Nuclear Energy in Green Transformation (GX)

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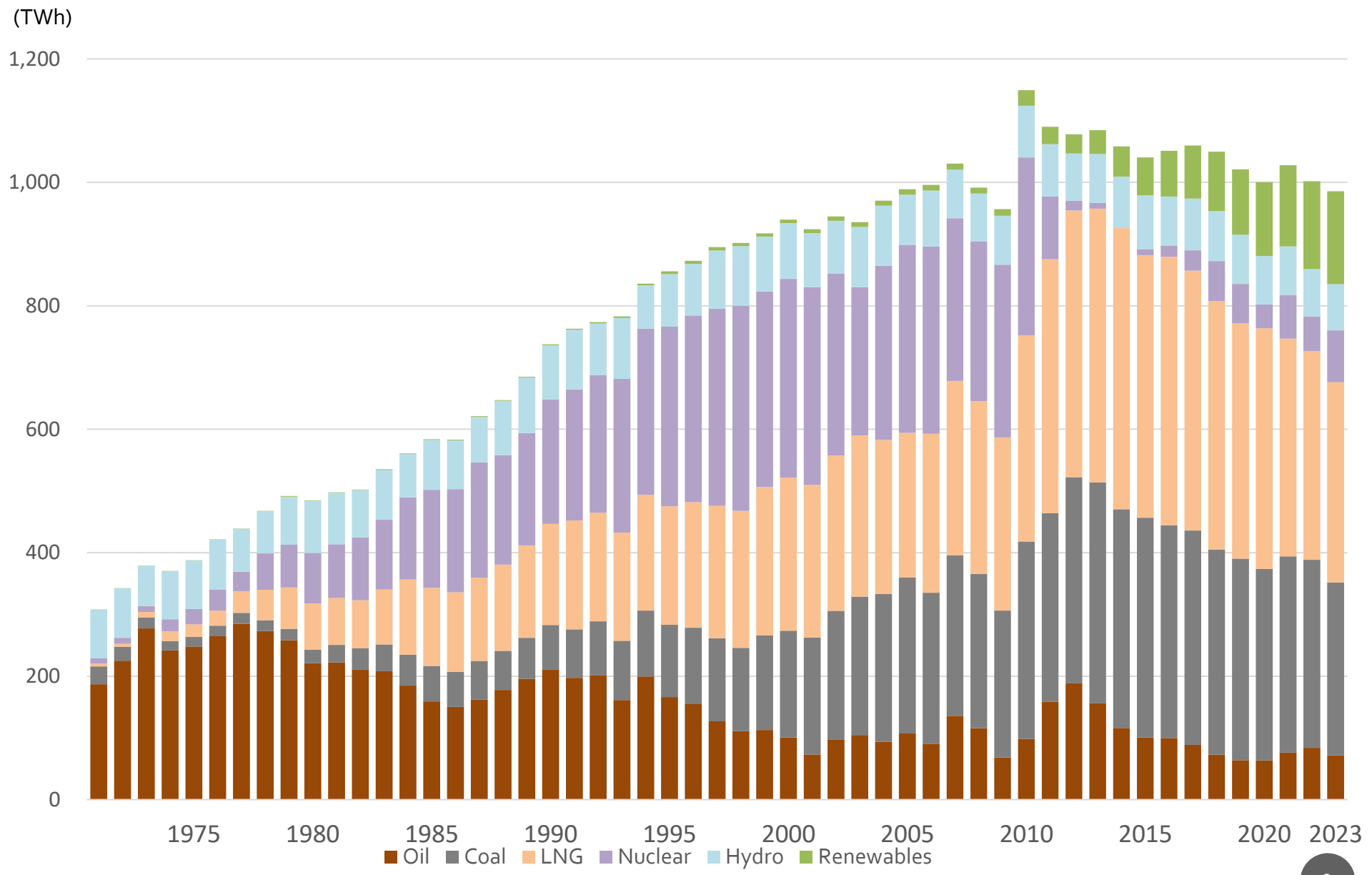
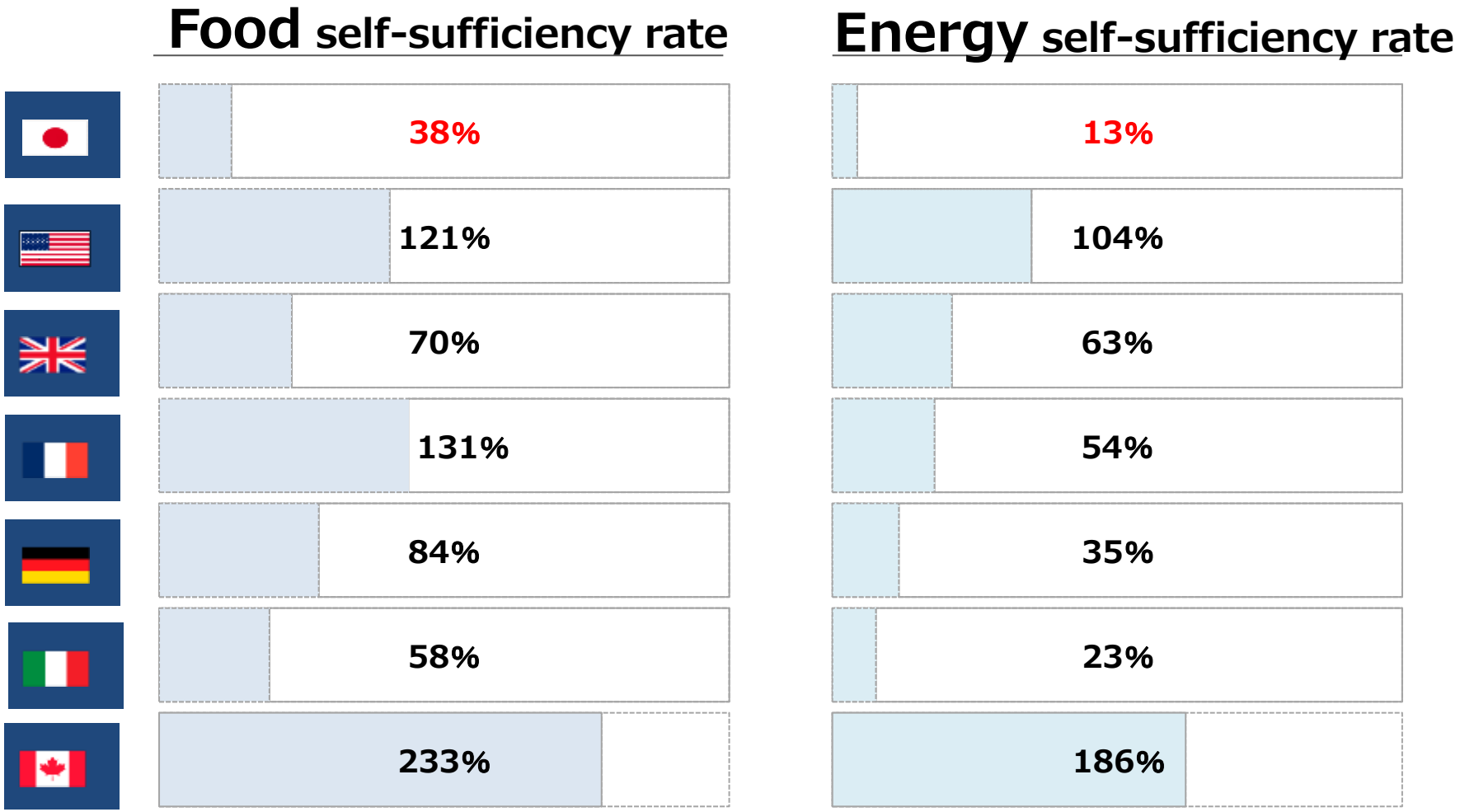
3E+S


Energy security
安定供給
Economic Efficiency
経済効率性
Environment
環境への適合
Safety
安全性

Japan's electricity production by sources



Japan's Challenge in Energy Security



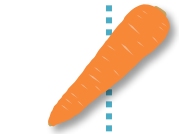
(Source) Food self-sufficiency rate (2019): Created by the Ministry of Economy, Trade and Industry based on materials disclosed by the Ministry of Agriculture, Forestry and Fisheries (Food Self-sufficiency Rate of Countries and Regions

Energy self-sufficiency rate (2021): IEA database (data obtained as of June 22, 2023), and created by the Ministry of Economy, Trade and Industry based on "General Energy Statistics (FY2021 firm data)" for Japan

GX (Green Transformation) enables Carbon Neutrality

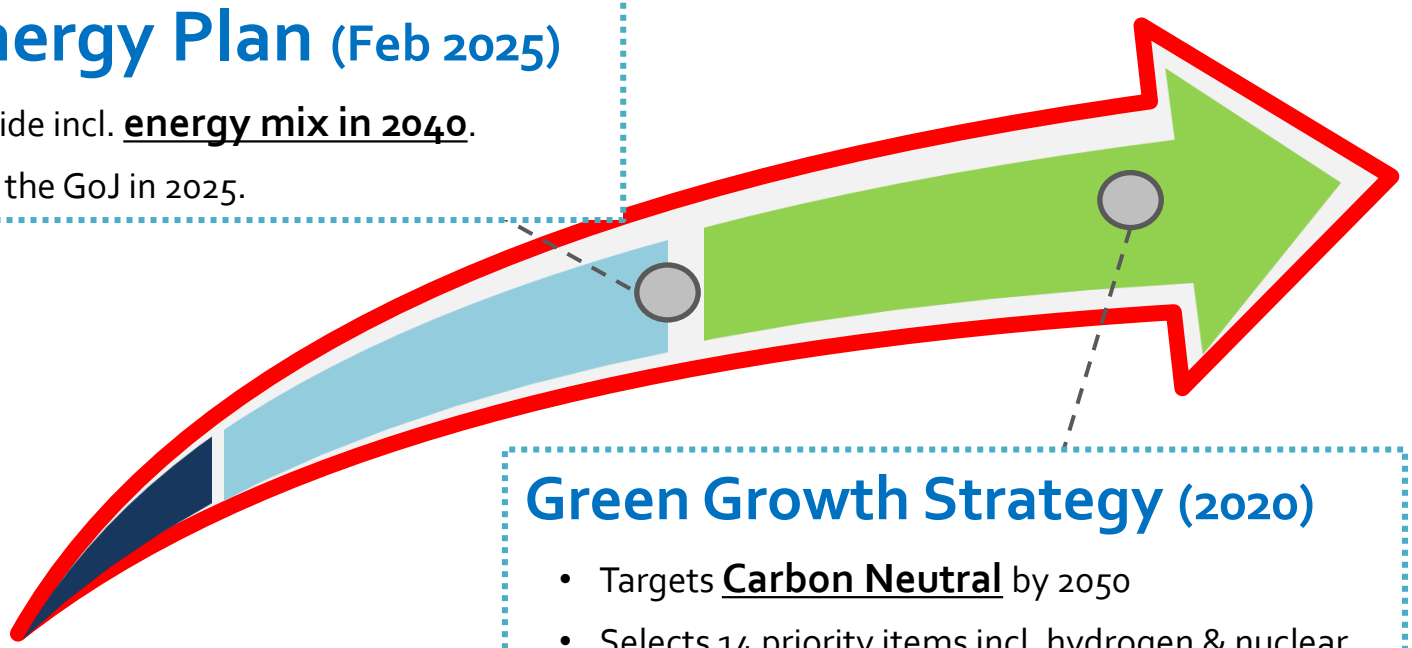
Basic Policy for GX (2023)

- Delivers both emission reduction and economic growth.
- Carrot: **¥150 trillion** of public + private investments over a decade, powered by **Transition Bonds**.
- Whip: Pro- Growth **Carbon Pricing** system to be introduced.



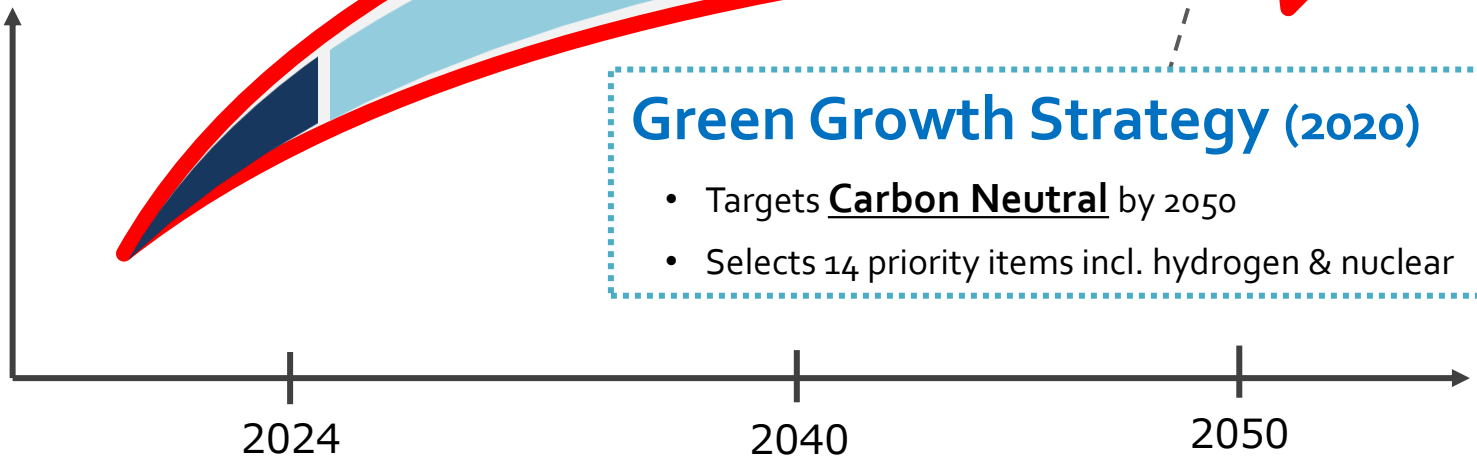
Strategic Energy Plan (Feb 2025)

- Focuses on supply-side incl. **energy mix in 2040**.
- To be authorized by the GoJ in 2025.

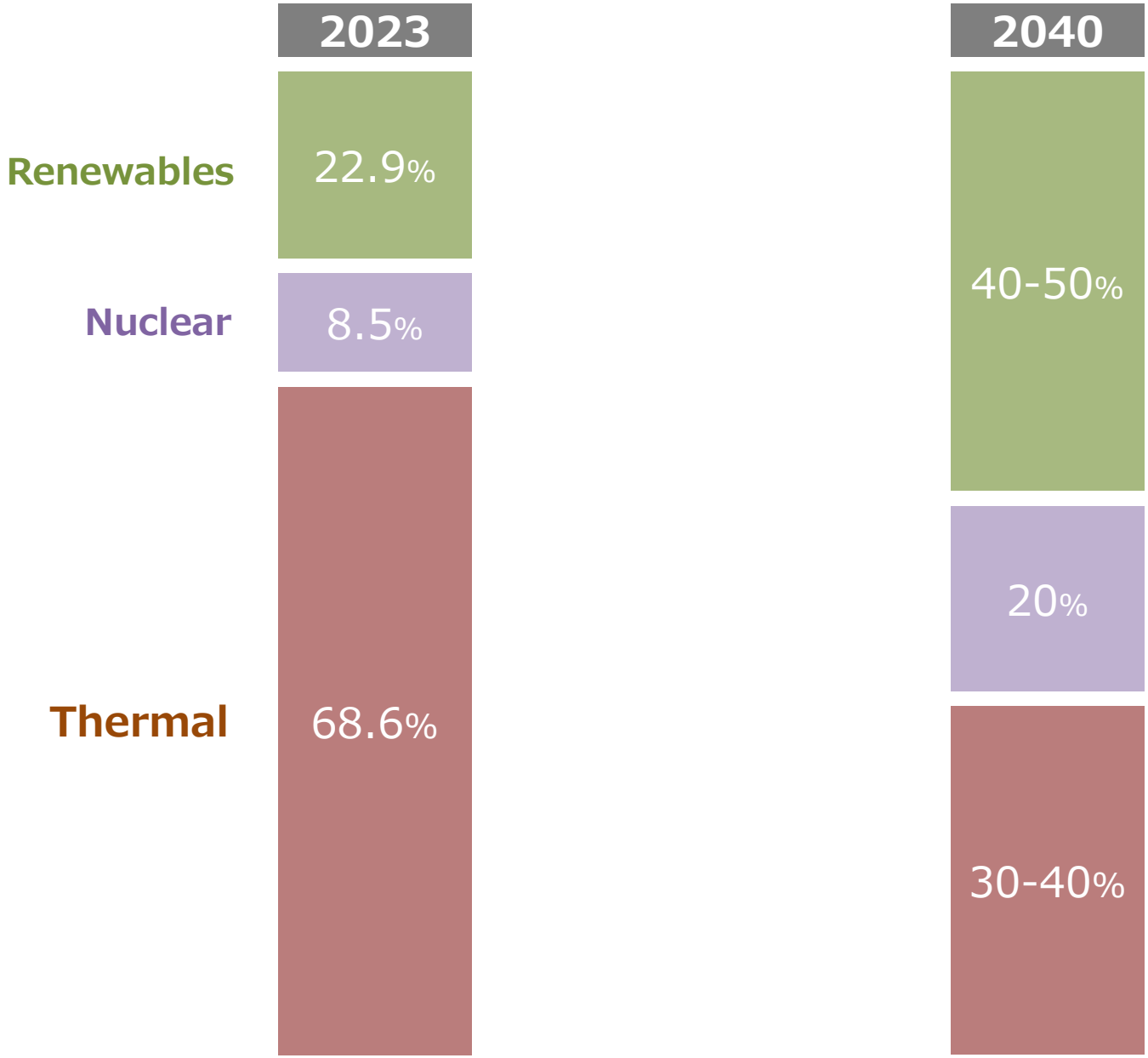


Green Growth Strategy (2020)

- Targets **Carbon Neutral** by 2050
- Selects 14 priority items incl. hydrogen & nuclear



Energy Mix in 2040 (on revised "Strategic Energy Plan")



Quotes from the latest "Strategic Energy Plan" (1)

- We maintain the principle of S+3E (Safety, Energy Security, Economic Efficiency, and Environment), the cornerstone of energy policy.
- On the premise of safety, **the first priority is to ensure a stable energy supply, while improving economic efficiency and environment suitability**.
- To realize a transition to a resilient energy supply-demand structure that can withstand energy crises, we will promote thorough energy efficiency improvement and fuel switching within the manufacturing, while **maximizing the use of decarbonized power sources such as renewables and nuclear power**, both of which contribute to energy security.

Quotes from the latest "Strategic Energy Plan" (2)

- **Nuclear power has features such as excellent supply stability and technological self-sufficiency rate**, cost levels comparable to other energy sources with little price fluctuation, and stable power generation at a constant output.
- These characteristics also meet the needs of new demand from data centers, semiconductor plants and others, and we will continuously utilize the necessary amount of nuclear power on the premise of ensuring safety and public trust.
- Policies aim at coexistence with host communities, deepening and enhancing communication with various sectors of the public, and **accelerate back-end processes such as nuclear fuel cycle, decommissioning, and final disposal.**

Quotes from the latest "Strategic Energy Plan" (3)

- The private sector and the government will work together to **accelerate the restart of nuclear power plants**, including industry collaboration, government-led activities to promote understanding, and nuclear disaster prevention measures, all based on the premise that safety must be ensured.

- The **development and deployment of next-generation advanced reactors** with built-in new safety mechanisms will be materialized, as long as they contribute to the maintenance and development of local industries and employment and can be understood by the local community, within the sites of operators with nuclear power plants that have been determined to be decommissioned, taking developments in back-end such as the completion of the Rokkasho Reprocessing Plant (RRP) into account.

Outlook for Energy Supply & Demand in 2040

		Fiscal Year 2023 (Preliminary Report)	Fiscal Year 2040 (Outlook)
Energy self-sufficiency rate		**15.2%**	**Approx. 30-40%**
Amount of electricity generated		**985.4 billion kWh**	**Approx. 1.1 to 1.2 trillion kWh**
Power generation mix	**Renewable energy**	**22.9%**	**Approx. 40-50%**
	Solar PV power	9.8%	Approx. 23% to 29%
	Wind power	1.1%	Approx. 4-8%
	Hydropower	7.6%	Approx. 8-10%
	Geothermal power	0.3%	Approx. 1-2%
	Biomass	4.1%	Approx. 5-6%
	Nuclear power	**8.5%**	**Approx. 20%**
	Thermal power	**68.6%**	**Approx. 30-40%**
Final energy consumption		**300 million kL**	**Approx. 260 to 270 million kL**
GHG reduction rate (compared to FY2013)		**22.9% (%)** (Actual results in FY2022)	**73%**

(Reference) In this outlook, in addition to the case where a 73% reduction is achieved in FY2040, an alternative scenario where the 73% reduction is not achieved (61% reduction) is also presented as a reference value. In the case of the 73% reduction, the primary energy supply of natural gas in FY2040 is estimated to be 53-61 million tons, but in the alternative scenario, it is estimated to be 74 million tons.

Progress in nuclear energy policy (2023)

February

2

Cabinet Decision

April

4

Ministers' Decision

May

5

Related legislation

Basic Policy for Realization of GX

"In order to ensure stable supply of energy, in addition to thorough energy efficiency improvement, we will promote decarbonization initiatives toward GX, such as switching to decarbonized power sources that contribute to improving the self-sufficiency rates of energy, like renewable energy and nuclear power."

—METI press release

Nuclear Energy Policy Direction

- ✓ All-out efforts for restart
- ✓ Maximum use of existing reactors
- ✓ Development/construction of next-generation advanced reactors
- ✓ Back-end process acceleration
- ✓ Maintain/strengthen supply chains
- ✓ Contribute to solving common international issues

GX-related Acts

New legislation made changes to energy-related laws so that the calculations of a NPP's operating lifetime would not include periods when its operation was suspended due to unforeseeable reasons, only in cases where the METI minister admit the adequacy.

Nuclear Energy Policy Direction in Japan

1. All-out Efforts for Restarting NPPs

- Voluntary Improvements on Safety, Coexistence with Local Communities

2. Maximum use of Existing Reactors

- Develop a Framework for NPP Operation Period, under the premise of safety

3. Develop/Construct of Next-gen Advanced NPPs

- Target on rebuilding the site which has been decided DCM (decommissioning),
- Improve in NPP Business Env and HRD, Promote Intl' R&D (incl. SMR)

4. Accelerate Back-end Process

- Promote Fuel Cycle, Steady & Efficient DCM, Efforts for Final Disposal

5. Maintain/Strengthen Supply-chain

- Reinforce JPN Supply-chain, by Support to Industry for join in Intl' Projects

6. Contribute to Solve Common Intl' Issues

- Cooperation among like-minded economies, Ensuring Nuclear Safety in Ukraine

NPPs in Japan

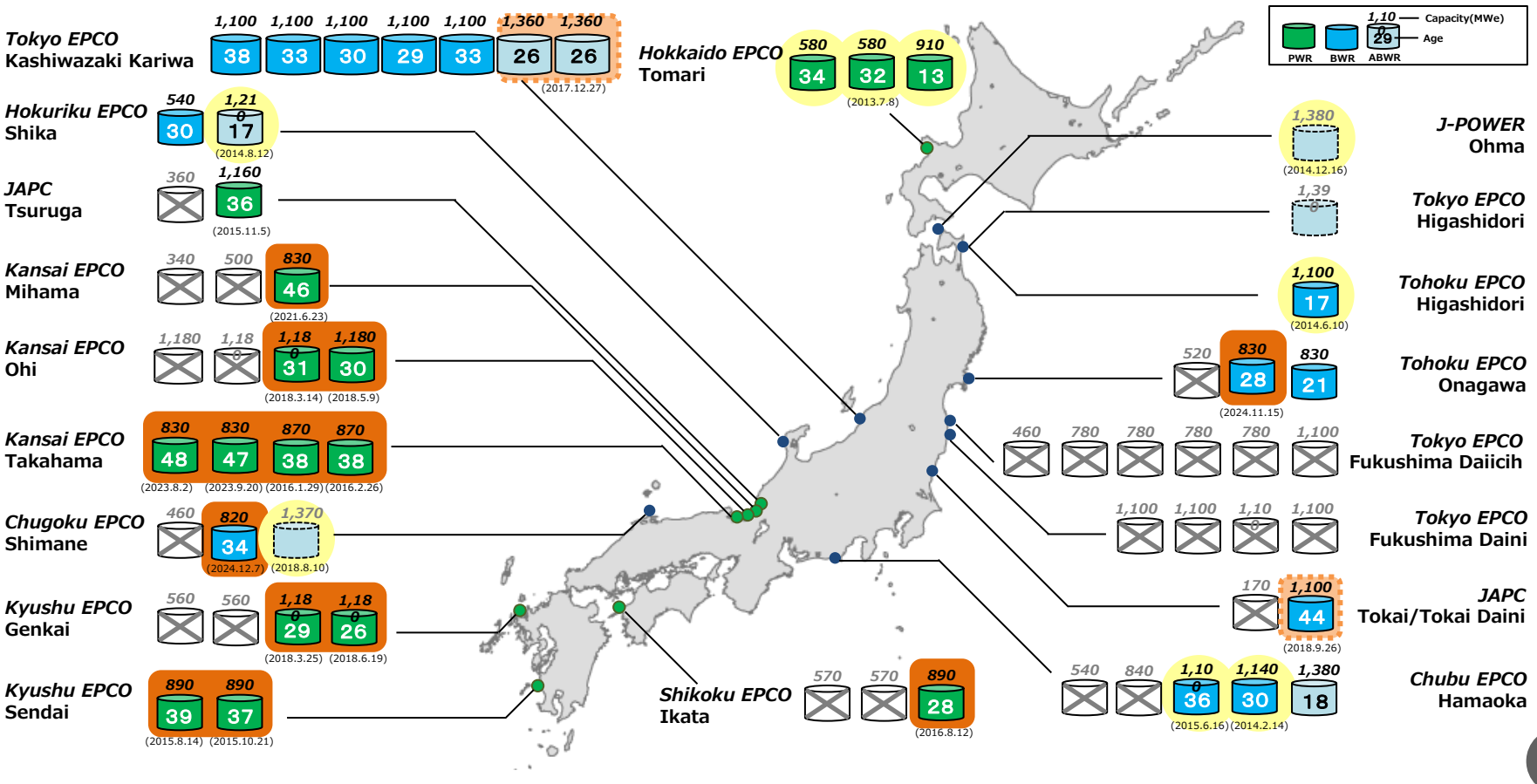
Restarted
14 reactors
(Date of Restart)

Passed NRA Review
for the Permission for Changes in Reactor Installation
3 reactors
(Date of Approval)

Under NRA Review
9 reactors
(Date of Application)

Not yet Applied
10 reactors

Decommission
24 reactors



Restarted BWRs finally!

女川

Onagawa-2 / **Tohoku EPCO**

- ✓ Restarted on **15 Nov 2024**
- ✓ Gross Capacity: 825MWe
- ✓ Operation Started: 28/Jul/1995

* Suspended since 11/Mar/2011

島根

Shimane-2 / **Chugoku EPCO**

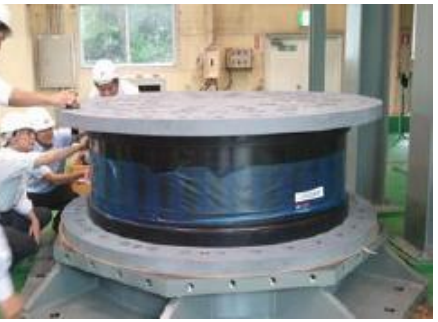
- ✓ Restarted on **7 Dec 2024**
- ✓ Gross Capacity: 820MWe
- ✓ Operation Started: 10/Feb/1989

* Suspended since 17/Jan/2012

Safety Improvements after the FDNPS Accident

High-temp. Resistant Corium Shield

- ✓ Catching Melted-fuel in Accident
- ✓ Installed in Kashiwazaki-Kariwa NPP, Unit 5/6



Seismic Isolation System

- ✓ Improve safety by standardizing seismic design
- ✓ Reflected in Tech Guideline by JEA*

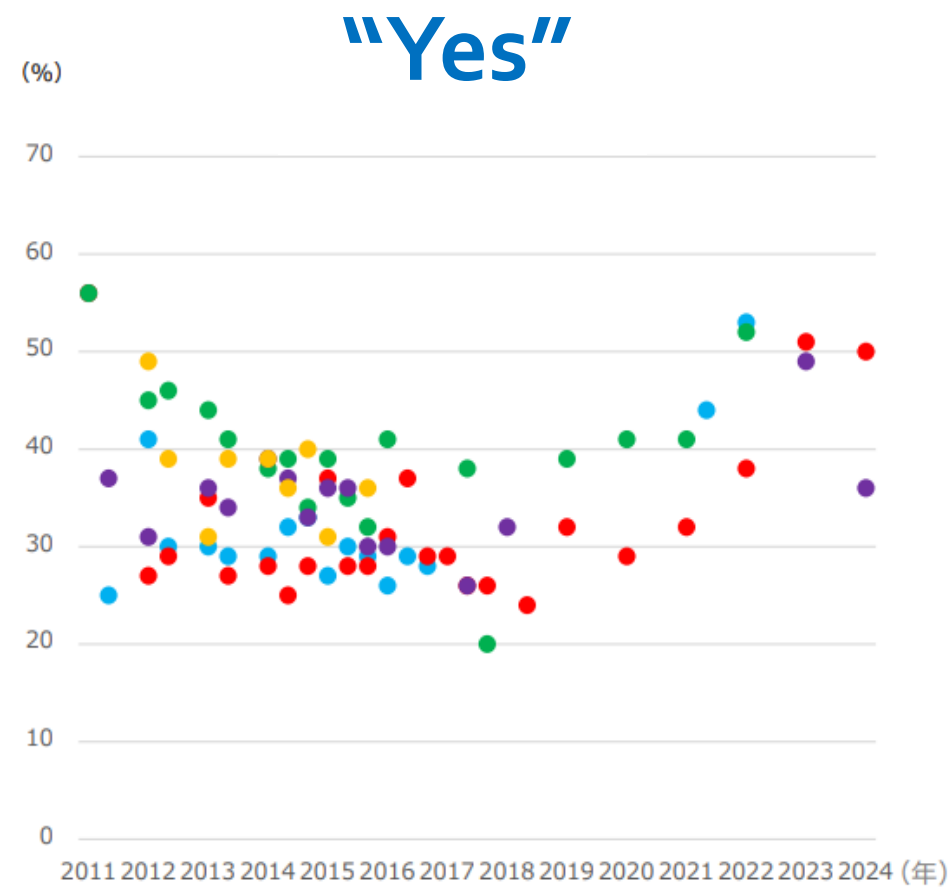
* Japanese Electric Association

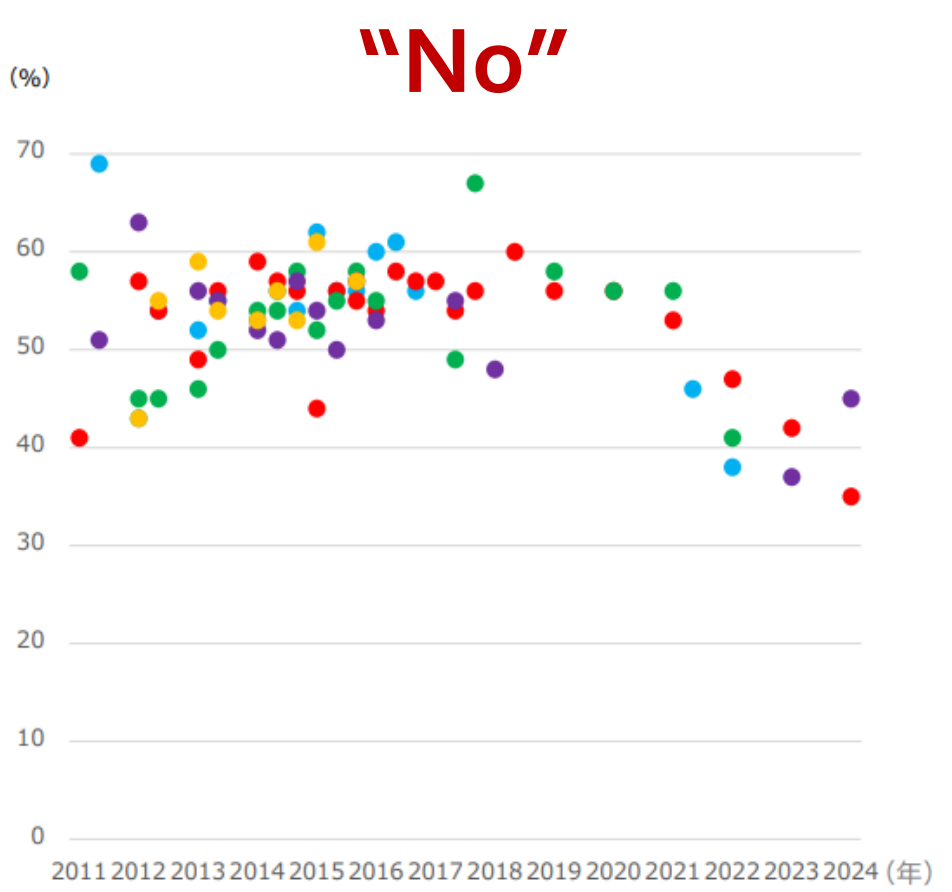
Accident Tolerant Fuel

- ✓ R&D on Coated Cladding Tubes (ex. Cr)
- ✓ Plans Irradiation Tests w/ intl' partners

Poll by newspapers

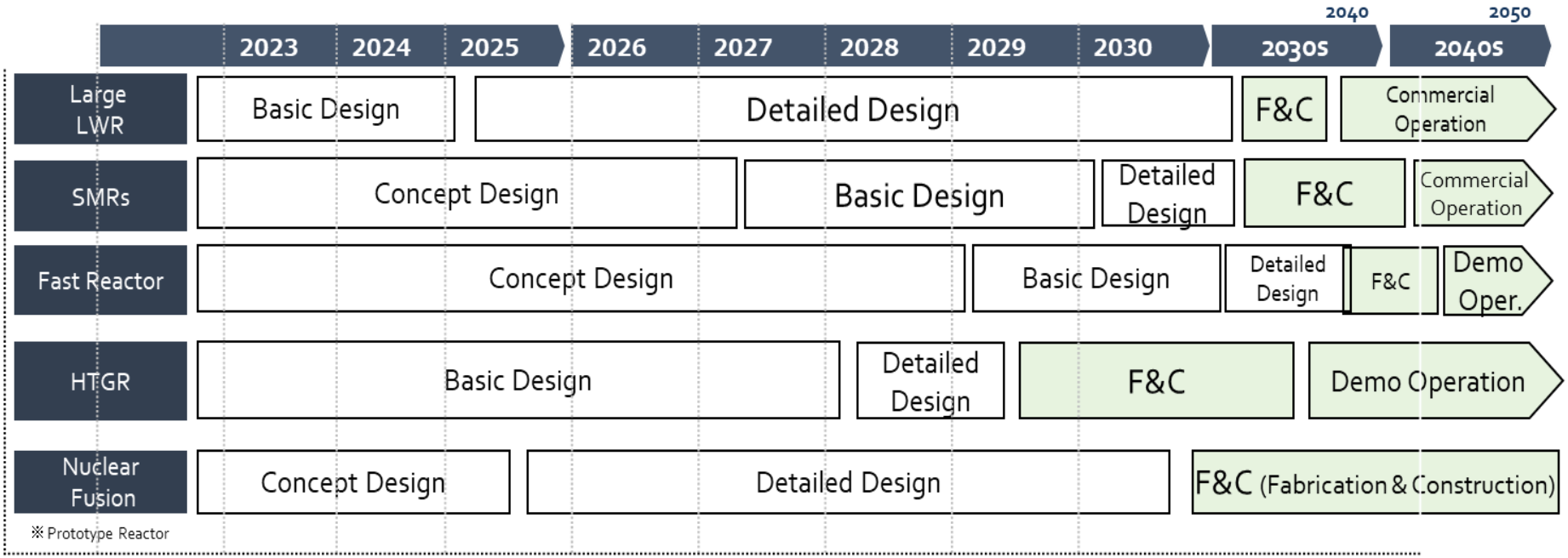
Q. Do you agree to restart existing NPPs?





Nikkei | Asahi | Yomiuri | Mainichi | Sankei

"GX" Funds for R&D of Advanced Reactors



The investment scale will be **1 Trillion JPY (6.1B EUR) in 10 years**, incl.

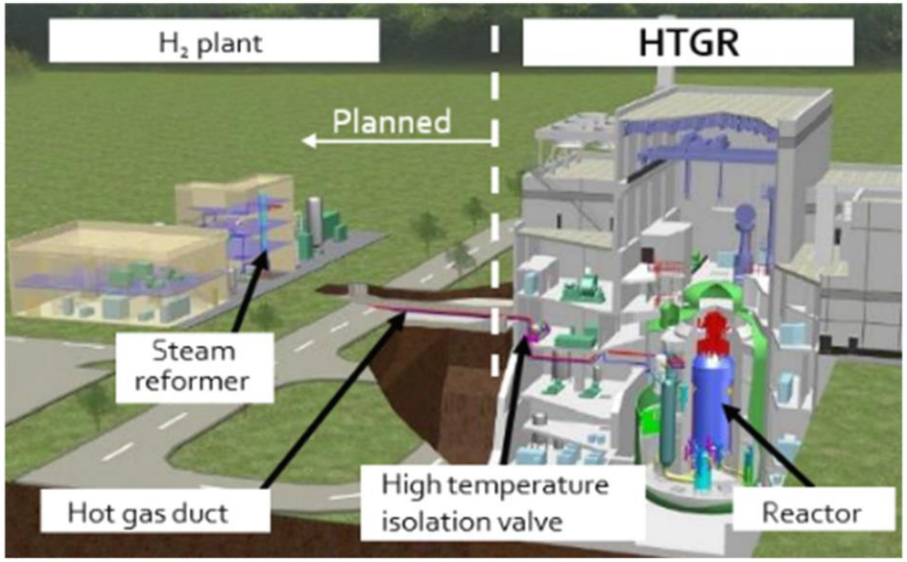
- **Sodium-cooled Fast Reactor**: **123B JPY (756M EUR) for 2023-26**
- **High Temp Gas-cooled Reactor**: **130B JPY (799M EUR) for 2023-26**

GX-funded R&D on the HTGR in Japan

2001	2004
Test Reactor (HTTR) started operation	Reactor Outlet marked **950°C** (1st in the world)

2022	2023	2024	2025	2026	2027	2028	2029
Design modified from HTTR (incl. H_2 Production Plant)				Manufacturing, Installment, H_2 Production Test (exp. 2028-30)			
	Basic – Detailed Design on Demonstration Reactor						**F&C**

2030s (exp.)
Construction & Operation



GX-funded R&D on the SFR in Japan

2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Competitive Studies					Conceptual Design, R&D on Demo-Reactor					Basic Design

Dec. 2022
SFR was evaluated as the most promising

Summer 2023
Reactor Specification was selected

Around 2026
Study on Specific Fuel Technologies
(ex. Oxide or Metal)

Around 2028
Decide whether to step to basic design

International Projects on SMR

NuScale / **VOYGR™**

- ✓ PWR, 50-77MW per module
- ✓ **JGC**, **IHI, CEPCO**, and **JBIC** involved
- ✓ Grid Connection by **2029** (exp.)

©GE-Hitachi

GE-Hitachi / **BWRX-300**

- ✓ BWR, 300MW
- ✓ **Hitachi** jointly developed with GE
- ✓ Grid Connection by **2030** (exp.)

Act on the Economic Security Promotion

内閣府
Cabinet Office

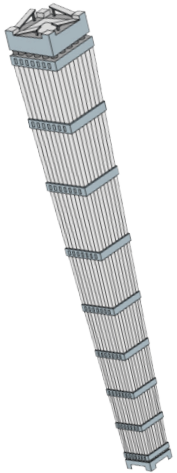
✓ designated **Uranium as Critical Minerals** in the Act in Feb 2024.

経済産業省
Ministry of Economy, Trade and Industry

✓ has granted Uranium mining yearly.

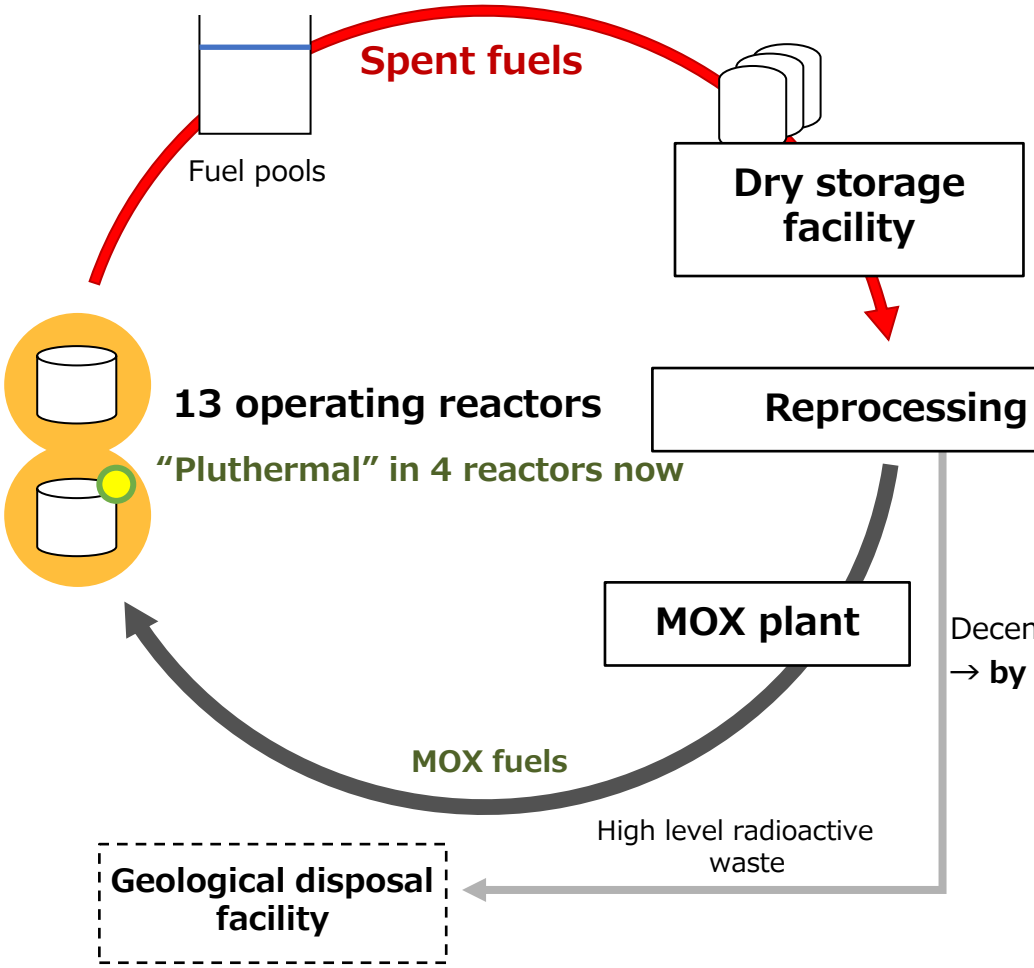
✓ Granted JNFL for increasing capacity of enrichment (10B JPY in Dec 2024)

↑ ↓ Photos taken in **Uzbekistan**



Japan seeks for nuclear fuel cycle incl. reprocessing

✓ Japan promotes fuel cycle by reprocessing SF, using recovered plutonium and others. It aims for **effective use of resources**, **reduction of radioactive waste volume**, and **reduction of radioactive waste toxicity**.



July 2020 general permission
→ by **the end of FY2026**

December 2020 general permission
→ by **the end of FY2027**

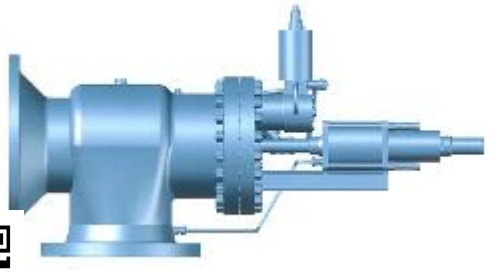
Industry makes LWR-SMR projects robust

Large forging
(Japan Steel Works)

Steam Turbine & Generator
(Toshiba)

Pressure Vessel
(IHI)

Moisture Separator Reheater Relief Valve (TVE)



Steam generator (MHI)

Reactor Feedwater Pump (Ebara Corporation)

Nuclear Supply Chain Map

1 RPVs, Turbines, Reactor Internals, etc.

Turbine
MHI, Toshiba

Turbine Materials
JSW M&E,
Pacific Steel MFG.

RPV
MHI, IHI

Large forgings
JSW M&E

Secondary System Equipment
MHI, Toshiba, IHI,
Tsubaki Nakashima (blowers)
Hitachi Zosen (Tank),
Hisaka Works (Heat exchanger)

Control Rod Drive
MHI, Toshiba, Hitachi

Control Rods/ Materials
Hitachi Metals,
Daido Steel

Steam Generator
MHI

Heat Transfer Tubes
Nippon Steel

Containment Vessel
MHI, Hitachi, IHI

Reactor Internal
MHI, Hitachi, Toshiba

Core Components
Toyo Tanso (High Purity Carbon) ,
Fuji Electric (High-temperature gas-cooled reactor, core)

Reactor Internal Materials
Daido Steel,
Hitachi Metals,
Tamagawa Seiki

Radiation related
NICHIAS,
Sugino Machine

Fuel related equipment
Fuji Electric,
Kimura Chemical Plants

2 Coolant, Safety Systems, etc.

Pumps
MHI, Ebara,
Hitachi, DMW,
Kansui Pump, Nikkiso,
Teikoku Machinery Works,
Sukegawa Electric (Electromagnetic pump)

Seals, etc.
VALQUA,
Advance Seal,
Shinwa Industries,
NICHIAS,
Nippon Pillar Packing

Valve
TVE,
Okano Valve MFG.,
Hirata Valve Industry,
Eagle Industry,
Fujikin,
Ohno Bellows,
Utsue Valve

Valve material
Nippon Gear (actuator),
Miyaji tekkosho (body)

Water supply, drainage and condensate systems
ORGANO,
Kurita Water Industries,
BENKAN KIKOH

Pipe, Pipe Support, Thermal Insulation
NIPPON STEEL,
JFE Steel,
SANWA TEKKI,
NHK Spring, NICHIAS,
Hanwa

3 Electrical, Instrumentation, etc.

Electrical
Toshiba,
Mitsubishi Electric,
KURIHALANT

Cables
Hitachi Metals,
Furukawa Electric,
Fujikura Dia Cable

Power Transmission and Distribution
SHIMADZU, TMEIC,
Sumitomo Electric Industries

Measuring Instruments
YOKOGAWA,
Sukegawa Electric,
Okazaki Manufacturing

Transformers
Toshiba, Hitachi
Mitsubishi Electric,
MEIDEN

4 Construction, Maintenance, Safety Management

Fuel
NFI
MNF
GNFJ

Air conditioning
SHINRYO,
SNK,
Hitachi Plant Services

Analysis and Inspection
Chiyoda,
Non-Destructive Inspections,
NEL, NESI,
DIA Consultants,
IHI Inspection & Instrumentation

Other
Mitsubishi Materials,
Waco Giken,
Taihei Dengyo,
KOBELCO,
Nuclear Fuel Transport,
KAMIGUMI, UTOC,
SANKYU, Denka,
Other Construction companies

You can see more details... →

Japan contributes to Embarking Economies

1. **Host Technical Tours in Japan**
   - Training, Seminar, Workshop, based on real lessons learned
   - In line with IAEA Milestones Approach with 19 items
   - Site visits such as Operating NPP, Scientific Labs, Manufacturing Factories
2. **Dispatch Ad-hoc Missions to the States**
   - Japanese experts (Gov, Lab, Industry, Utilities) helps based on your needs
   - Business-focused mission can promote your economic growth
3. **Financial Support in deployment of SMR and others**
   - Mainly after contracting vendors, involved by Japanese companies

FIRST Study Tour in Japan (June 2024)

8. Nuclear energy: These countries recognise **nuclear energy as a source of baseload power, providing grid stability and flexibility**, and optimising use of grid capacity, while countries that do not use nuclear energy or do not support its use prefer other options to achieve the same goals, taking into account their assessment of associated risks and costs of nuclear energy.

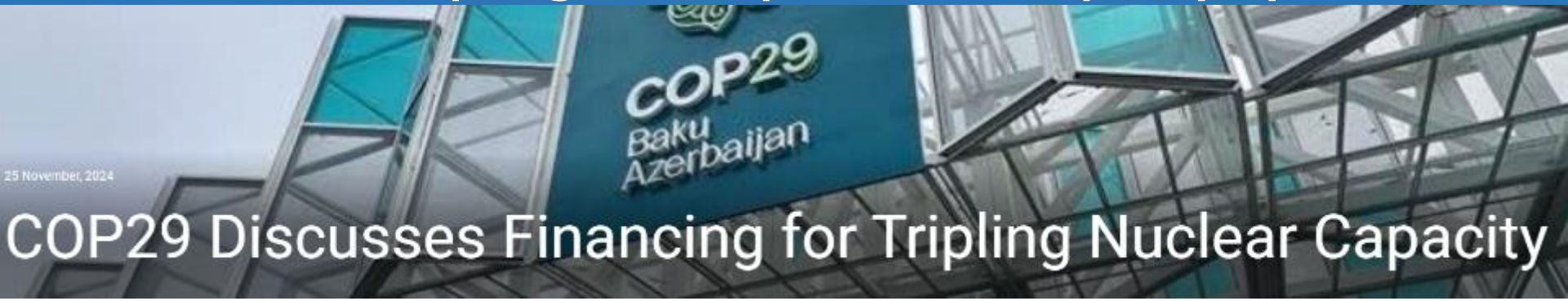
G7 Climate, Energy and Environment Ministers' Communiqué (Excerpt)

Trino, April 29-30, 2024

We commit to:

- support multilateral efforts to **strengthen resilience of nuclear supply chains;**
- for those countries that opt to use nuclear energy or support its use, **promote research and development initiatives on innovative nuclear power technologies;**
- …**promote the responsible deployment of nuclear energy technologies** including for advanced and small modular reactors, including microreactors, and work collectively to share national best practices,…

31 countries pledged to triple nuclear capacity by 2050



…*Recognizing* that analysis from the Intergovernmental Panel on Climate Change shows nuclear energy approximately tripling its global installed electrical capacity from 2020 to 2050 in the average 1.5° C scenario;

… *Commit* to work together to advance a global aspirational goal of tripling nuclear energy capacity from 2020 by 2050, recognizing the different domestic circumstances of each Participant;

…*Commit* to supporting the development and construction of nuclear reactors, such as small modular and other advanced reactors for power generation as well as wider industrial applications for decarbonization, such as for hydrogen or synthetic fuels production;

ご清聴
ありがとう
ございました

Thank you for your attention!

谢谢您的关注!

謝謝您的關注!

주목해 주셔서 감사합니다!

Terima kasih atas perhatian Anda!

¡Gracias por su atención!

Merci de votre attention!

Salamat sa iyong atensyon!

Спасибо за ваше внимание!

ขอบคุณสำหรับความสนใจของคุณ!

Cảm ơn bạn đã chú ý!