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Nuclear Policy Outlook and Challenges for 2023
—Can Ambitious Policy Objectives Be Realized?—

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Key Points of the Report

- ✓ In European, North American and other countries that pursue low-carbonization and energy security, new ambitious policies for the expansion of nuclear energy use have been announced.
- ✓ We would like to pay attention to how these policies would be materialized. Whether future projects would take advantage of lessons learned from recent nuclear plant construction will be questioned.

- ✓ In Japan as well, talks are growing on the effective use of nuclear energy. In particular, debates on how to revise the service life of nuclear reactors are going on.
- ✓ Advanced nuclear reactor development is given policy priority. We would like to pay attention to whether moves to construct new demonstration reactors would arise in the future.

New reactor construction trends in 2022

- In 2022, China launched commercial operation of two nuclear reactors. It also put into commercial operation the third reactor of the Karachi Nuclear Power Complex in Pakistan under an export project.
- The Republic of Korea launched commercial operation of one reactor in 2022, while proceeding with a nuclear plant export project for the United Arab Emirates.
- In Finland, Unit 3 of the Olkiluoto nuclear power station launched operation in December 2021 and achieved a grid connection in March 2022, but troubles have delayed its full-fledged operation.

Nuclear power generation capacity in commercial operation in 2022: 407 GW

+List of nuclear reactors put into operation in 2022

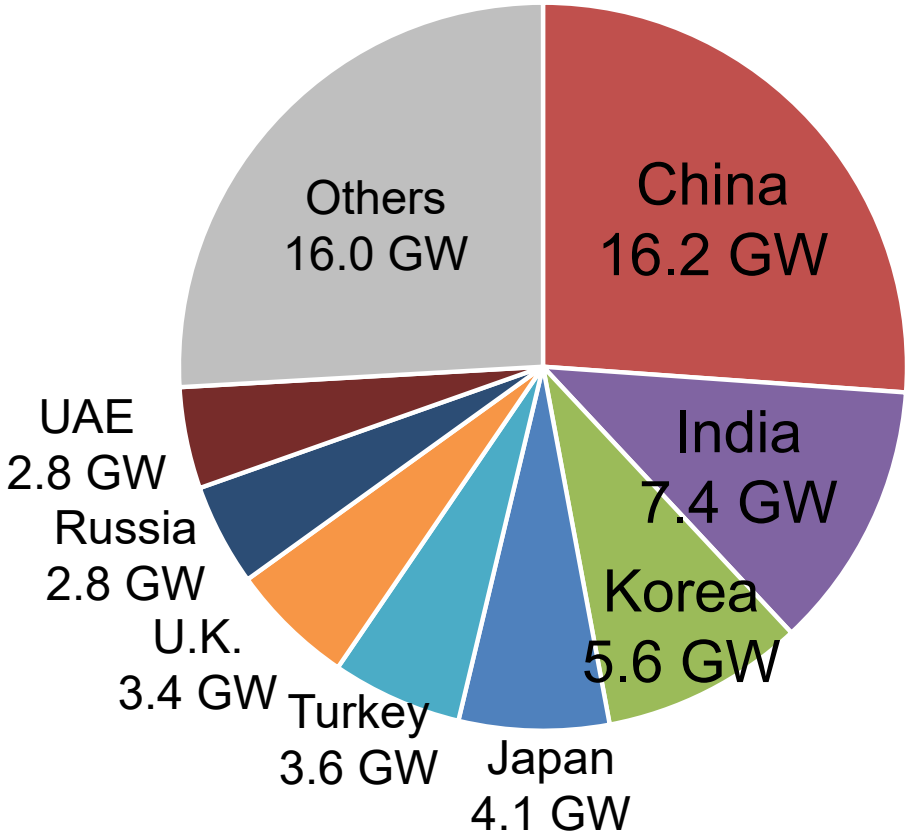
Month	Country	Nuclear reactor	Installed capacity	Status
March	Finland	Olkiluoto Unit 3	1.72 GW	Grid connection
	UAE	Barakah Unit 2	1.40 GW	Commercial operation
	China	Fuqing Unit 6	1.16 GW	Commercial operation
April	Pakistan	Karachi Unit 3	1.10 GW	Commercial operation
May	Korea	Shin Hanul Unit 1	1.40 GW	First criticality
June	China	Hongyanhe Unit 6	1.12 GW	Commercial operation
September	UAE	Barakah Unit 3	1.40 GW	First criticality

Sources: Tabulated from Japan Atomic Industrial Forum Inc. “2022 world nuclear power generation development trends,” etc.

New reactor construction trends from 2023

- China launched construction of four reactors in 2022.
- Egypt started construction of its first commercial nuclear power plant in El Dabaa.

Nuclear power generation capacity under construction launched by 2021



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Reactors under construction launched in 2022

Month	Country	Nuclear reactor
February	China	Tianwan Unit 8
June	China	Sanmen Unit 3
July	China	Haiyang Unit 3
July	Egypt New!	El Dabaa Unit 1
July	Turkey	Akkuyu Unit 4
September	China	Lufeng Unit 5 (Before Units 1-4)
November	Egypt	El Dabaa Unit 2

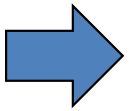
Sources: Tabulated from Japan Atomic Industrial Forum Inc. “2022 world nuclear power generation development trends,” etc.

Remarkable trends from 2023

- Remarkable developments have been seen in Europe and North America that give priority to nuclear energy from the viewpoints of global warming countermeasures and energy security.
- U.S.
  - Given the significance of nuclear power plants as stable low-carbon electricity sources, support was launched for existing reactors facing the danger of being closed.
  - New reactor development has been promoted. Outside the United States, such countries as Bulgaria, Romania and Poland are moving to introduce NuScale small modular reactors.
  - Poland and Ukraine adopted the Westinghouse AP1000 reactor.
- U.K.
  - The attitude of giving priority to nuclear energy has been maintained while old existing reactors have been being closed.
  - The energy security strategy (April 2022) set out the goal of developing up to 24 GW in nuclear power generation capacity by 2050 to boost nuclear energy's share of power generation to 25%.
  - The nuclear regulated asset base (RAB) model is planned for supporting new nuclear power plant construction projects.
    - The RAB provides some income even before the power generation stage to reduce uncertainties for business operators.
  - Efforts are focused on research and development of high-temperature gas-cooled reactors. Rolls-Royce is developing light-water small modular reactors.
- France
  - As some existing reactors have been shut down due to stress corrosion cracking, France plans to check all existing reactors by 2025.
  - Plans were announced to construct at least six (additionally, up to eight) large light-water reactors, based on an analysis of a future energy mix.
  - A plan was announced to fully nationalize French utility EDF to strongly promote energy security and decarbonization.
  - EDF and others are developing light-water small modular reactors.

Remarkable trends from 2023

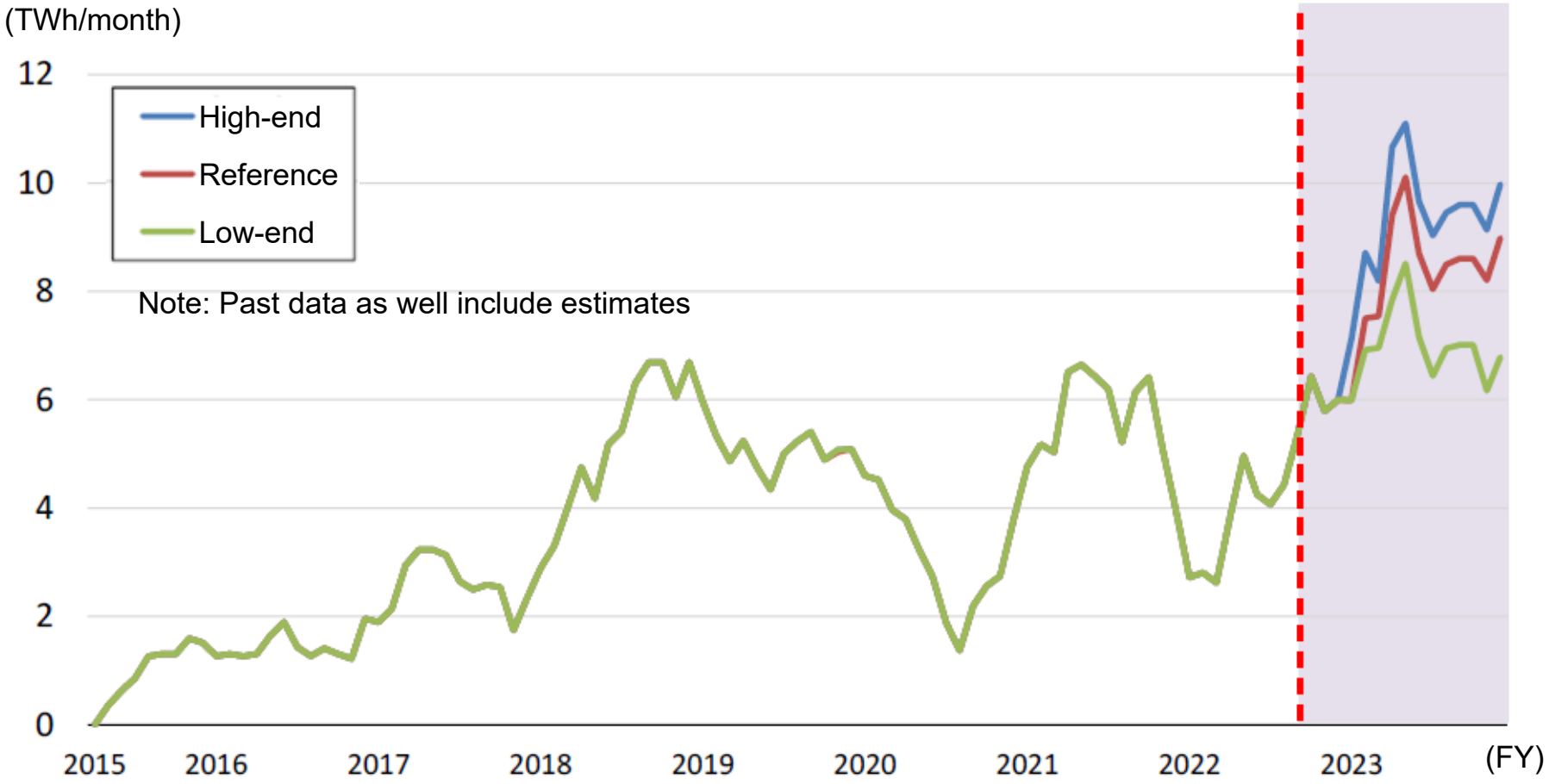
- Central and eastern European countries are moving to expand nuclear energy use or introduce nuclear energy.
- Poland
  - Poland has explored the introduction of nuclear energy to address global warming and air pollution.
  - It plans to construct a 1.0-1.6 GW nuclear reactor by 2033 and five more later, and it considers introducing high-temperature gas-cooled reactors.
- Czech Republic
  - In November 2022, the Czech Republic invited bids for expanding the Dukovany nuclear power station.
  - In 2021, it was announced that Chinese and Russian firms would be excluded from bidding.
- Estonia
  - Estonia gives priority to phasing out its dependence on Russian energy sources.
  - In September 2022, Estonia invited bids from three U.S. and U.K. small modular reactor manufacturers.



- France and the United Kingdom announced ambitious goals. We would like to pay attention to how these goals would be materialized in 2023.
- In the United States and France, new nuclear reactor construction projects have been delayed substantially, causing excessive costs. Whether future projects would take advantage of lessons learned from such delays will be questioned.
  - This issue is related to whether they could export nuclear power plants successfully.

Short-term outlook for Japan

- A reference scenario for FY2023 has been developed in line with published nuclear plant operation plans, prospects about the restart of reactors, and safety measures for restarted reactors.
  - High-end case: Counterterrorism facilities will be completed faster than planned for two reactors that are now suspended due to their incompletion. Safety screening will make more progress than in the reference scenario, allowing one more reactor to be restarted.
  - Low-end case: No new restart will be seen in FY2023 due to delays in safety screening and construction of counterterrorism facilities.



Ongoing talks in Japan

- In Japan, the Strategic Energy Plan has positioned nuclear energy as an important low-carbon electricity source.
- In response to the recent significance of greenhouse gas emission cuts and energy price spikes, talks toward nuclear energy use have become active.

➢ Prime Minister Kishida's speech in London (May 2022)

- Russia's aggression against Ukraine has made clear the importance of energy security. Climate change remains an urgent issue.
- In addition to renewable energy, we will utilise nuclear reactors with safety assurances to contribute to worldwide reduction of dependence on Russian energy.

➢ Clean energy strategy (interim report)

- Promoting long-term operation of nuclear reactors while securing safety, improving the nuclear capacity utilization rate through longer operation cycles.
- Accelerating government-private cooperation in innovative nuclear reactor research and development.

➢ Industry sector's voluntary, continuous efforts to improve safety (May 2022):

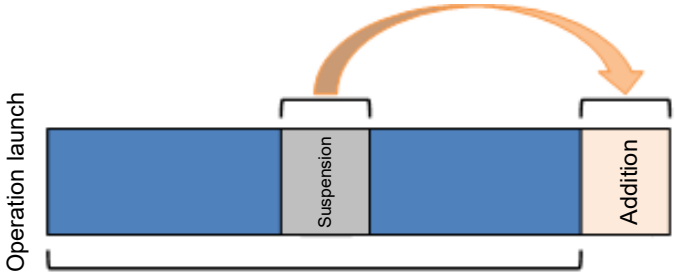
- The early resolution of technical problems with safety screening and the securement of human resources are challenges toward accelerating the restart of nuclear reactors.
- As it is important to quickly share information and horizontally cooperate on an industry-wide basis in order to solve the challenges, a restart acceleration task force and other panels are considering or implementing specific additional measures.

Ongoing talks in Japan: Service life

- Latest talks focus on the service life of existing nuclear reactors.
- Current rules:
  - 40 years from the operation launch date (principle)
  - The service life can be extended for 20 years once on condition of passing examinations.

Room for reconsideration has existed from the initial phase

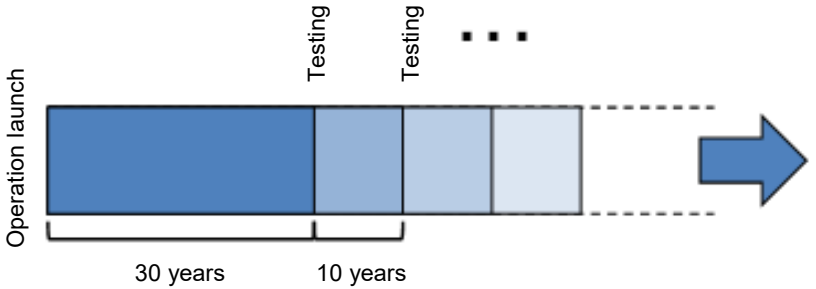
- Proposal on service life by Ministry of Economy, Trade and Industry
  - Subtracting a total operation suspension period from the 40-year (or 60-year) service life and extending closure deadlines for such period.



Fixed service life
(40 or 60 years under current rules)

(Reference) Proposal by Nuclear Regulation Authority proposal on continuation of operation

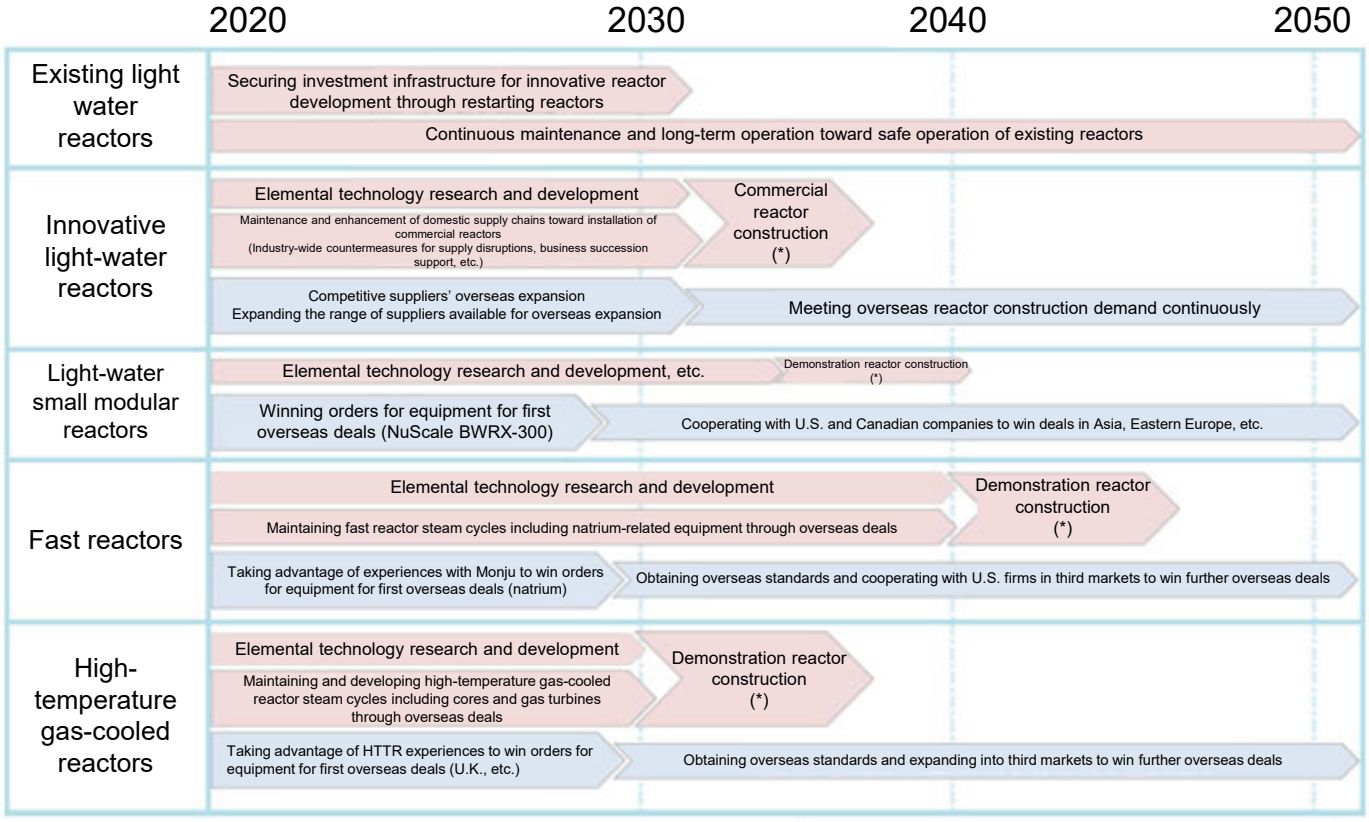
- In 30 years after the operation launch, anti-aging measures are tested to decide whether operation should be continued.
- Later, a test will be conducted every 10 years.



Ongoing talks in Japan: Innovative reactors

- In July 2022, the government published a technology roadmap for innovative reactor development.
- In September, Mitsubishi Heavy Industries Ltd. announced the SRZ-1200 innovative light water reactor.
- In November, the Japan Atomic Energy Agency announced its participation in a high-temperature gas-cooled reactor project in Poland.

- Foreign countries such as the United States, the United Kingdom and Canada are moving to construct new demonstration reactors.
- We would like to pay attention to whether such move would come out in Japan.



* Timings for launching operation may be determined based on business operators' plans to be formulated on condition of understanding by communities at construction locations.

Source: Ministry of Economy, Trade and Industry, document for the innovative reactor working group (November 2022)