- ② Dialogue-based interactive explanatory meetings across the country on the final disposal of high-level radioactive waste have been held. Dialogue sessions also have been held in Suttsu Town and Kamoenai Village, Hokkaido, in conjunction with the implementation of literature surveys since April 2021.
- ③ Meetings to exchange views took place from May to July 2021 with local governments, farmers, forester groups, fishers, tourist agencies, consumer groups, and other stakeholders who could be subjected to reputational damage from the discharge of ALPS-treated water into the ocean.

2. Coexistence with local communities

- ① The Conference for Co-creating the Future of Host Municipalities of Nuclear Power Plants in Fukui Prefecture was held three times in FY2021.



Fukushima Daiichi NPP Virtual Tour
presented by TEPCO



A scene from a dialogue session

Chapter 6: Decommissioning of nuclear stations and response to radioactive waste

1. Decommissioning of TEPCO's Fukushima Daiichi NPP

- ① The government announced a policy for discharging ALPS-treated water in April 2021, and an outline of immediate measures in August 2021.
- ② The trial fuel debris retrieval device (including a robotic arm), jointly developed with the U.K., arrived in Japan in July 2021. This was followed by performance testing, mock-up testing, operational training, etc.
- ③ In February 2022, the IAEA conducted a review on the safety of discharging ALPS-treated water.

2. Decommissioning of NPPs and nuclear-related R&D facilities, disposal of radioactive waste

- ① As of March 31, 2022, 18 commercial power reactors and 17 R&D facilities are under decommissioning.
- ② In October 2021, the Nuclear Regulation Authority (NRA) additionally established regulations on the burial and disposal of LLW.
- ③ In December 2021, the JAEC made a decision regarding its position on the processing and disposal of LLW.



Performance
testing of the
robotic arm, etc.

Chapter 7: Promoting the utilization of radiation and radioisotopes

1. Making use of radiation and radioisotopes (RI) in medical fields

- ① The "Follow-up on the Growth Strategy" decided by the Cabinet in June 2021 clearly states that the country will tackle RI production using test and research reactors, etc.
- ② JAEC kicked off an Expert Committee on the Production and Use of Radioisotopes for Medical Purposes in November 2021, and discussed matters necessary for formulating an action plan.
- ③ In June 2021, a Lutetium-177-based therapeutic RI drug received pharmaceutical approval from the Ministry of Health, Labour and Welfare.

2. Use of radiation in other fields

- ① Radiation is used in various sectors, such as industry and agriculture, as an essential technology underpinning society.
- ② In science and technology as well, radiation is used in a wide spectrum of fields including material science, space science, archaeology, environmental science, and life science. Since June 2021, radiation has been applied in particle analysis of samples of the asteroid Ryugu collected by the Hayabusa 2 mission.



Virtual tour of RI-producing JRR-3

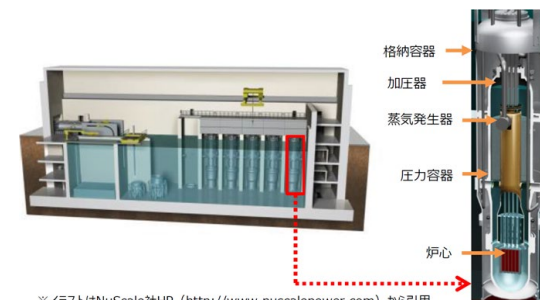
Chapter 8: Strengthening the foundation for using nuclear energy

1. Promoting research, development and innovation

- ① In February 2022, the Japan Atomic Energy Agency (JAEA) formulated the Fourth Medium- and Long-term Objectives (covering the period from April 2022 to March 2029).
- ② Japan has continuously been promoting R&D on greater safety of light water reactors, on innovative reactors such as high temperature gas reactors, fast reactors and small modular reactors, and on nuclear fusion at both national and international levels.
- ③ In January 2022, JAEA, Mitsubishi Heavy Industries, Ltd., and others signed a memorandum of understanding (MOU) with US-based TerraPower Corporation regarding the development of sodium-cooled fast reactors.

2. Strengthening foundational facilities, securing and fostering human resources

- ① In July 2021, the High Temperature Engineering Test Reactor (HTTR) was restarted.
- ② In 2021, the "Advanced Nuclear Education Consortium for the Future Society" (ANEC) was established under the International Nuclear Human Resource Development Initiative Program by the Ministry of Education, Culture, Sports, Science and Technology (MEXT).



※イラストはNuScale社HP (<http://www.nuscalepower.com>) から引用

Schematic diagram of an SMR

Useful Information

Commissioners of JAEC (as of Aug. 2022)



Dr. UESAKA, Mitsuru
Chairman



Mr. SANO, Toshio
Commissioner



Dr. OKADA, Yukiko
Commissioner

JAEC Website

<http://www.aec.go.jp/jicst/NC/eng/index.htm>



Decisions of JAEC

“White Paper on Nuclear Energy”

http://www.aec.go.jp/jicst/NC/about/hakusho/index_e.htm

“Basic Policy for Nuclear Energy” July 2017

http://www.aec.go.jp/jicst/NC/about/kettei/kettei170720_e.pdf

“Plutonium Utilization in Japan” October 2017

http://www.aec.go.jp/jicst/NC/about/kettei/kettei171003_e.pdf

“Basic Policy for Nuclear Research and Development (R&D)”
June 2018

http://www.aec.go.jp/jicst/NC/about/kettei/180612_e.pdf

