自然エネルギー財団
RENEWABLE ENERGY INSTITUTE

Japan’s Nuclear Power New Policy: Off the Mark

February 2023

Renewable Energy Institute

Ikata nuclear power plant, Ehime Prefecture, Japan

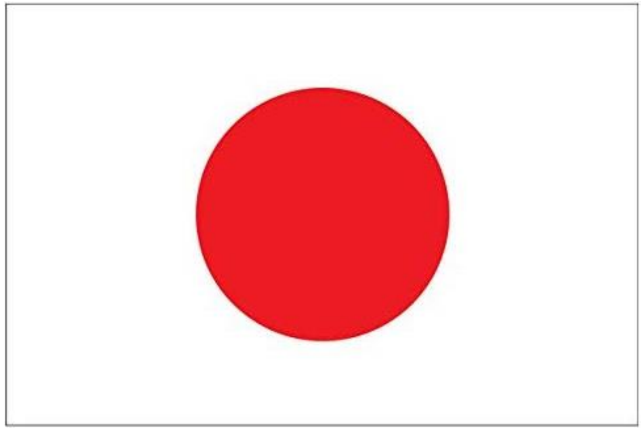
Executive Summary

Amid the current global energy crisis, the Japanese government aims at reviving the country’s domestic nuclear power industry. Disconnected from reality and overly ambitious, the new Japanese nuclear power policy is off the mark. As such, it is inappropriate as decarbonization, and energy security policy efforts should urgently prioritize the acceleration of energy efficiency improvements and renewable energy deployment.

Table of Contents

Part 1: Japan Focus

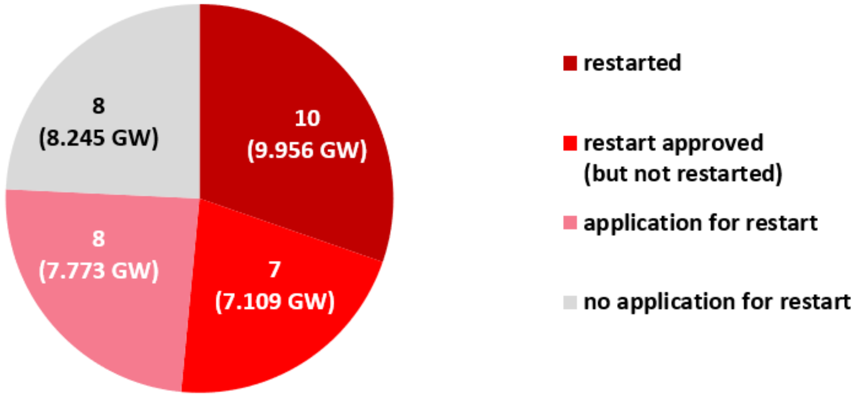
- *Issue #1* Japanese government’s FY 2030 nuclear power target: wishful thinking (page 3)
- *Issue #2* Existing nuclear reactors: uneconomic (page 4)
- *Issue #3* Nuclear reactors availability: prolonged outages (page 5)
- *Issue #4* Japanese “next-generation” nuclear reactors: not innovative design prioritized (page 6)
- *Issue #5* Nuclear power to strengthen energy security: impossibility to go from theory to reality (page 7)
- *Issue #6* Reactor decommissioning and spent fuel & radioactive waste disposal: slow progress (page 8)



Issue #1 Japanese government’s FY 2030 nuclear power target: wishful thinking

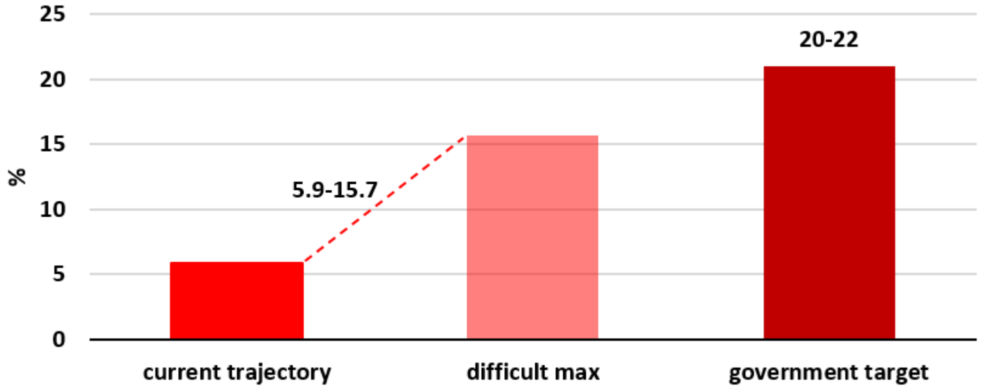
Japan Existing Nuclear Reactors Status as of February 7, 2023

**total: 33 reactors
(gross capacity: 33.083 GW)**



Source: JAIF

Japan Share of Nuclear Power in Electricity Mix FY 2030 Projections VS. Government Target



- “current trajectory”: restarted reactors and reactors with an identified restart date / including granted lifetime extensions / assuming a 70% capacity factor
- “difficult max”: restarted reactors, reactors having at least submitted their application to restart, and Shimane-3 & Ohma / including granted & requested lifetime extensions / assuming a 70% capacity factor

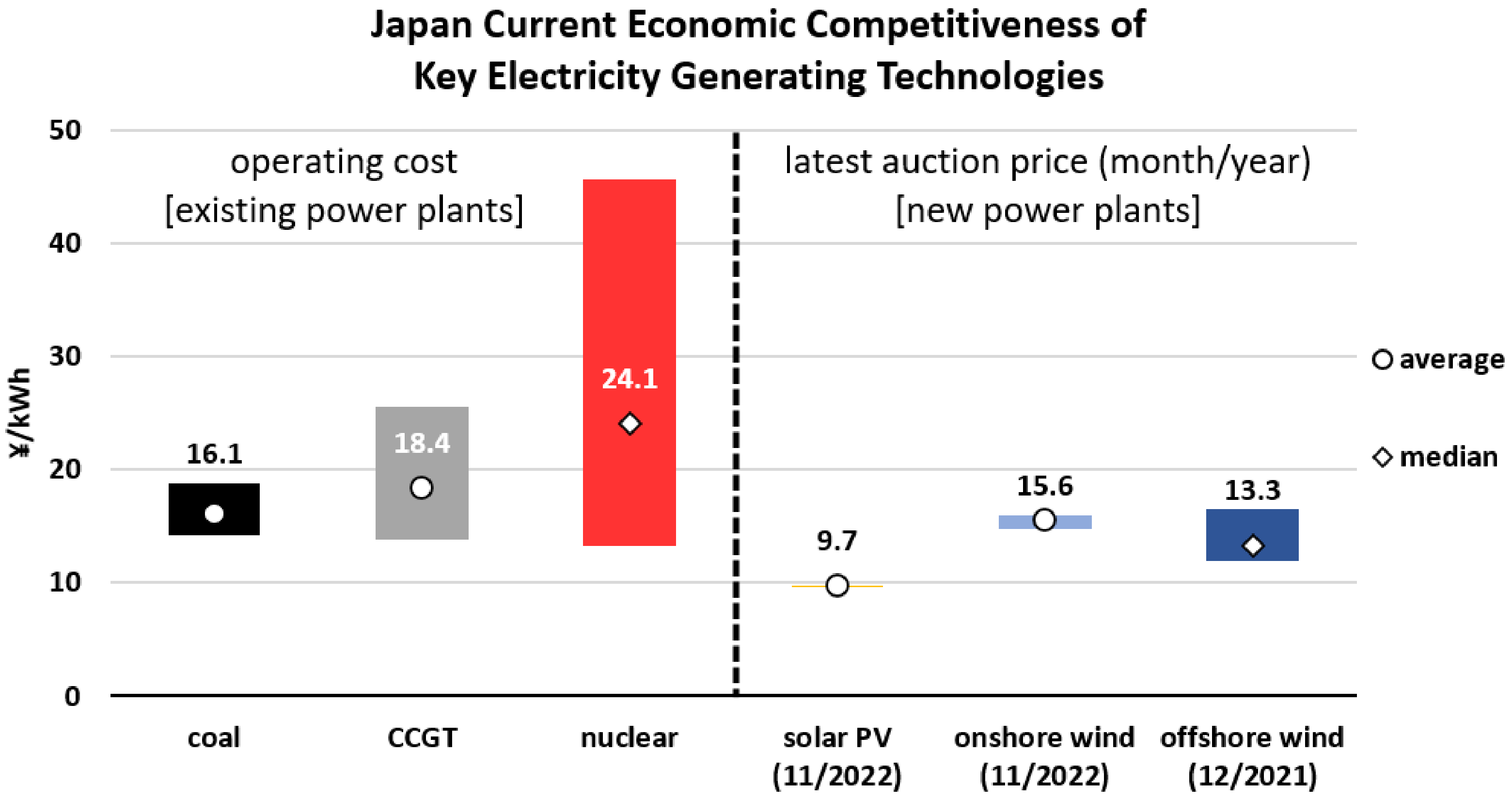
Overly ambitious government’s target	Share of nuclear power to account for 20-22% of Japan’s total electricity generation (934 TWh) in fiscal year (FY) 2030 (i.e., April 2030 to March 2031), against 6.9% in FY 2021 (Japan government 1). Under the current trajectory, with the permanent closures of 4 restarted reactors (3.52 GW) reaching the end of their 40-year lifetime (2024-2025), the share of nuclear power will fall to 5.9% in FY 2030.
Major obstacles	Costs and technical feasibility of safety upgrades, Nuclear Regulation Authority’s safety clearing process, and local opposition.
Existing reactors: time-consuming restart process	For the 10 restarted reactors (9.956 GW), it took 2.2-6.4 years (4.0 years in average) between the submission of their application to restart and the restart of their commercial operation. For the 15 other reactors having submitted their application to restart (14.882 GW), 7.3-9.6 years (8.8 years in average) already passed without a restart, and only 3 of these reactors (2.477 GW) have a restart date identified (2023-2024). For the remaining 8 existing reactors (8.245 GW) not having submitted their application to restart yet, a restart by FY 2030 is improbable.
Existing reactors: lifetime extensions	60-year lifetime extensions granted to 4 reactors (3.578 GW): 1 restarted reactor (0.826 GW), 2 reactors approved to restart with a restart date identified (1.652 GW), and 1 reactor approved to restart without a restart date identified (1.1 GW). Applications by 4 restarted reactors (3.52 GW).
New reactors: uncertain start dates	The construction of Shimane-3 (1.373 GW) is expected to be completed in 2024 and that of Ohma (1.383 GW) in 2029. Start dates yet to be announced. Tokyo EPCO’s Higashidori-1 (1.385 GW) which construction is stopped because of Fukushima nuclear accident will likely not start by FY 2030.

See also Appendix on page 16

The Japanese government’s FY 2030 nuclear power target will largely be missed, resulting in a problematic significant lack of decarbonized electricity.

Issue #2 Existing nuclear reactors: uneconomic

- For existing coal and CCGT power plants: the operating cost is essentially the latest fuel cost observed (i.e., steam coal and LNG in December 2022). Operation & maintenance cost is marginal for fossil power plants and therefore not included. Initial investment is assumed fully amortized
- For existing nuclear power plants: the operating cost includes restart cost (i.e., safety upgrades), fuel cost, and operation & maintenance cost. Initial investment is assumed fully amortized
- For new renewable energy power plants: price includes total cost and profit. After auctions, solar PV and onshore wind power plants should typically start operation within 3 and 4 years, respectively, and offshore wind between 2028 and 2030



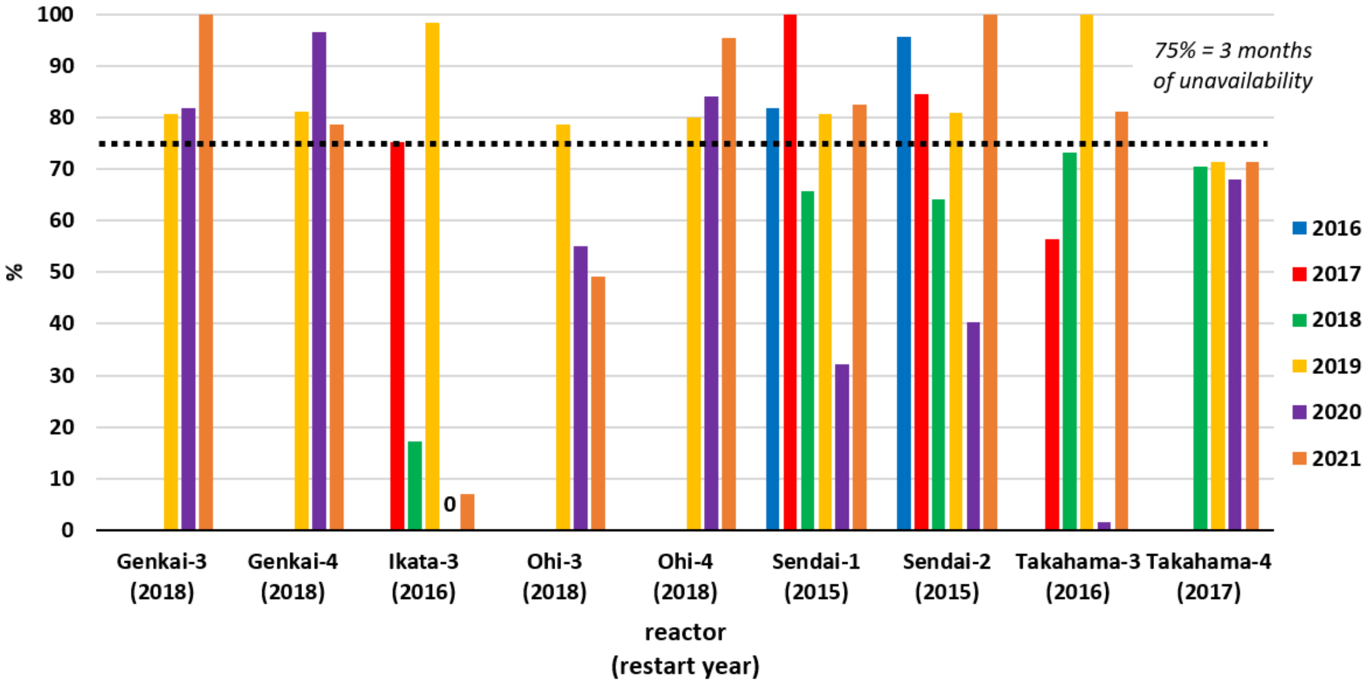
Sources: steam coal from Japan MoF 1, LNG from Japan MoF 2, nuclear from Professor K. Oshima (Ryukoku University), solar PV from OCCTO 1, onshore wind from OCCTO 2, and offshore wind from Japan METI

Existing nuclear reactors	With generating costs ranging between ¥13.3/kWh and ¥45.7/kWh, and a median cost of ¥24.1/kWh, the myth of cheap nuclear power in Japan is debunked.
Comparison with expensive fossil fuels	Even amid the current energy crisis characterized by the high costs of steam coal and LNG, the cost competitiveness of existing nuclear reactors is often not obvious.
Comparison with affordable renewable energy	With auction prices below ¥10/kWh new solar photovoltaic (PV) completely outcompetes existing nuclear power. And only a few nuclear reactors can compete with new onshore and offshore wind projects.

Because the economics of nuclear power is weak, affordable renewable energy should be prioritized to protect consumers from imminent rising electricity bills.

Issue #3 Nuclear reactors availability: prolonged outages

Japan Restarted Nuclear Reactors Operation Factors



- Operation factor: ratio of the number of hours a reactor is online to the total number of hours in a year (regardless of performance)
- Data from the first full year of operation after restart. Mihama-3 having restarted in 2021, it is not included in this chart

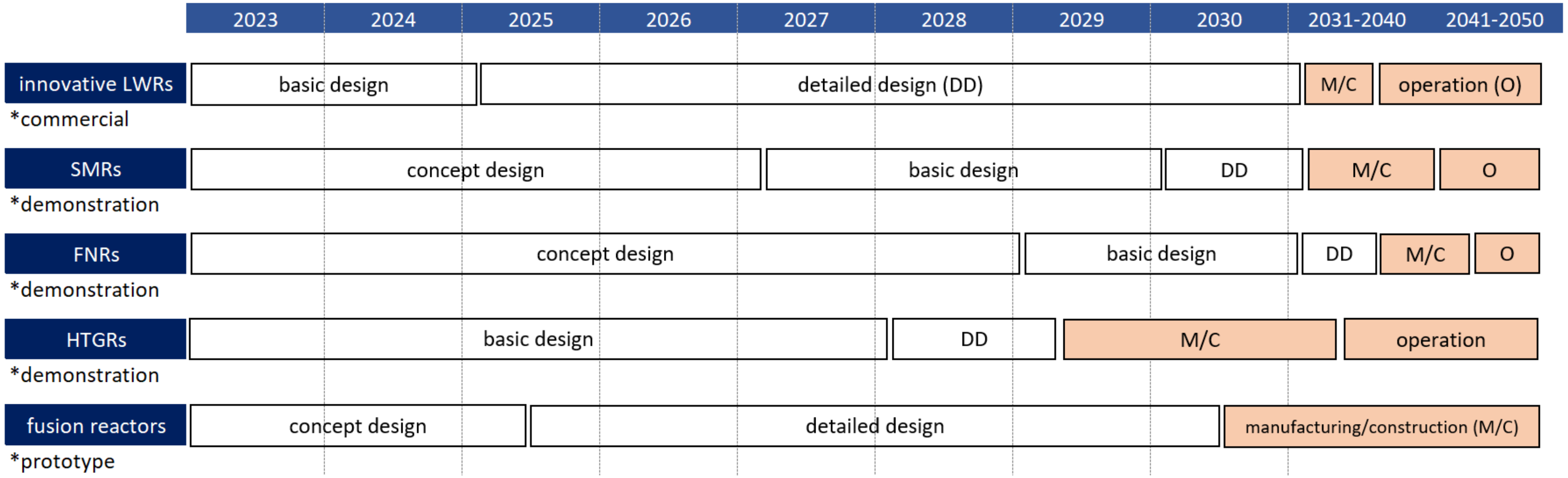
Sources: operation factors from IAEA 1 and restart dates from JAIF

Reasons for nuclear reactor outages	Outages can be planned or unplanned. Planned outages take place for refueling, major maintenance, tests, and inspections. Unplanned outages are related to unexpected issues such as surprising equipment failures, operational errors, external environmental events (e.g., earthquake, hurricane, heat wave…), or political decisions.
Availability 2016-2021	In total, since their restart the Japanese nuclear reactors cumulated 38 full years of operation between 2016 and 2021 (2022 data unavailable). In 16 of these 38 full years, the operation factors of the restarted reactors were below 75%. This means many reactors were frequently unavailable for a minimum of 3 months over a year.
Outages 2022	For various reasons (e.g., periodic inspection, installation of specialized safety facility, lifetime extension application, pressurizer defect, leakage of water…) all restarted reactors – with the exceptions of Ikata-3 and Sendai-1 – saw their operation factors affected by outages lasting at least 4 months.
Offline periods and ageing	Ageing determines the limits of a nuclear power reactor lifetime. A mothballed reactor is not immune from the effects of ageing (IAEA 2). Excluding the periods when a reactor is offline from the limit on its lifespan – as currently planned by the Japanese government – is in contradiction with this principle.

Nuclear power reactors may suffer lengthy outages affecting their availability and penalizing power system adequacy.

Issue #4 Japanese “next-generation” nuclear reactors: not innovative design prioritized

Japan “Next-Generation” Innovative Nuclear Reactors Roadmap



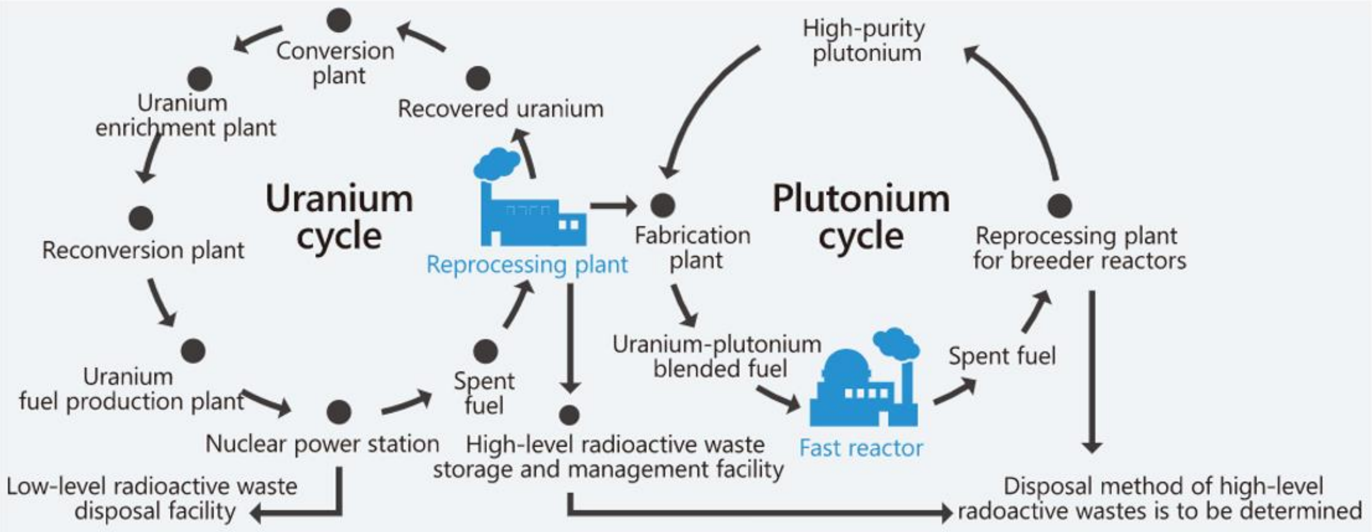
Source: Japan government 2

“Next-generation” nuclear reactors	Small modular reactors (SMRs), fast neutron reactors (FNRs), high-temperature gas-cooled reactors (HTGRs), and fusion reactors can be considered “next-generation” nuclear reactors. None of these technologies is mature (see page 13). Regardless of the evolution of their designs, conventional large light water reactors (LWRs) (e.g., pressurized water reactors (PWRs) or boiling water reactors (BWRs)) are fundamentally not “next-generation” reactors. The presentation by the Japanese government of innovative LWRs (e.g., SRZ-1200), which construction is prioritized, as “next-generation” nuclear reactors is misleading.
SRZ-1200	Developed by Mitsubishi Heavy Industries together with four Japanese electric power companies (Hokkaido, Kansai, Kyushu, and Shikoku EPCOs), the SRZ-1200 is simply an advanced LWR of 1.2 GW at a conceptual design stage (MHI). It is wrongly touted as a “next-generation” nuclear reactor because it will provide some safety improvements and flexibility features. These features are not particularly innovative.
Safety improvements	The SRZ-1200 will feature safety mechanisms, including passive equipment such as a “core catcher” (to contain, spread, and cool the reactor core in the event of a core meltdown). Core catchers have already been introduced in many reactors around the world (Bangladesh, China, Finland, France, India, Russia, Turkey, United Kingdom…).
Flexibility	The SRZ-1200 will seek halving its output or going back online in 17 minutes. France already has a long experience in operating nuclear power reactors flexibly and already manages to quickly ramp up and down the output of its reactors.
Untimely deployment	The SRZ-1200 will likely not be in operation until 2035-2040 at the earliest, whereas the urgency of the current crisis requires immediate action.

Designating innovative LWRs as “next-generation” nuclear reactors is misleading. The innovations considered are too little too late.

Issue #5 Nuclear power to strengthen energy security: impossibility to go from theory to reality

Fictious Example of a Simplified Idealistic Closed Nuclear Fuel Cycle

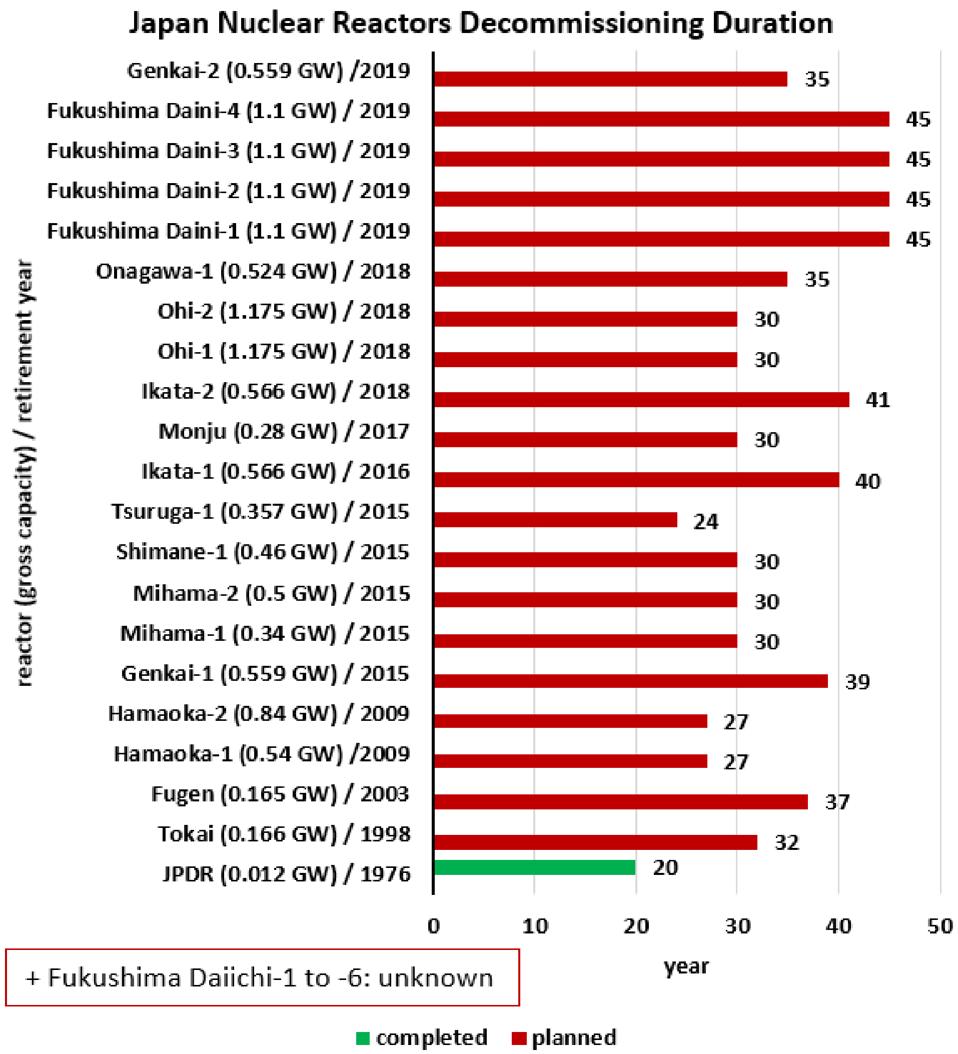


Source: Toshiba

Uranium imports	Japan has no indigenous uranium resources, and essentially relies on imports to meet its uranium needs. This is certainly a weakness in terms of energy security. This issue could theoretically be partially alleviated by successfully developing a closed nuclear fuel cycle – which no country ever achieved.
Two prerequisites for the closed nuclear fuel cycle	A functioning reprocessing plant (to recover reusable materials from spent fuel) and operational fast neutron reactors (FNRs) (using the output of the reprocessing plant). Until now, Japan failed in developing these two indispensable technologies.
Rokkasho reprocessing plant – endless delays	Under construction since 1993 and originally planned to be completed in 1997, this plant is now expected to be finally completed in 2024 at the earliest after an at least 27-year delay (JNFL). The project is estimated to cost ¥14.44 trillion (about $109 billion) (NuRO).
Monju fast breeder reactor – a failure and an end	The prototype fast breeder reactor (FBR) Monju (gross capacity: 0.28 GW) was Japan's unique FNR (a FBR is a type of FNR designed to produce more plutonium than the uranium and plutonium it consumes) (IAEA 3). Connected to the grid in August 1995, it suffered a sodium leakage causing a fire in December 1995. Until its permanent shutdown in 2017, it remained largely offline. No new FNR is emerging for the succession of Monju, making it impossible for Japan to realize its closed nuclear fuel cycle.

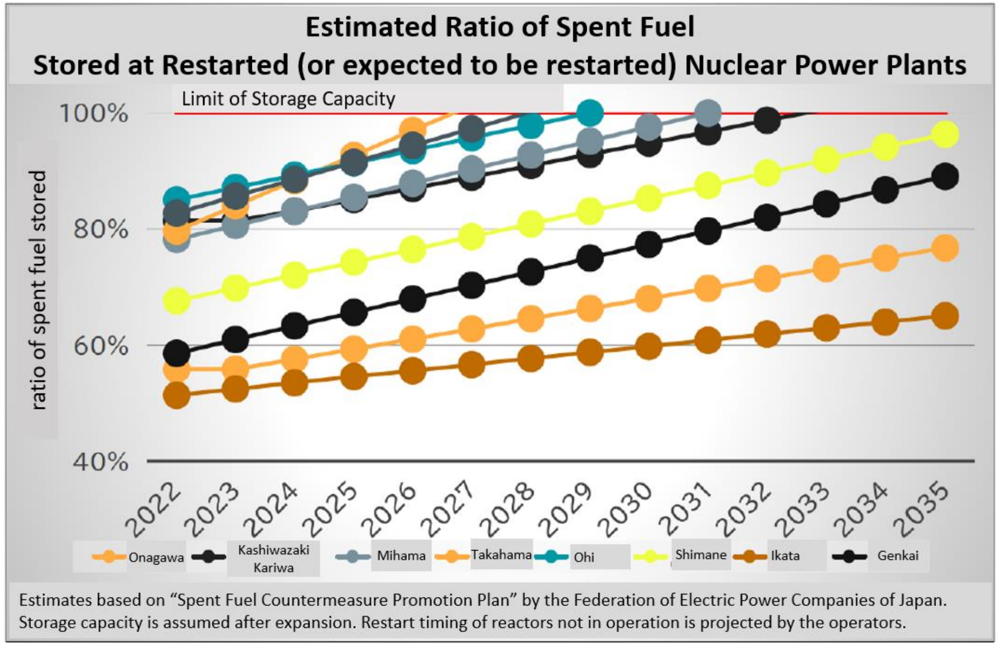
The closed nuclear fuel cycle is a pipe dream, therefore nuclear power cannot strengthen Japan's energy security.

Issue #6 Reactor decommissioning and spent fuel & radioactive waste disposal: slow progress


Japan Nuclear Reactors Decommissioning Duration

+ Fukushima Daiichi-1 to -6: unknown

Source: JAIF


Estimated Ratio of Spent Fuel
Stored at Restarted (or expected to be restarted) Nuclear Power Plants

Estimates based on "Spent Fuel Countermeasure Promotion Plan" by the Federation of Electric Power Companies of Japan. Storage capacity is assumed after expansion. Restart timing of reactors not in operation is projected by the operators.

Source: CNIC

Decommissioning	The decommissioning of only 1 of Japan's 27 permanently shut down nuclear reactor has been completed: Japan Power Demonstration Reactor (JPDR), a small (gross capacity: 0.012 GW) research BWR. The planned decommissioning periods for the remaining 26 reactors are 24-45 years (35 years in average). As of July 2022, all these reactors were in the first active stage of their decommissioning (i.e., warm-up), and only 4 of them were defueled (WNISR).
Spent fuel & radioactive waste disposal	In Japan, spent fuel is not regulated as waste, and the principle is to reprocess all of it domestically – which is currently not done. Spent fuel storage capacity at several nuclear power plants is already approaching saturation. High-level radioactive waste is to be geologically disposed of, but no deep geological repository site has been selected yet. This project is estimated to cost ¥3.9137 trillion (about $30 billion). As of fiscal year 2021, less than ¥1.1201 trillion (about $8 billion) had been provisioned (NUMO).

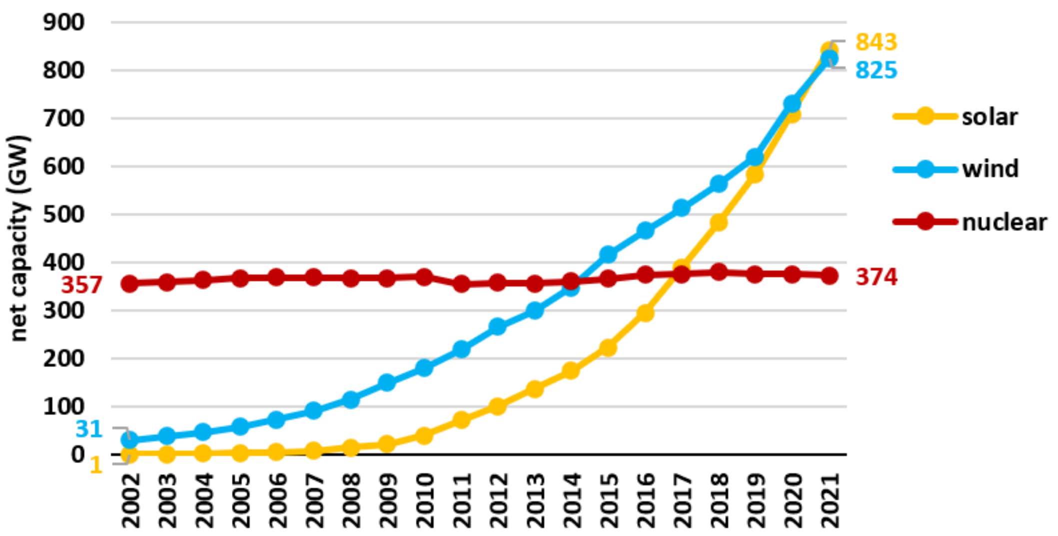
Reactor decommissioning and radioactive waste disposal are critical challenges for which almost everything remains to be done.

Part 2: Global Trends

- *Issue #1* Nuclear power installed capacity and electricity generation: eclipsed by solar and wind (page 10)
- *Issue #2* Nuclear reactors under construction: China and Russia’s leaderships (page 11)
- *Issue #3* Nuclear power costs: new builds outcompeted everywhere (page 12)
- *Issue #4* “Next-generation” reactors: general lack of maturity (page 13)
- *Issue #5* Nuclear power new policies: more favorable, but significant hurdles remain to be cleared (page 14)
- *Issue #6* Reactor decommissioning and spent fuel & radioactive waste disposal: widespread difficulties (page 15)

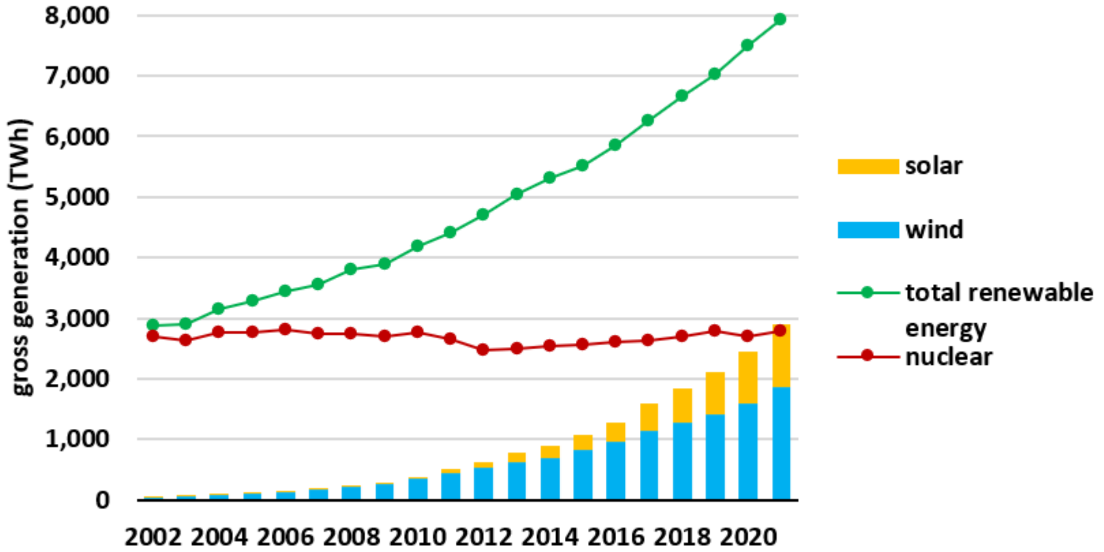
Issue #1 Nuclear power installed capacity and electricity generation: eclipsed by solar and wind

World Nuclear, Solar, and Wind Power Installed Capacity 2002-2021



Sources: nuclear from IAEA 4, and solar & wind from BP

World Nuclear VS. Solar + Wind and VS. Total Renewable Energy Electricity Generation 2002-2021



Source: BP

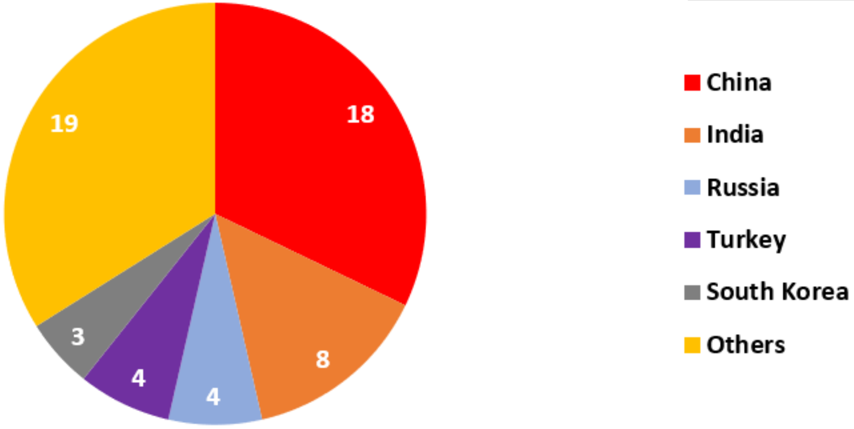
Installed capacity	In 2015, global wind power installed capacity exceeded global nuclear power installed capacity. In 2017, global solar power installed capacity exceeded global nuclear power installed capacity.
Electricity generation	In 2021, electricity generation from solar + wind power surpassed electricity generation from nuclear power.
Share in electricity generation – 2021 & 2050 projection	While in 2021 the shares of solar + wind and nuclear in the world's total electricity generation were both approximately 10%, it is forecasted that to reach carbon neutrality by 2050 the share of solar + wind will be an impressive 71% and that of nuclear a modest 8% (IEA).

In the past ten years, stagnating nuclear power has been overtaken by the explosive growths of solar and wind power. In the coming decades, the gap between these technologies will just keep widening.

Issue #2 Nuclear reactors under construction: China and Russia’s leaderships

Nuclear Reactors Under Construction, by Country as of February 7, 2023

total: 56 reactors
(net capacity 58.418 GW)



- “Others”:

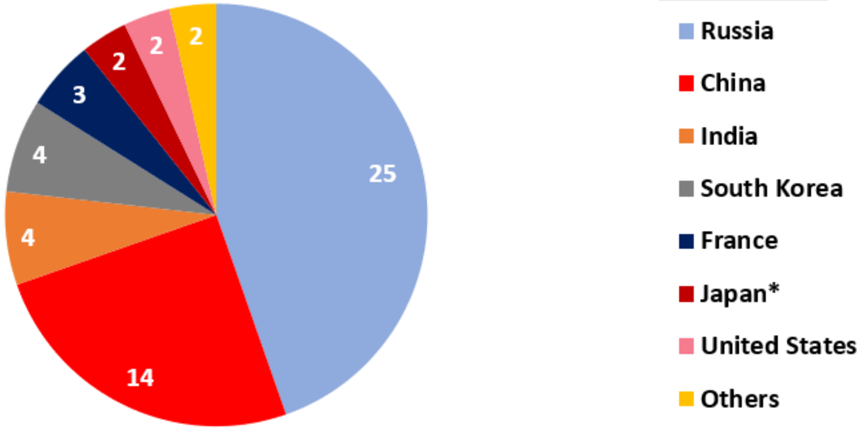
- 2 reactors: Bangladesh, Egypt, Japan*, Ukraine, United Kingdom, and United States, and
- 1 reactor: Argentina, Belarus, Brazil, France, Iran, Slovakia, and United Arab Emirates

*For Japan, Tokyo EPCO’s Higashidori-1 is not considered under construction by the IAEA because the first major placing of concrete for the base mat of the reactor building has not been made

Source: IAEA 5

Nuclear Reactors Under Construction, Reactor Design by Country as of February 7, 2023

total: 56 reactors
(net capacity: 58.418 GW)



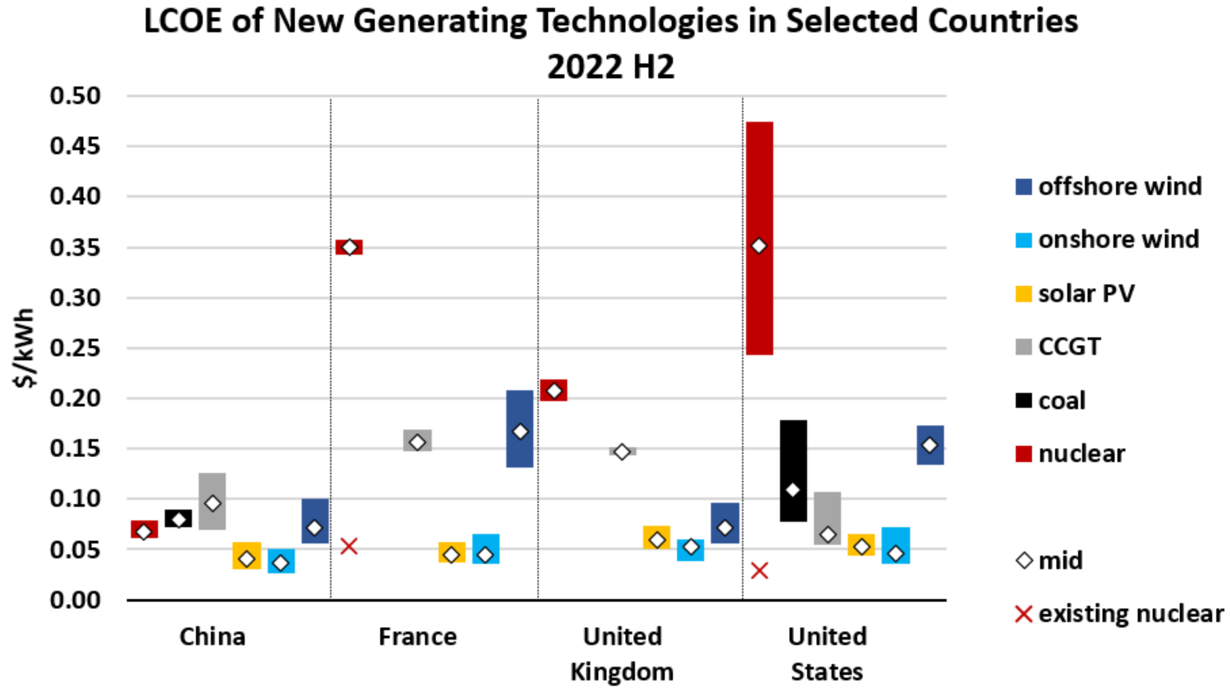
- “Others”: Argentina and Germany

*For Japan, Tokyo EPCO’s Higashidori-1 is not considered under construction by the IAEA because the first major placing of concrete for the base mat of the reactor building has not been made

New constructions: by country	China is the world leading country for nuclear reactors under construction: 18 nuclear reactors under construction (32% of the world’s nuclear reactors under construction). China also has 55 operational nuclear reactors (#3 behind the United States and France). However, the share of nuclear power in China’s electricity generation mix was only 5% in 2021 (against 12% for solar + wind) (BP).
New constructions: reactor design by country	Russia is the world leading country for the design of nuclear reactors under construction: 25 nuclear reactors under construction are based on Russian designs (45% of the world’s nuclear reactors under construction). The fact that only 4 of these 25 reactors are being built in Russia shows well how remarkably successful Russia is in exporting its reactor designs (e.g., China, India, Turkey…).
China & Russia common point	In both countries there is a strong national policy support in favor of nuclear for both civilian and military (i.e., nuclear weapons) purposes.

While China is the main country for nuclear reactors under construction, Russia is the main designer for nuclear reactors under construction.

Issue #3 Nuclear power costs: new builds outcompeted everywhere



Sources: BloombergNEF, except "France existing nuclear" from France NA, and "United States existing nuclear" from NEI

Existing reactors	On the one hand, existing nuclear reactors may still be economically competitive, as for examples in France and the United States. Regarding the United States more specifically, from 2012 to 2021, the average cost of existing reactors went down from $0.048/kWh to $0.029/kWh mainly thanks to: (1) the permanent shutdowns of 12 unprofitable reactors, (2) the increase of the fleet's capacity factor from 86% to 93% (which is outstandingly high and means very short outage periods), and (3) the decrease of capital expenditures for lifetime extensions, power uprates, and safety upgrades. Compared to France, it may also be noted that the United States has a less strict nuclear safety approach.
New reactors	On the other hand, even in China – the world's most dynamic country for new reactors – the cost competitiveness of new nuclear is relatively weak compared to new solar PV and onshore wind. In France, the United Kingdom, and the United States, new reactors are prohibitively expensive compared to new solar PV, onshore wind, and offshore wind.

Though existing nuclear reactors may sometimes still be economically competitive, this is not the case of new reactors. Hence, nuclear power contribution to meet future electricity needs will necessary be limited.

Issue #4 "Next-generation" reactors: general lack of maturity

Design of the VOYGR-6 SMR (United States)

Source: NuScale Power

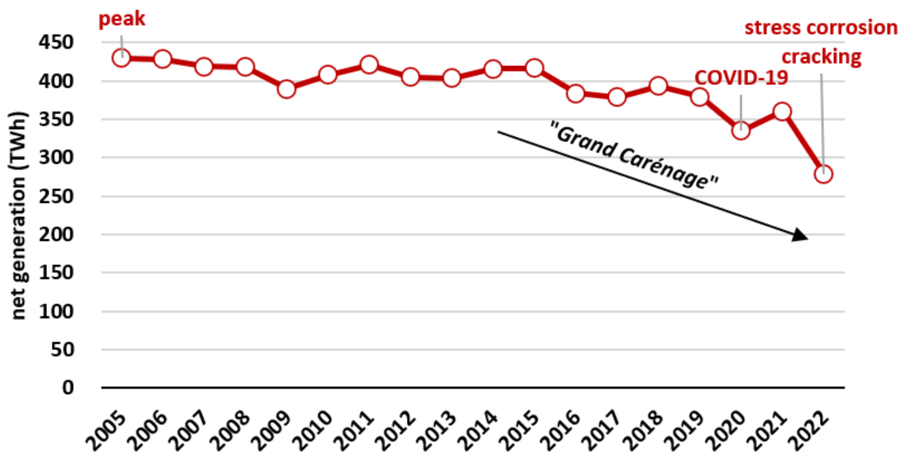
SMRs	SMRs are small-scale fission reactors (typically up to 300 MW) which systems and components can be factory-assembled and transported as a unit to a location for installation. Unlike large-scale reactors, SMRs do not benefit from economies of scale. In the United States, the cost of generating electricity from the Carbon Free Power Project using NuScale Power's VOYGR-6 SMR (462 MW / 6 modules of 77 MW), beginning of commercial operation expected in 2029, is estimated at $0.089/kWh – three times the cost of existing large-scale reactors in this country (WNN).

FNRs	FNRs are fission reactors which do not need a neutron moderator (e.g., water in PWRs and BWRs). By reusing spent fuel, FNRs theoretically lessen the need for uranium imports and reduce nuclear waste. FNRs are not new, but their deployment has been slow because of their poor performances: the top-3 lifetime capacity factors for FNRs are those of Russian Beloyarsk-3 (net capacity: 0.56 GW, operational since 1981) and Beloyarsk-4 (0.82 GW, operational since 2016), and French Phenix (0.13 GW, 1974-2010): only 76.4%, 65.9%, and 40.5%, respectively (IAEA 6).
HTGRs	HTGRs are fission reactors using gas as coolant and graphite as moderator. HTGRs can theoretically generate electricity and produce high temperature process heat. Like FNRs, HTGRs are not new and their deployment has been slow because of their poor performances: the top-3 lifetime capacity factors for HTGRs are those of German AVR Juelich (0.013 GW, 1969-1988) and THTR-300 (0.296 GW, 1987-1988), and American Fort St. Vrain (0.33 GW, 1979-1989): only 62.0%, 41.3%, and 15.2%, respectively (IAEA 6).
Fusion reactors	No fusion reactor has ever been connected to the grid. The most significant fusion experiment project is the ITER project in France, under construction since 2010 and scheduled to be fully operational in 2035 (ITER). The objective of ITER is the investigation and demonstration of burning plasmas (i.e., plasmas in which the energy produced by fusion reactions is enough to maintain the temperature of the plasma, thereby reducing or eliminating the need for external heating – which is key since conventional power plants use heat to produce steam and then electricity by way of turbines and generators). ITER will not generate electricity but prepares the way for future fusion reactors.

Because of their economic and technological immaturity, none of the "next-generation" reactors are credible solutions to tackle the immediate global climate and energy crises the world is confronted with.

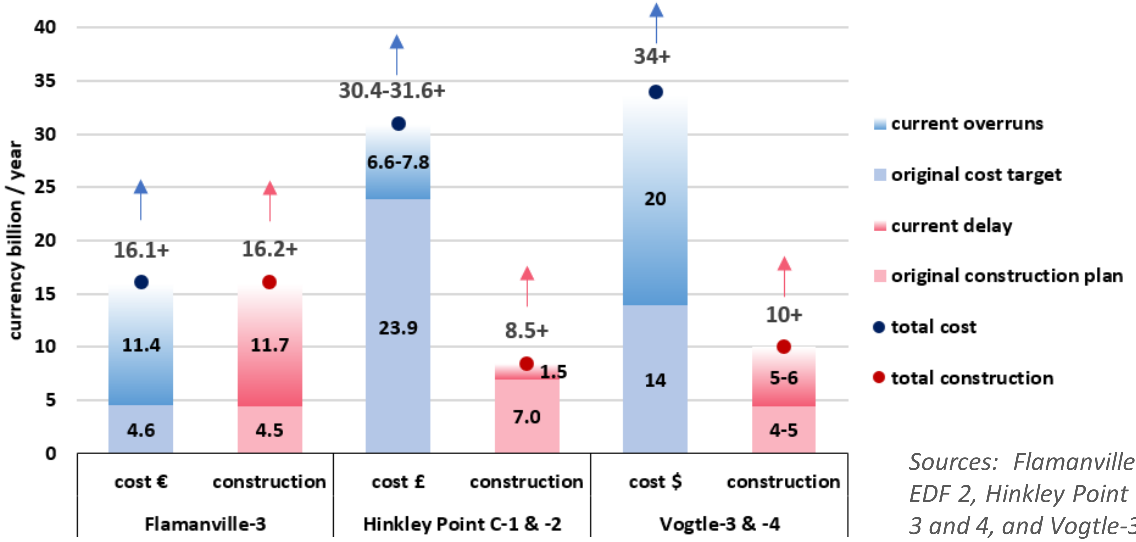
Issue #5 Nuclear power new policies: more favorable, but significant hurdles remain to be cleared

France Electricity Generation from Nuclear Power 2005-2022



Sources: 2005-2021 RTE and 2022 EDF 1

New Nuclear Reactors Affected by Enormous Cost Overruns and Multiyear Delays



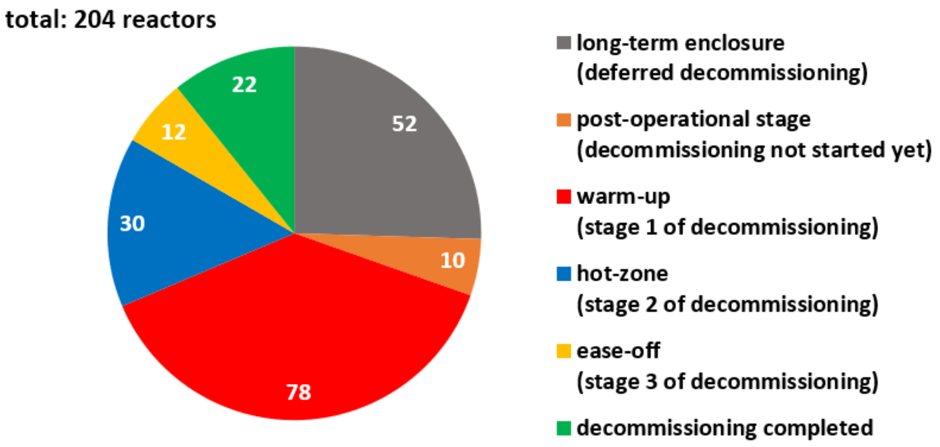
Sources: Flamanville-3 from CdC and EDF 2, Hinkley Point C-1 & -2 from EDF 3 and 4, and Vogtle-3 & -4 from WNISR

Ongoing climate and energy crises result in a renewed interest in nuclear power	Several countries recently announced new policies in favor of nuclear power: France pursues lifetime extensions beyond 50 years for all its 56 existing reactors and plans to build 6-14 large new reactors and some SMRs (France government). South Korea abandoned its nuclear power phaseout policy, and instead now targets to increase the share of nuclear power in its electricity mix from 28.0% in 2021 to 34.6% in 2036 (IAEA 7 and KEEI). The United Kingdom intends to extend the lifetime of its existing reactors and construct 8 large new reactors and some SMRs (United Kingdom government).
Major obstacles	Cost overruns, delays, deteriorated supply chains, and loss of competent human resources.
Existing reactors: seeking lifetime extensions limits availability	Extending the lifetime of nuclear reactors involves considerable efforts and limits the availability of reactors. France currently works on its "*Grand Carénage*", a program notably focusing on reactor lifetime extensions (2014-2025). At a time of vulnerability, the French nuclear power fleet has been struck by the COVID-19 pandemic (derailing maintenance) and the detection of stress corrosion cracking in emergency cooling systems. In 2022, electricity generation from nuclear power collapsed, and the country became again – for the first time since 1980 – a net importer of electricity.
New reactors: cost overruns and delays	French Flamanville-3 (net capacity: 1.63 GW, under construction since 2007), British Hinkley Point C-1 & -2 (3.26 GW, under construction since 2018-2019), and American Vogtle-3 & -4 (2.234 GW, under construction since 2013) are examples of new reactors suffering from enormous cost overruns and multiyear delays. To avoid repeating these failures, revitalizing lethargic supply chains, and training a new capable workforce will be critical.

Renewed political interest in nuclear power could be jeopardized by outages affecting existing reactors and cost overruns & delays plaguing new reactors.

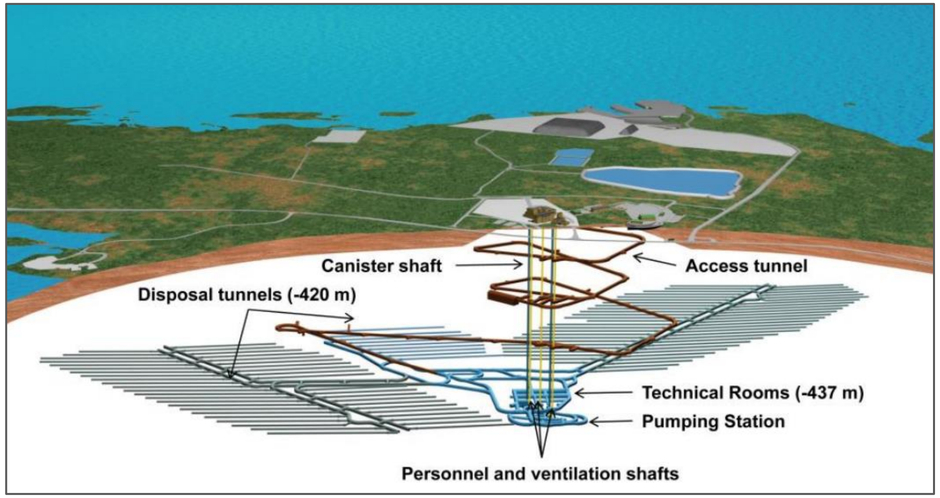
Issue #6 Reactor decommissioning and spent fuel & radioactive waste disposal: widespread difficulties

World Permanently Shut Down Nuclear Reactors Decommissioning Status as of July 2022



Source: WNISR

Onkalo Deep Geological Repository Illustration (Finland)



Source: STUK

Decommissioning	Decommissioning is a technically complex process that poses major challenges in terms of long-term planning, execution, and financing. Of the world's 204 permanently closed nuclear reactors, 140 reactors (or 69%) have seen little to no progress in their decommissioning (i.e., long-term enclosure, post-operational stage, and warm-up). In comparison, 22 reactors (or 11%) have been completely decommissioned – out of which 10 reactors have been returned to greenfield sites for unrestricted use. The United States, Germany, and Japan are the only three countries to have achieved the decommissioning of a nuclear reactor.
Spent fuel & radioactive waste disposal	Following temporary storage, spent fuel and high-level waste are to be disposed of in deep geological repositories at depths of several hundred meters or more in suitable geological formations. Today there is still no deep geological repository in operation anywhere in the world. Finland leads global efforts and schedules to start the final disposal of spent fuel in the deep geological repository ONKALO in the mid-2020s (Posiva). It is followed by France and Sweden which are making concrete progress towards the construction of their own deep geological repositories. Other countries lag behind. In the framework of the European Union Taxonomy, nuclear power was included as an eligible technology under the condition that Member States should have in place a detailed plan to have in operation a disposal facility for high-level radioactive waste by 2050 (OJEU).

Despite decades of global experience in generating electricity from nuclear power, decommissioning reactors and disposing of radioactive waste remain difficult for all countries.

Appendix: Status of Existing Nuclear Reactors in Japan (as of February 7, 2023)

Status	Reactor (company)	Commercial operation start date	Restart date	Operational lifetime (year)	Gross capacity (GW)
Restarted	Genkai-3 (Kyushu EPCO)	March 18, 1994	May 16, 2018	40	1.18
	Genkai-4 (Kyushu EPCO)	July 25, 1997	July 19, 2018	40	1.18
	Ikata-3 (Shikoku EPCO)	December 15, 1994	September 7, 2016	40	0.89
	Mihama-3 (Kansai EPCO)	December 1, 1976	July 27, 2021	60	0.826
	Ohi-3 (Kansai EPCO)	December 18, 1991	April 10, 2018	40	1.18
	Ohi-4 (Kansai EPCO)	February 2, 1993	June 5, 2018	40	1.18
	Sendai-1 (Kyushu EPCO)	July 4, 1984	September 10, 2015	40 (application for 60)	0.89
	Sendai-2 (Kyushu EPCO)	November 28, 1985	November 17, 2015	40 (application for 60)	0.89
	Takahama-3 (Kansai EPCO)	January 17, 1985	February 26, 2016	40 (application for 60)	0.87
	Takahama-4 (Kansai EPCO)	June 5, 1985	June 16, 2017	40 (application for 60)	0.87
Sub-total	10				9.956
Restart approved (But not restarted)	Kashiwazaki Kariwa-6 (Tokyo EPCO)	November 7, 1996		40	1.356
	Kashiwazaki Kariwa-7 (Tokyo EPCO)	July 2, 1997		40	1.356
	Onagawa-2 (Tohoku EPCO)	July 28, 1995	February 2024	40	0.825
	Shimane-2 (Chugoku EPCO)	February 10, 1989		40	0.82
	Takahama-1 (Kansai EPCO)	November 14, 1974	June 3, 2023	60	0.826
	Takahama-2 (Kansai EPCO)	November 14, 1975	July 15, 2023	60	0.826
	Tokai-2 (Japan Atomic Power Company)	November 28, 1978		60	1.1
Sub-total	7				7.109
Application for restart	Hamaoka-3 (Chubu EPCO)	August 28, 1987		40	1.1
	Hamaoka-4 (Chubu EPCO)	September 3, 1993		40	1.137
	Higashidori-1 (Tohoku-EPCO)	December 8, 2005		40	1.1
	Shika-2 (Hokuriku EPCO)	March 15, 2006		40	1.206
	Tomari-1 (Hokkaido EPCO)	June 22, 1989		40	0.579
	Tomari-2 (Hokkaido EPCO)	April 12, 1991		40	0.579
	Tomari-3 (Hokkaido EPCO)	December 22, 2009		40	0.912
	Tsuruga-2 (Japan Atomic Power Company)	February 17, 1987		40	1.16
Sub-total	8				7.773
No application for restart	Hamaoka-5 (Chubu EPCO)	January 18, 2005		40	1.38
	Kashiwazaki Kariwa-1 (Tokyo EPCO)	September 18, 1985		40	1.1
	Kashiwazaki Kariwa-2 (Tokyo EPCO)	September 28, 1990		40	1.1
	Kashiwazaki Kariwa-3 (Tokyo EPCO)	August 11, 1993		40	1.1
	Kashiwazaki Kariwa-4 (Tokyo EPCO)	August 11, 1994		40	1.1
	Kashiwazaki Kariwa-5 (Tokyo EPCO)	April 10, 1990		40	1.1
	Onagawa-3 (Tohoku EPCO)	January 30, 2002		40	0.825
	Shika-1 (Hokuriku EPCO)	July 30, 1993		40	0.54
Sub-total	8				8.245
Total	33				33.083

Source: JAIF

References

- BloombergNEF, Levelized Cost of Electricity 2H 2022 (December 2022) [subscription required].
- BP, Statistical Review of World Energy 2022 (June 2022).
- CdC (Cour des Comptes), The EPR Industry (July 2020) (in French).
- CNIC (Citizens' Nuclear Information Center), Providing Information to the Atomic Energy Subcommittee: Issues Related to the Development, Introduction and Utilization of Nuclear Power Plants (October 2022) (in Japanese).
- EDF 1 (Électricité de France), Nuclear Generation (accessed February 7, 2023) (in French).
- EDF 2 (Électricité de France), Update on the Flamanville EPR – December 16, 2022 (accessed February 7, 2023).
- EDF 3 (Électricité de France), Clarifications on Hinkley Point C Project – July 3, 2017 (accessed February 7, 2023).
- EDF 4 (Électricité de France), Hinkley Point C Update – May 19, 2022 (accessed February 7, 2023).
- France government, France's New Energy Strategy – February 11, 2022 (accessed February 7, 2023) (in French).
- France NA (National Assembly), Emergency Measures for the Protection of Purchasing Power – July 15, 2022 (in French).
- IAEA 1 (International Atomic Energy Agency), Power Reactor Information System: Countries: Japan (accessed February 7, 2023).
- IAEA 2 (International Atomic Energy Agency), Safety Aspects of Nuclear Power Plant Ageing (January 1990).
- IAEA 3 (International Atomic Energy Agency), Power Reactor Information System: Countries: Japan – Monju Reactor (accessed February 7, 2023).
- IAEA 4 (International Atomic Energy Agency), Power Reactor Information System: Nuclear Power Capacity Trend (accessed February 7, 2023).
- IAEA 5 (International Atomic Energy Agency), Power Reactor Information System: Under Construction (accessed February 7, 2023).
- IAEA 6 (International Atomic Energy Agency), Power Reactor Information System (accessed February 7, 2023).
- IAEA 7 (International Atomic Energy Agency), Power Reactor Information System: Countries: Korea, Republic of (accessed February 7, 2023).
- IEA (International Energy Agency), World Energy Outlook 2022 (October 2022).
- ITER, What Is ITER? (accessed February 7, 2023).
- JAIF (Japan Atomic Industrial Forum), Current Status of Nuclear Power Plants in Japan – February 7, 2023.
- Japan government 1, Basic Policy for Realizing GX (Draft): Roadmap for the next 10 years – Document 1 (December 2022) (in Japanese).
- Japan government 2, Basic Policy for Realizing GX (Draft): Reference Material – Document 2 (December 2022) (in Japanese).
- Japan METI (Ministry of Economy, Trade and Industry), Selection of Offshore Wind Farm Operators Off the Coast of Noshiro City, Mitane Town and Oga City, Akita Prefecture, Off the Coast of Yurihonjo City, Akita Prefecture, and Off the Coast of Choshi City, Chiba Prefecture – December 24, 2021 (accessed February 7, 2023) (in Japanese).
- Japan MoF 1 (Ministry of Finance), Trade Statistics of Japan – Steam Coal Imports December 2022 (accessed February 7, 2023).
- Japan MoF 2 (Ministry of Finance), Trade Statistics of Japan – Liquefied Natural Gas Imports December 2022 (accessed February 7, 2023).
- JNFL (Japan Nuclear Fuel Limited), Reprocessing (accessed February 7, 2023).
- K. Oshima, 10 Years Since the Fukushima Nuclear Disaster: Where Does Japan's Energy Policy Go from Here? – March 8, 2021 (accessed February 7, 2023).
- KEEI (Korea Energy Economics Institute), South Korea to Raise Nuclear Energy Dependence to Over 30 Percent by 2036 – January 12, 2023 (accessed February 7, 2023).
- MHI (Mitsubishi Heavy Industries), Advanced Light Water Reactor "SRZ-1200" – September 29, 2022 (accessed February 7, 2023).
- NEI (Nuclear Energy Institute), Nuclear Costs in Context (October 2022).
- NUMO (Nuclear Waste Management Organization), Cost of Geological Disposal: Contribution (accessed February 7, 2023) (in Japanese).
- NuRO (Nuclear Reprocessing Organization), Project Costs for Reprocessing – June 25, 2021 (in Japanese).
- NuScale Power, VOYGR Power Plants (accessed February 7, 2023).
- OCCTO 1 (Organization for Cross-regional Coordination of Transmission Operators), Results of the 14th Solar Power Auction (3rd in 2022) (Photovoltaic Power Generation Facilities with a Power Output of 1,000 kW or more among the FIP Target Categories) – November 25, 2022 (in Japanese).
- OCCTO 2 (Organization for Cross-regional Coordination of Transmission Operators), Results of the Second Onshore Wind Power Auction (FY2022) – November 4, 2022 (in Japanese).
- OJEU (Official Journal of the European Union), Commission Delegated Regulation (EU) 2022/1214– March 9, 2022.
- Posiva, Major Construction Work Progresses on Posiva's ONKALO Worksite – December 5, 2022 (February 7, 2023).
- RTE (Réseau de Transport d'Électricité), Electricity Report 2021: Nuclear Generation (February 2022) (in French).
- STUK (Säteilyturvakeskus), Safeguards-by-Design: Experiences from New Nuclear Installations (November 2010).
- Toshiba, Fuel Cycle that Protects Natural Resources from Depletion (accessed February 7, 2023).
- United Kingdom Government, British Energy Security Strategy (April 2022).
- WNISR (World Nuclear Industry Status Report), The World Nuclear Industry Status Report 2022 (October 2022).
- WNN (World Nuclear News), Further Cost Refinements Announced for First US SMR Plant – January 9, 2023 (accessed February 7, 2023).

Japan’s Nuclear Power New Policy: Off the Mark
February 2023

Author
Romain Zissler, Senior Researcher, Renewable Energy Institute

Editor
Masaya Ishida, Senior Manager, Business Alliance, Renewable Energy Institute

Renewable Energy Institute
11F, KDX Toranomon 1-Chome Bldg., 1-10-5 Toranomon, Minato-ku, Tokyo 105-0001 JAPAN　TEL：+813-6866-1020

www.renewable-ei.org/en/