

# Electric Power Policy Challenges for 2025

How will stable electric power supply be maintained amid increasing demand?

---

**The Institute of Energy Economics, Japan**

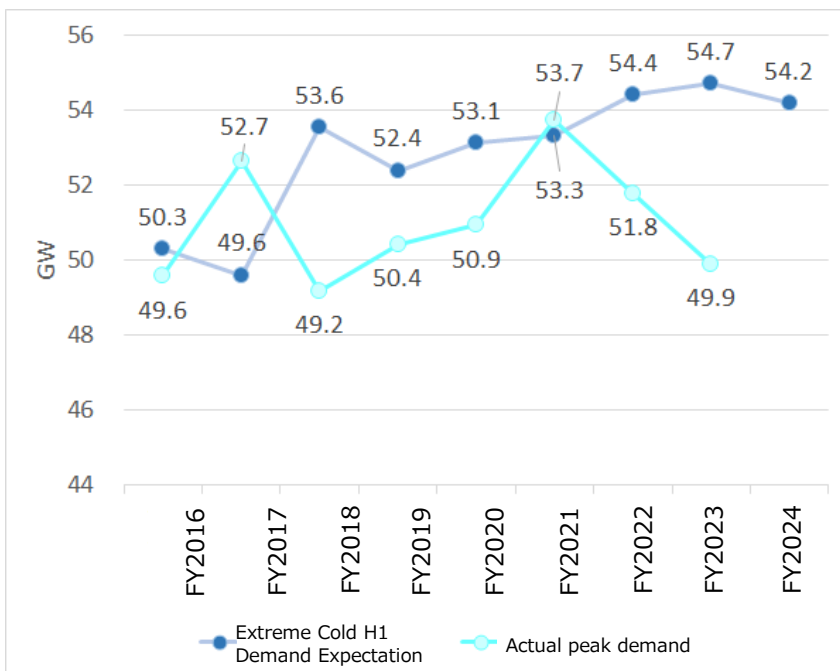
Kenichi Onishi

Electric Power Group, Electric Power Industry Unit

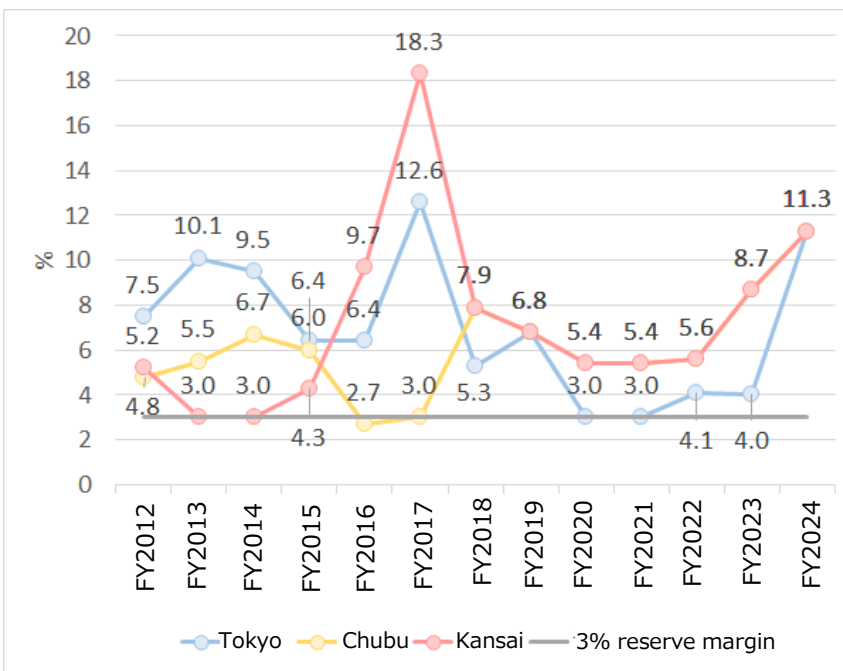
# Japan: Supply/demand outlook for winter FY2024

- For the winter of FY2024, it is expected to be possible to secure a **reserve margin of the 3% necessary minimum or higher** in all areas in the case of Extreme Cold H1 Demand (1).
- Extreme Cold H1 Demand in the Tokyo area is trending up. The mild winter of FY2023 saw actual demand fall.
- Due to the **supply capacity secured in the capacity market from FY2024**, provisions for stable electric power supply have been enhanced. However, securing power supply volume (kWh) will continue to be important in the medium- to long-term.

1. "Extreme Cold H1 Demand" references the peak electricity demand (Extreme Cold H1 Demand) of the coldest year in the past 10 years.



Expected and actual winter demand in the Tokyo region



Forecast reserve margin for January

Chart: Forecast supply and demand at time of winter Extreme Cold H1 Demand

Source: The Institute of Energy Economics, Japan, using figures for 2013–2015 from the Electricity Supply and Demand Verification Subcommittee Report and for 2016 onward, from the Electricity Supply and Demand Verification Report

# Japan: Supply/demand outlook for summer and winter FY2025

- In the supply and demand forecast for FY2025 released in October 2024, factors such as shutdown or closure of power plants and regular inspections and large-scale repairs overlap, so while a reserve margin of the 3% necessary minimum or higher is expected to be secured, there is little leeway.
- To summarize the supply plans, from FY2025 the suspension or discontinuation of thermal power plants increases and is anticipated to continue to exceed new building and plant expansion. Therefore, capacity needs to be secured (be it restarting nuclear power plants or Long-Term Decarbonization Power Source Auctions, etc.), the power grid upgraded, and demand measures taken.

	Jul	Aug	Sep
Hokkaido	7.9	7.2	13.6
Tohoku	7.9	7.2	13.6
Tokyo	5.5	7.2	13.6
Chubu	5.5	7.2	13.6
Hokuriku	9.2	11.1	13.6
Kansai	9.2	11.1	13.6
Chugoku	9.2	11.1	13.6
Shikoku	25.8	23.6	21.5
Kyushu	13.6	11.1	13.6
Okinawa	27.2	36.8	32.3

Dec	Jan	Feb	Mar
20.5	7.7	8.1	14.8
20.5	7.7	8.1	12.3
20.5	7.7	8.1	20.1
11.1	7.7	9.7	20.1
11.1	8.9	9.7	20.1
11.1	8.9	9.7	20.1
11.1	8.9	9.7	20.1
11.1	8.9	9.7	20.1
11.1	8.9	9.7	20.1
10.3	6.0	3.2	20.1
37.0	34.1	45.6	51.0

	Jul	Aug	Sep
Hokkaido	12.9	18.9	23.8
Tohoku	8.4	5.5	7.8
Tokyo	4.5	5.5	4.0
Chubu	4.5	5.5	4.0
Hokuriku	4.5	5.5	8.5
Kansai	4.5	5.5	8.5
Chugoku	4.5	5.5	8.5
Shikoku	4.5	5.5	8.5
Kyushu	4.5	5.5	19.7
Okinawa	28.8	29.2	34.3

Dec	Jan	Feb	Mar
14.1	7.3	10.4	16.2
13.2	5.1	10.4	16.2
9.6	2.1	0.4	6.7
9.6	6.1	3.2	9.1
9.6	6.1	5.9	16.4
9.6	6.1	5.9	16.4
9.6	6.1	5.9	16.4
9.6	6.1	5.9	16.4
9.6	6.1	5.9	16.4
9.6	6.1	5.9	16.4
30.7	31.3	51.2	63.1

(FY2025 forecast, %)

(Ref: FY2022 forecast, %)

Chart: Forecast supply and demand under Extreme Weather H1 Demand

# Japan: Electricity demand forecast

- In demand estimates for the coming decade by the Organization for Cross-regional Coordination of Transmission Operators (OCCTO), electric power demand nationwide (end user) will increase by an average of 0.4% from FY2023 to FY2033, which contrasts with the demand estimates of January 2023, which anticipated a 0.2% reduction on average from FY2022 to FY2032. This upturn is worth watching.
- Demand in FY2023 was lower than FY2022 due to falling residential demand as the work-from-home rate dropped as well as conservation measures. Power demand is anticipated to increase in the future as a result of the continued construction and expansion of data centers and semiconductor plants.

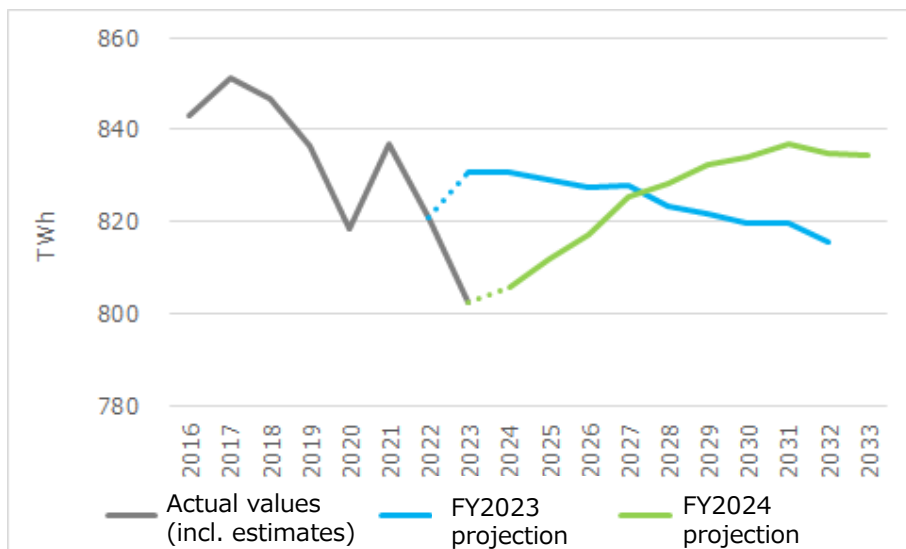


Chart: Total national electricity demand (end user)

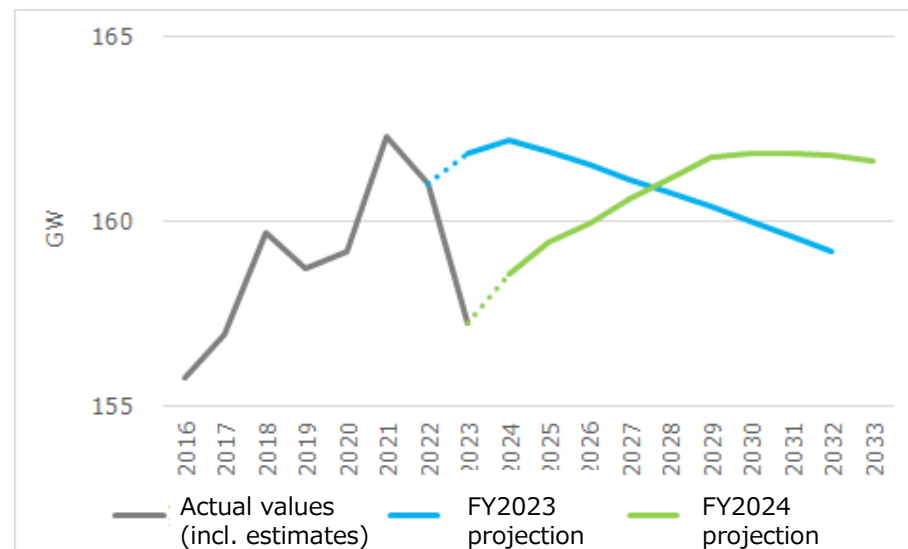


Chart: Peak national electricity demand (Aug: output)

# Japan: Forecast data center power demand

- OCCTO predicts that increased construction and expansion of data centers and chip plants will add 5.37 GW to peak power demand in FY2033.
- Across Japan, there are about 1.5 million m<sup>2</sup> of data centers on the basis of surface area covered by servers (around 30 Tokyo Domes). More than 80% of these are concentrated in Tokyo and Osaka regions.
- In the Tokyo region, there may be long-term delays in the future in connecting new data centers to the grid where grid strengthening is required. In addition to measures to ensure quick grid connections going forward, it is important to promote the dispersal of data centers outside of the Tokyo and Osaka regions for those projects not requiring ultra-high data speeds.

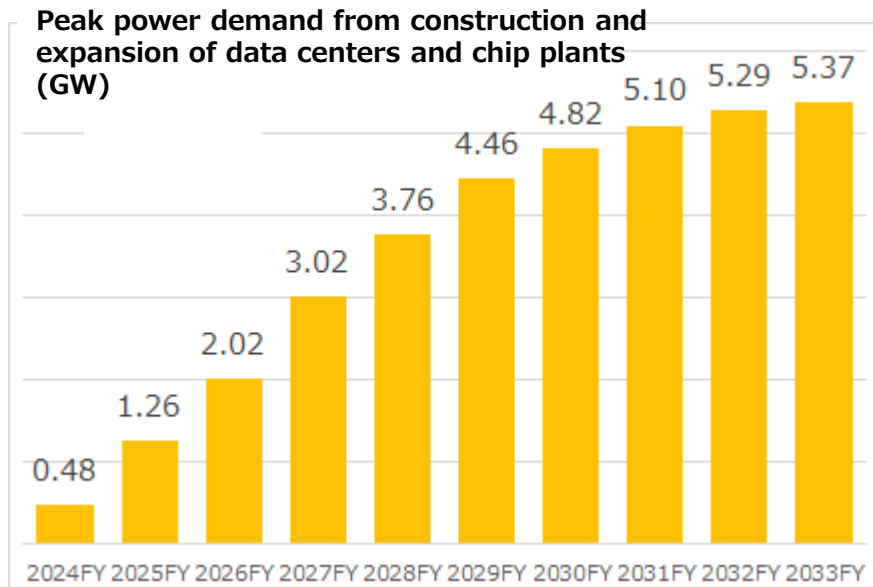


Chart: Peak power demand from construction and expansion of data centers and chip plants

Source: OCCTO, 2024. Demand forecast nationally and by supply area (FY2024)

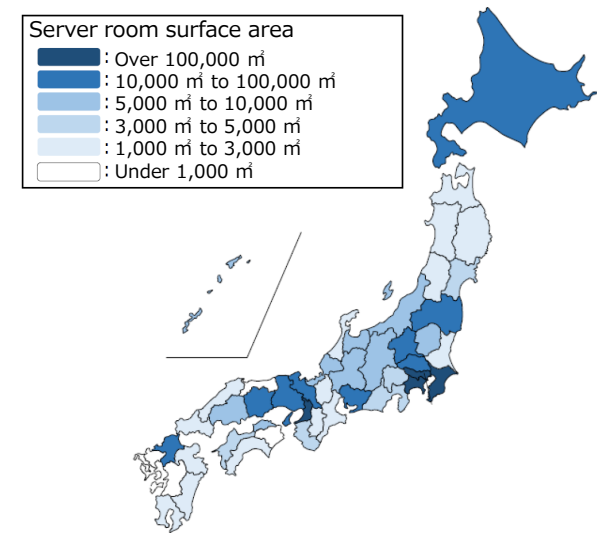


Chart: Geographic distribution of data centers in Japan

Source: Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry, 2024. Expert Committee on Digital Infrastructure (7th Secretariat presentation, May 30, 2024)

# Japan: capacity prices and future outlook

- The capacity market was introduced with the goal of securing supply capacity four years ahead. An auction of supply capacity for FY2027 was held, and capacity prices rose on the whole.
- The main reasons capacity prices rose were (1) an increase of about 6 GW from last year in the target procurement capacity and (2) the rising level of the bid price.
- It will depend on trends in Long-Term Decarbonization Power Source Auctions and plant closures and decommissioning, but capacity prices may rise if power demand rises and capacity is limited. This would likely lead to higher power prices.

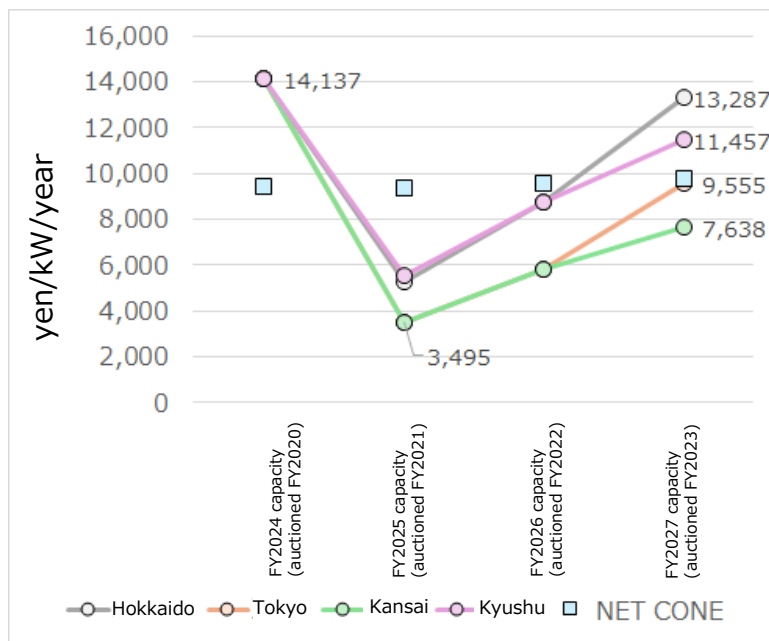


Chart: Capacity prices

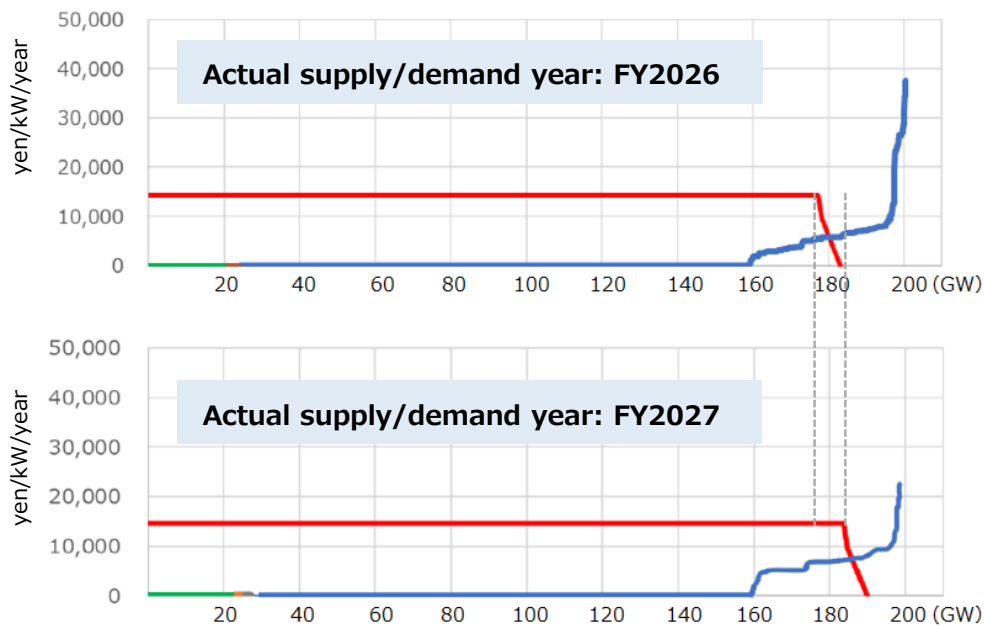


Chart: Demand and supply curves in capacity market

# U.S.: Electricity demand forecast

- U.S. firm PJM recently lifted its demand forecast.
- For example, in 2020 it predicted annual average growth in power consumption for the next 15 years of 0.6%, but in 2024 it predicted 2.2%.
- In 2024 it predicted peak demand growth of 1.6% (in 2020 it forecast 0.5%).

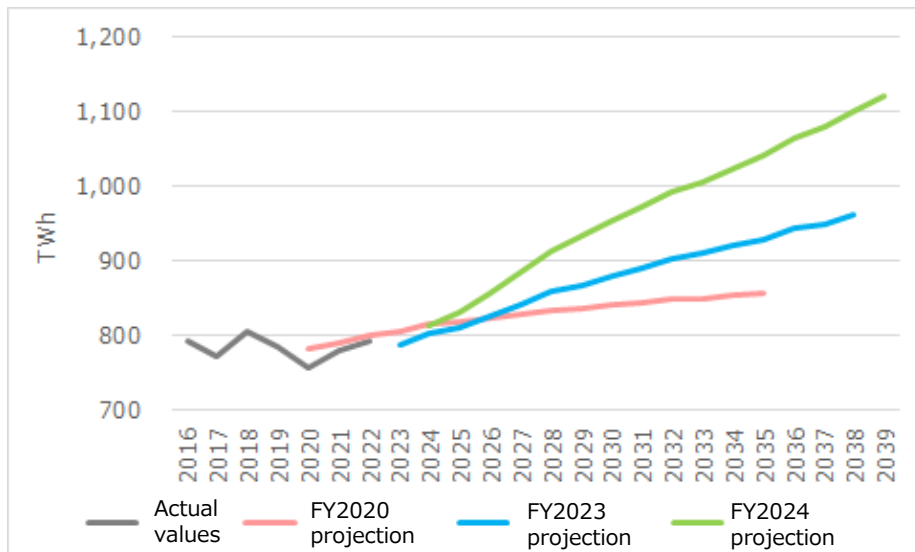


Chart: Power consumption forecasting by PJM

- Demand in the state of Texas peaked in 2023 at 85.5 GW. This could double to 152 GW in 2030 as power demand grows in line with crypto-asset mining, data centers, hydrogen production, and electrification.
- The Texas Energy Fund (TEF) started in November 2023, offering fixed, low-interest 20-year loans for construction of gas-fired power plants.

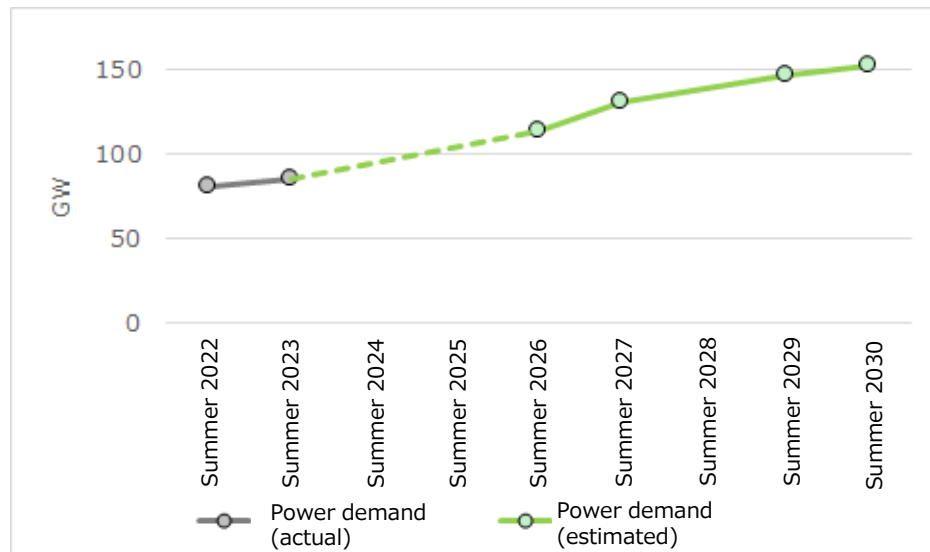


Chart: Forecast peak power demand in Texas

# U.S.: Capacity prices

- According to PJM, the capacity auction for 2025/26 held in July 2024 achieved a record price of \$269.92/MW/day (around 14,000 yen/kW/year) (nine times higher than the year before).
- Key reasons for the spike in capacity prices are (1) 13,252 MW less capacity bid than the previous year (−9% from previous year), (2) a 3,243 MW increase in expected electricity demand compared to a year earlier (+2.2% from the previous year) and (3) the lift in the required supply reserve margin from 14.7% the previous year to 17.8%.
- As a result, power retailer BGE mentions the possibility of double-digit electricity tariff increases. Meanwhile, Dominion Energy, which is both an electricity generator and retailer, has predicted that it may be able to avoid large power price rises thanks to the "natural hedge" of being both a generator and retailer.

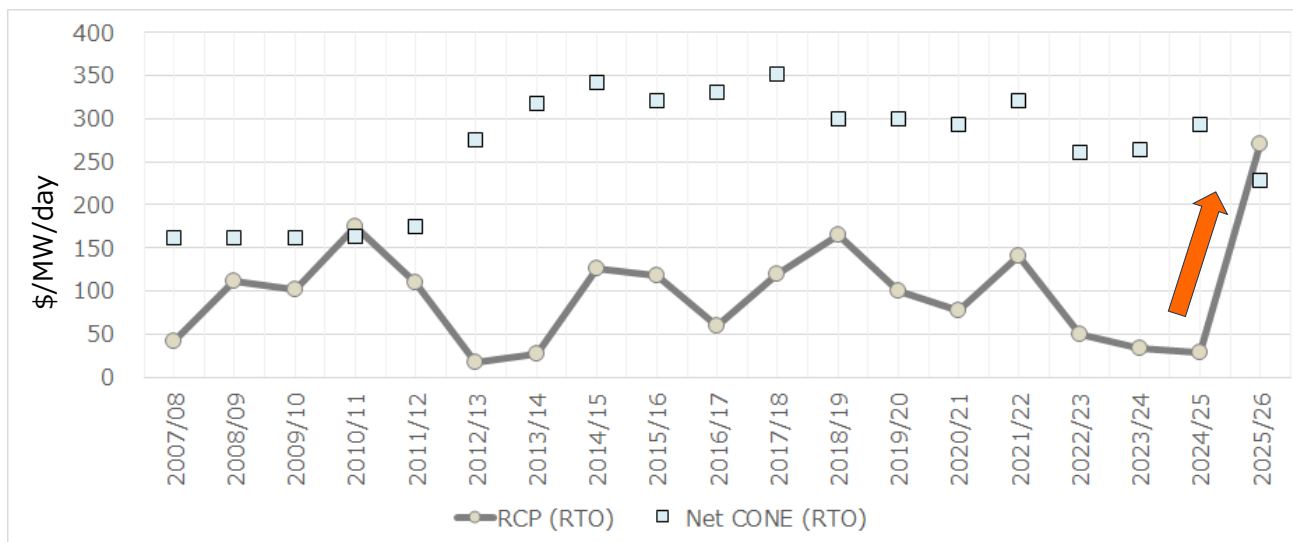


Chart: PJM capacity prices



# U.S.: Response to high-capacity prices

- PJM long-term load forecast predicts an annual average growth in summer peak demand of 1.7% over the 10 years from 2024 and an annual average growth in winter peak demand of 2%. The prospect of capacity prices jumping to the limit of \$695/MW/day (around 37,000 yen/kW/year) at the next auction has been raised.
- The utilities are looking to build new generations, postpone decommissioning of aging plants, and restarting decommissioned plants.

	Example
Construction of new generation	IPP Calpine is looking at construction of new plants in Ohio and Pennsylvania.
Postponement of decommissioning	Middle River Power has withdrawn its decommissioning plan for a 540 MW gas-fired power plant in Illinois.
Restarting of decommissioned plants	In September 2024, Constellation Energy announced its plan to restart Three Mile Island Nuclear Power Plant Unit 1, which was closed down in 2019, in 2028.



- The future lack of capacity is a clear price signal. There are limits to what can be done about it in the short term, but whether or not new supply capacity can be smoothly added is putting the true value of market mechanism in the capacity market to the test.
- If new supply does not smoothly come online, it may prove an opportunity to reconsider the framework which is reliant on market mechanism.

# Japan: First Long-Term Decarbonization Power Source Auction results

- A Long-Term Decarbonization Power Source Auction was held in Japan in January 2024 with the goal of improving the predictability of power generation investment and promoting new investment in decarbonized power sources. Winning power generators gain fixed capacity payments over a 20-year period, with refunding of around 90% of other market profits.
- In this first auction, a large number of bids were placed for battery storage, while there was limited bidding for ammonia mixed combustion upgrades. As for LNG-burning thermal power, despite competitive bidding, all bids were successful. Bidding volume and competition heavily favored some types of generation over others.

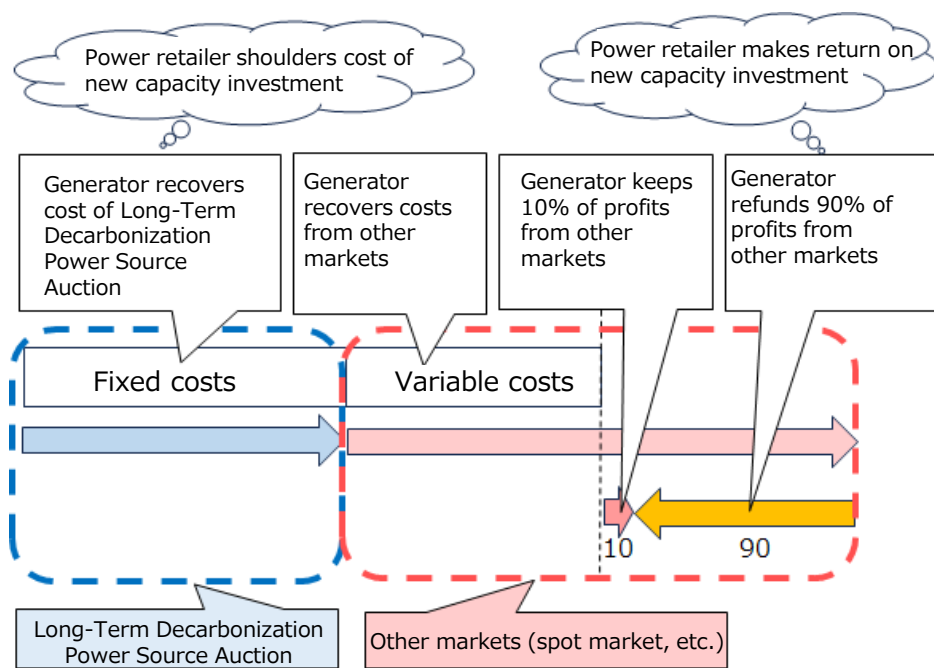


Chart: Cost recovery and profit refunds under Long-Term Decarbonization Power Source Auction

Source: Created by IEEJ from OCCTO document

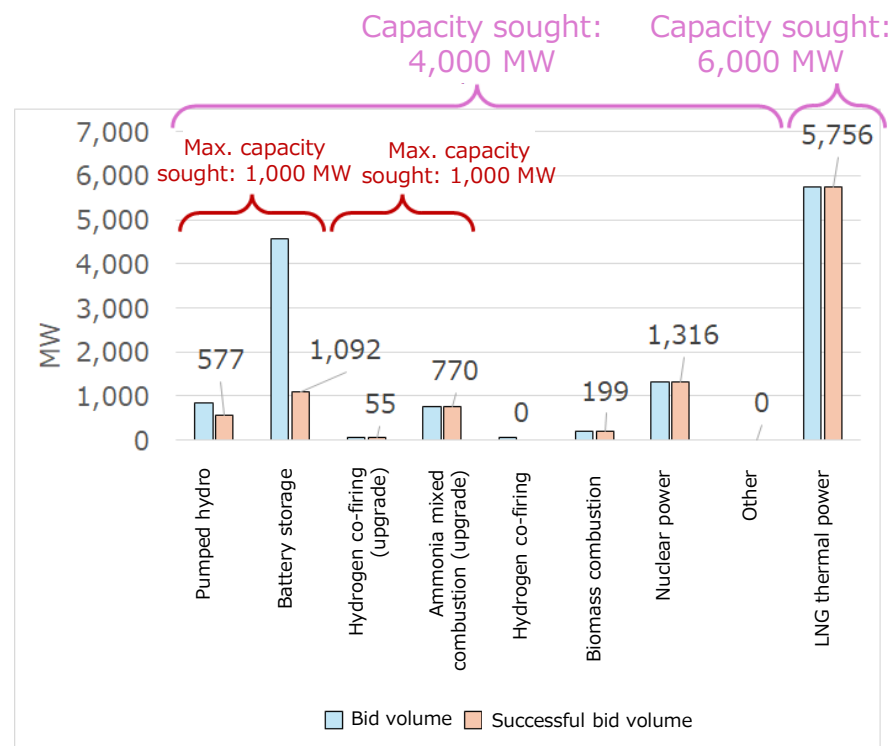


Chart: Results of first Long-Term Decarbonization Power Source Auction

# Japan: Outlook for future Long-Term Decarbonization Power Source Auctions

- The following changes have been made to the framework for the next auction.

Key changes											
Sought capacity, ceiling for sought capacity	<table border="1"> <tr> <td style="text-align: center;">Capacity sought for decarbonization capacity in FY2024 <b>5 million kW</b></td> <td style="text-align: center;">Ceiling for sought existing thermal upgrading capacity <b>1 million kW</b></td> <td style="text-align: center;">Ceiling for sought capacity of 3-6 hours continuously operating pumped hydro and battery storage <b>750,000 kW</b></td> <td style="text-align: center;">Ceiling for sought capacity of 6 hours or more continuously operating pumped hydro and battery storage <b>750,000 kW</b></td> <td style="text-align: center;">Ceiling for sought capacity of investment in safety of existing nuclear plants <b>2 million kW</b></td> </tr> <tr> <td style="text-align: center;">Capacity sought for LNG thermal power in FY2024 <b>Approx. 22.4 million kW</b></td> <td colspan="2" style="text-align: center;">Additional sought capacity <b>2 million kW</b></td> <td colspan="2" style="text-align: center;">Residual <b>Approx. 240,000 kW</b></td> </tr> </table>	Capacity sought for decarbonization capacity in FY2024 <b>5 million kW</b>	Ceiling for sought existing thermal upgrading capacity <b>1 million kW</b>	Ceiling for sought capacity of 3-6 hours continuously operating pumped hydro and battery storage <b>750,000 kW</b>	Ceiling for sought capacity of 6 hours or more continuously operating pumped hydro and battery storage <b>750,000 kW</b>	Ceiling for sought capacity of investment in safety of existing nuclear plants <b>2 million kW</b>	Capacity sought for LNG thermal power in FY2024 <b>Approx. 22.4 million kW</b>	Additional sought capacity <b>2 million kW</b>		Residual <b>Approx. 240,000 kW</b>	
Capacity sought for decarbonization capacity in FY2024 <b>5 million kW</b>	Ceiling for sought existing thermal upgrading capacity <b>1 million kW</b>	Ceiling for sought capacity of 3-6 hours continuously operating pumped hydro and battery storage <b>750,000 kW</b>	Ceiling for sought capacity of 6 hours or more continuously operating pumped hydro and battery storage <b>750,000 kW</b>	Ceiling for sought capacity of investment in safety of existing nuclear plants <b>2 million kW</b>							
Capacity sought for LNG thermal power in FY2024 <b>Approx. 22.4 million kW</b>	Additional sought capacity <b>2 million kW</b>		Residual <b>Approx. 240,000 kW</b>								
Conditions for power sources, etc.	<ul style="list-style-type: none"> <li>Investments in the safety of existing nuclear plants are now included in the auction</li> <li>New builds and replacement of hydro and battery storage, and large upgrades of at least 30,000 kW to existing pumped hydro now included in the auction</li> </ul>										
Ceiling price	<ul style="list-style-type: none"> <li>Ceiling price adjusted in consideration of added costs able to be incorporated into bid price (cost of overseas upstream facilities, etc.)</li> </ul>										

- Where hydrogen and ammonia thermal power sources are concerned it has become possible to factor in fuel costs, including the fixed costs of upstream facilities overseas, into bid prices, but it has also been pointed out that the modified price ceiling is too low.
- As for nuclear power sources and battery storage, important points for further consideration going forward are:
  - because nuclear power sources are constructed over a long period, it should be made possible to recover costs during the construction period
  - because with battery storage there is a possibility of an orientation toward conservative operation if fixed costs are guaranteed, conceivably a premise should be the transfer of usage rights to grid operators and others.

# Europe: Recovery of the cost of building nuclear plants during the construction period, scheme for transferring usage rights for battery storage to grid operators

## Scheme for cost recovery during construction

- **Regulated Asset Base (RAB)**
  - The regulator determines a permitted profit level, allowing a certain level of return. Has been applied to new nuclear power sources built in the UK (Sizewell C).
  - Operator can recover costs during all phases - construction, testing and commercial operation.
  - The guarantee of a certain level of profit may lower the risk premium.

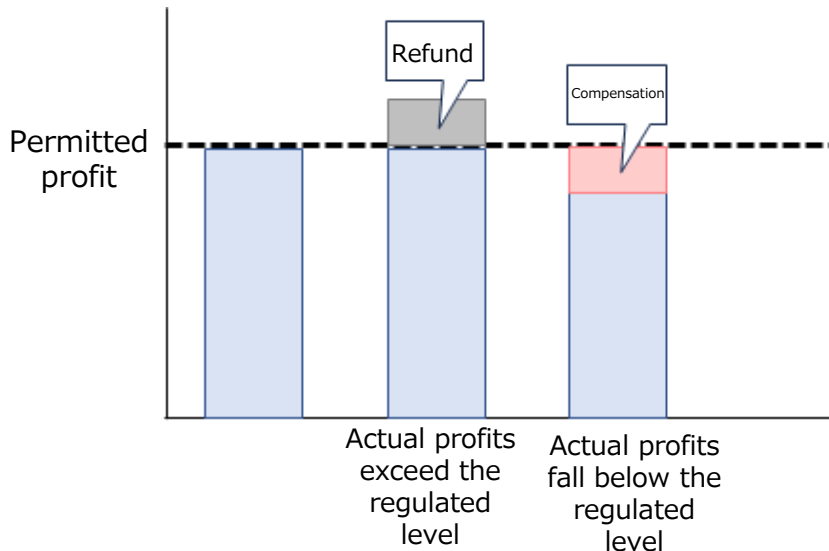


Chart: How the RAB scheme works in the UK

Source: Created by IEEJ from OFGEM document

## Scheme for transferring usage rights for battery storage

- **Electricity Storage Capacity Procurement Mechanism (MACSE)**
  - Italian grid operator Terna obtains storage capacity through competitive tender. Winning power storage facilities are able to gain fixed, long-term compensation.
  - However, winning storage facilities are (1) used by Terna as a time-shifting product and (2) used by Terna on the demand/supply adjustment market.

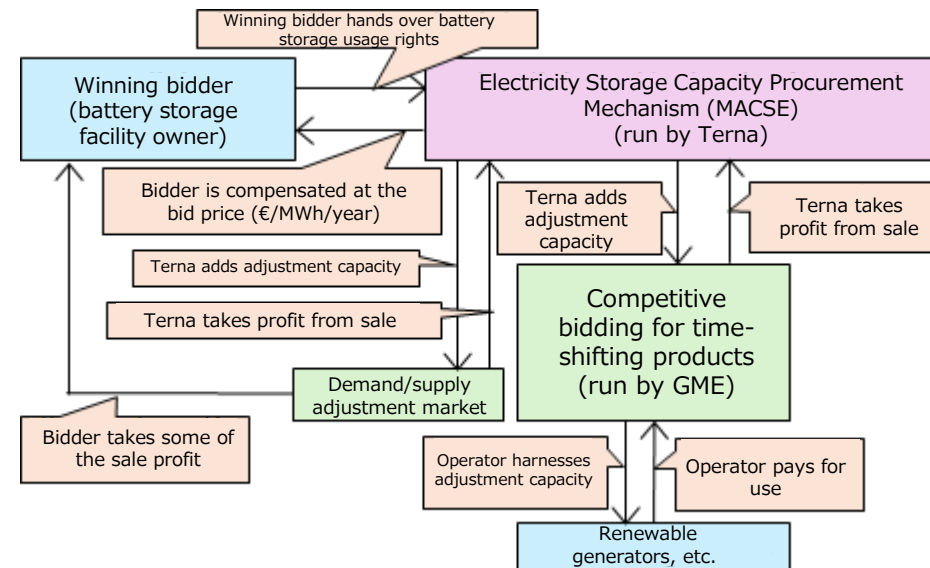


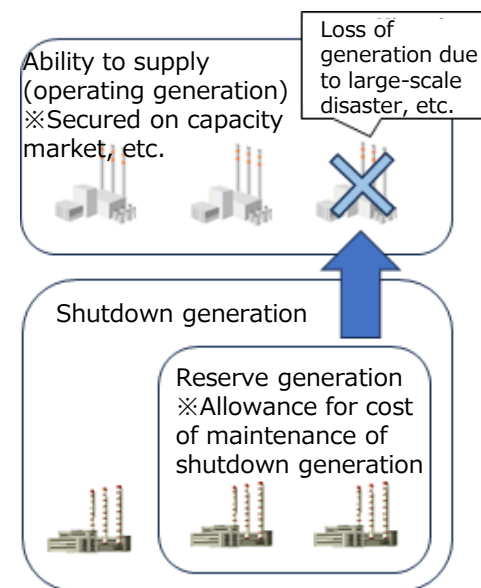
Chart: The MACSE scheme in Italy

Source: Created by IEEJ from Fichtner document

# Japan: First result of the reserve power source system and observations

- The reserve power source system was introduced for FY2025 and FY2026 with the goal of preventing supply capacity shortfalls by operating inactive reserve power sources over a given period when the need has arisen for additional power capacity to be secured, such as when generation drops out as a result of large-scale disasters or when demand increases on a longer term basis.
- However, in the first auction in September 2024 there were no bids whatsoever for reserve power sources.

Item	Key point
Sought capacity	1 million kW in each of 50 Hz grid (East Japan) and 60 Hz zone (West Japan)
Power source	Over 100,000 kW of unbid or underbid thermal generation plant in the capacity market main auction over past two years
Requirements	Bidding when the start-up process is in place (kW public tender, additional capacity market auction, etc.)
Pricing system	Multi-price method (contract price is the price bid for each power source)
Costs that can be incorporated in bids	Cost of necessary maintenance of shutdown generation (labor, repairs, tax, taxes levied on generator, shutdown costs, fuel costs – but only for short-term start-up oil-fired power plants – and project compensation) (※Start-up costs recovered in kW public tender, additional capacity market auction, etc.)
Ceiling price	Less than the capacity market main auction price for the year of long-term start-up



- This is likely due to a decision not to bid on account of lack of economic benefits.
- Without forgetting about opportunity costs, it would surely be useful to adjust the system to allow for economic benefits. For example, we might consider (1) a single price pricing system (contract price is the top price bid for each power source), (2) flexible cost allocation, and (3) raising the ceiling price.

# Japan: Points to note in view of Strategic Energy Plan

- The recently-released draft of the 7<sup>th</sup> Strategic Energy Plan incorporates increased power demand from data center construction into its forecast FY2040 power generation. It calls for maximization of decarbonized power sources – renewables and nuclear power.
- It also supports Long-Term Decarbonization Power Source Auctions in order to decarbonize electricity and the reserve power source system in case of emergencies.

Table: Energy demand and key strategies to secure supply in the draft Strategic Energy Plan

Topic	Main points
Need to invest in generation due to rising power demand	<ul style="list-style-type: none"> <li>● <u>Power demand is expected to increase in Japan with the advance of DX and GX</u>. Future power demand growth needs to be met with the expansion of decarbonized generation.</li> <li>● <u>Should opportunities for investment in data centers or chip factories go begging</u> due to an inability to secure sufficient non-carbon generation, <u>Japan would lose opportunities for economic growth and industrial competitiveness</u>. <u>This is to be strictly avoided</u>. Now is the time for <u>large-scale investment in generation</u>.</li> </ul>
Securing supply through Long-Term Decarbonization Power Source Auctions and the reserve power source system	<ul style="list-style-type: none"> <li>● We need to consider the steady operation and changes to the capacity market including the Long-Term Decarbonization Power Source Auctions in order to secure the required supply. <u>Continued measures to secure steady supply are also needed</u>, such as retaining the reserve power source system in case of emergencies.</li> <li>● From the second Long-Term Decarbonization Power Source Auction, fixed payments for hydrogen and ammonia fuel costs are subsidized, and <u>investigation of ways to adapt the system, including raising the ceiling price, continues</u>, while commercialization is steadily pursued.</li> </ul>

# Summary

- ✓ A minimum reserve margin of at least 3% is forecast to be secure for winter FY2024. Stable supply of electricity has been improved through supply secured on the capacity market.
- ✓ In the 10-year future forecasts, electricity demand had been expected to decline but this has now turned into a growth prediction based on the progress of DX. This trend is worth watching.
- ✓ In the U.S., the prospect of a doubling of power demand in the state of Texas by 2030 has been raised. The PJM capacity price has jumped nine-fold, a sign of insufficient supply in the face of growing power demand.
- ✓ And in Japan, power prices might be affected by a lack of supply in response to growing future power demand and higher capacity prices.
- ✓ While the introduction of Long-Term Decarbonization Power Source Auctions is supporting the adoption of carbon-free electricity generation, challenges remain in terms of the investment environment and operating conditions for hydrogen and ammonia co-firing, nuclear power, and battery storage.
- ✓ Concerns also remain about future stable power supply given the absence of bids for power sources under the reserve power source system.
- ✓ The recently released draft of the Strategic Energy Plan incorporates increased power demand from data center construction into its forecast FY2040 power generation. It calls for maximization of decarbonized power sources – renewables and nuclear power. It also supports Long-Term Decarbonization Power Source Auctions in order to decarbonize electricity and the reserve power source system in case of emergencies.