

Japan's Challenges for triple renewables capacity by 2030

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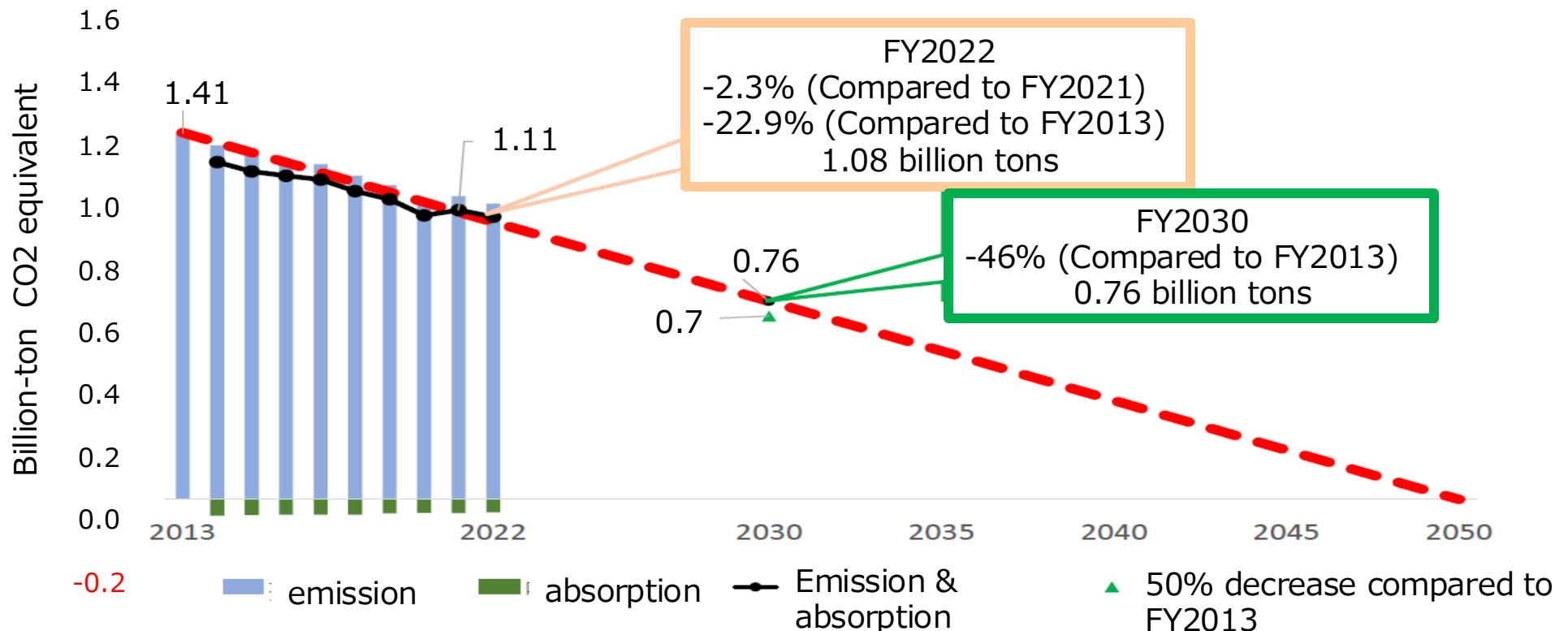
Secretary General

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Ministry of Economy, Trade and Industry

1. Japan's Progress towards Carbon Neutrality in 2050

- Japan declared that it would achieve carbon neutrality by 2050 in October 2020 and reported progress at COP28.
 - In FY2022, Japan's Greenhouse Gas emissions and absorption was 1.08 billion tons (CO2 equivalent).
 - This is the lowest recorded value to date, continuing the steady downward trend toward net-zero emissions in 2050.



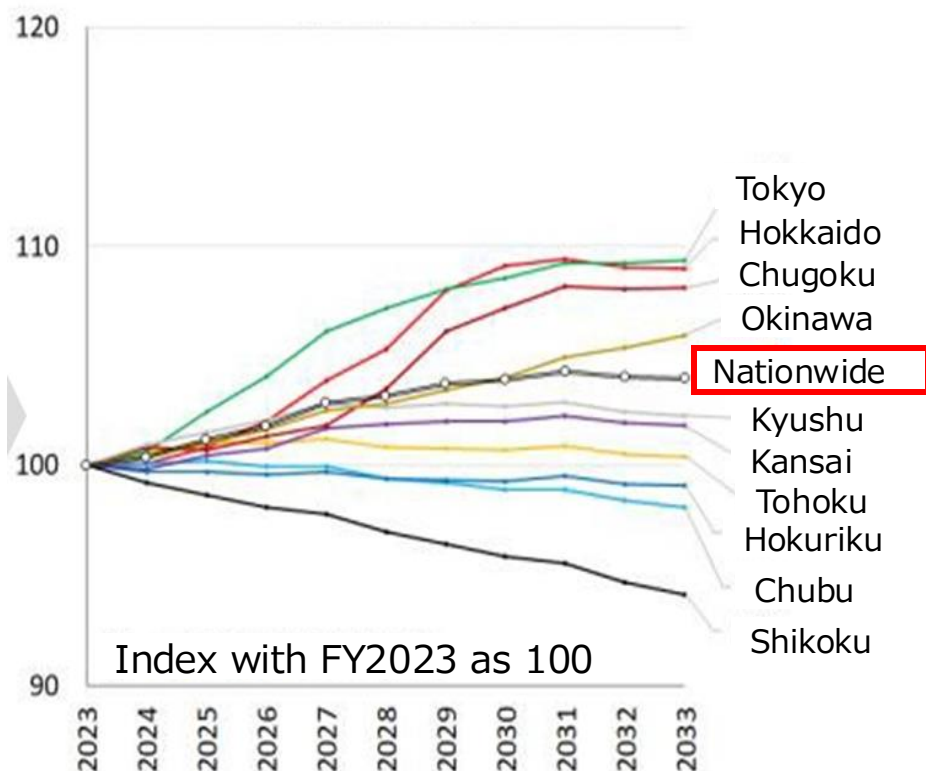
2. Outline of Japan's Electricity System

- Electricity generating capacity: **299 GW**
- Electricity generation: **939 TWh**
- Electricity System reform was started from 1995.
- The retail market was gradually liberalized starting in 2000.
- **Full market liberalization** was completed in 2016, with regulated pricing for household customers.
- **Legal unbundling for TSOs**
- **Balancing group model**
- The volume of transactions at the Japan Electric Power Exchange (JEPX) was **34.8%** as of May 2024.
- **FIT and FIP** have been introduced.
- **Restarting nuclear plants is limited (12 out of 33 plants).**

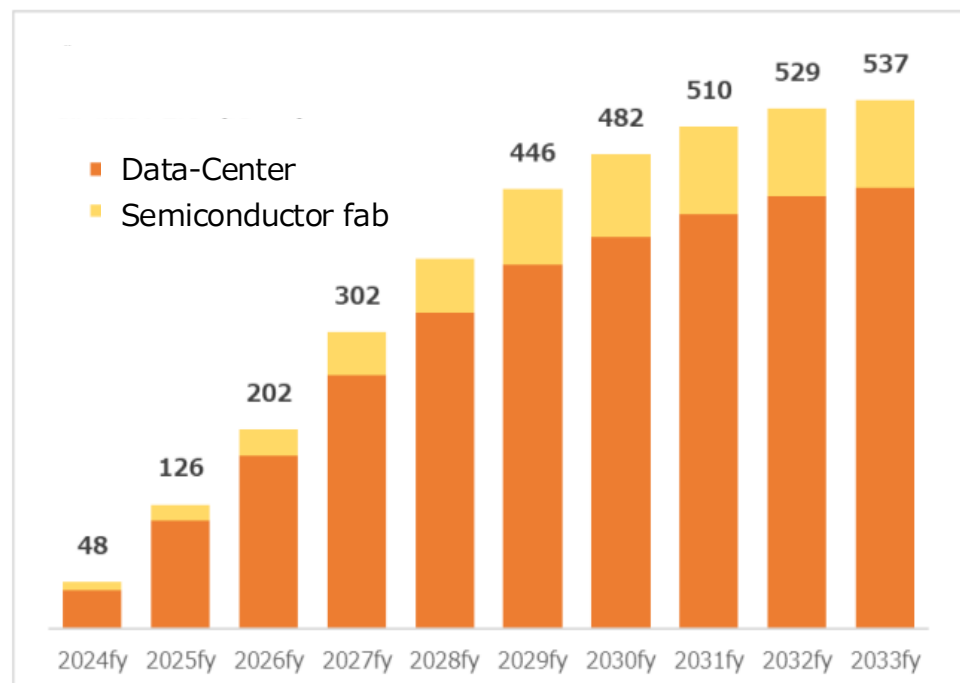
3. Japan's Electricity Demand Projection

- The electricity demand in Japan was expected decline after a historical national peak in FY2007, but now this is expected to increase by 0.4% per year over the 10-year period beginning in FY2023, after incorporating the demand of new data centers and semiconductor fabrication plants.

Electricity demand (kWh base) projection nationwide and by service area



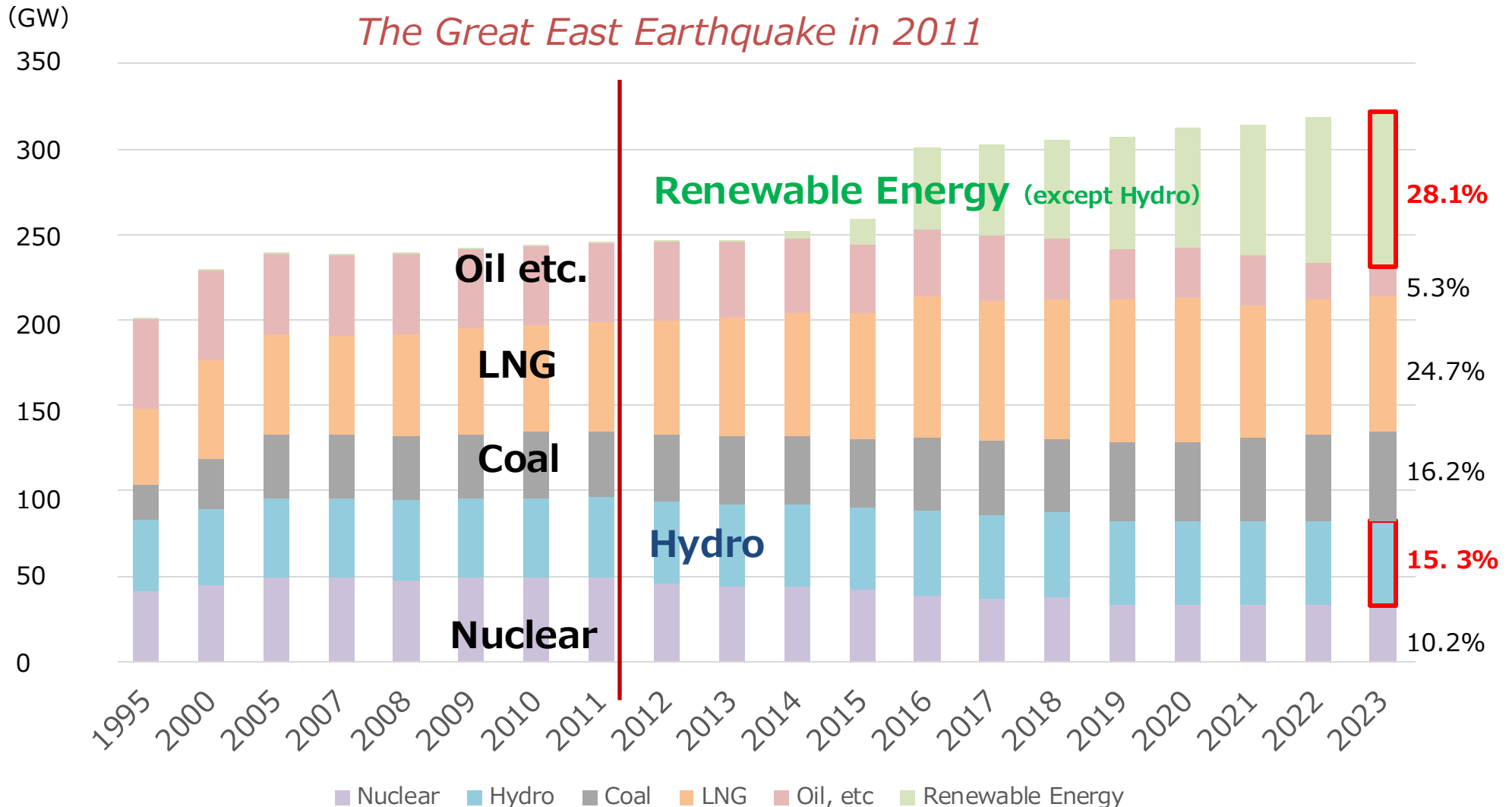
Maximum electricity demand (kW base) per new datacenter and semiconductor fab



(Source) Partially processed data from "the Study Group on Local Electricity Demand Growth and Transmission/Distribution Networks"

4. Power Production Capacity in Japan | 1995-2023

- The share of renewable energy power production capacity has been increasing in recent years and now total 43% is from renewable energy including hydro.



5. FIT/FIP certified and installed amount by power source

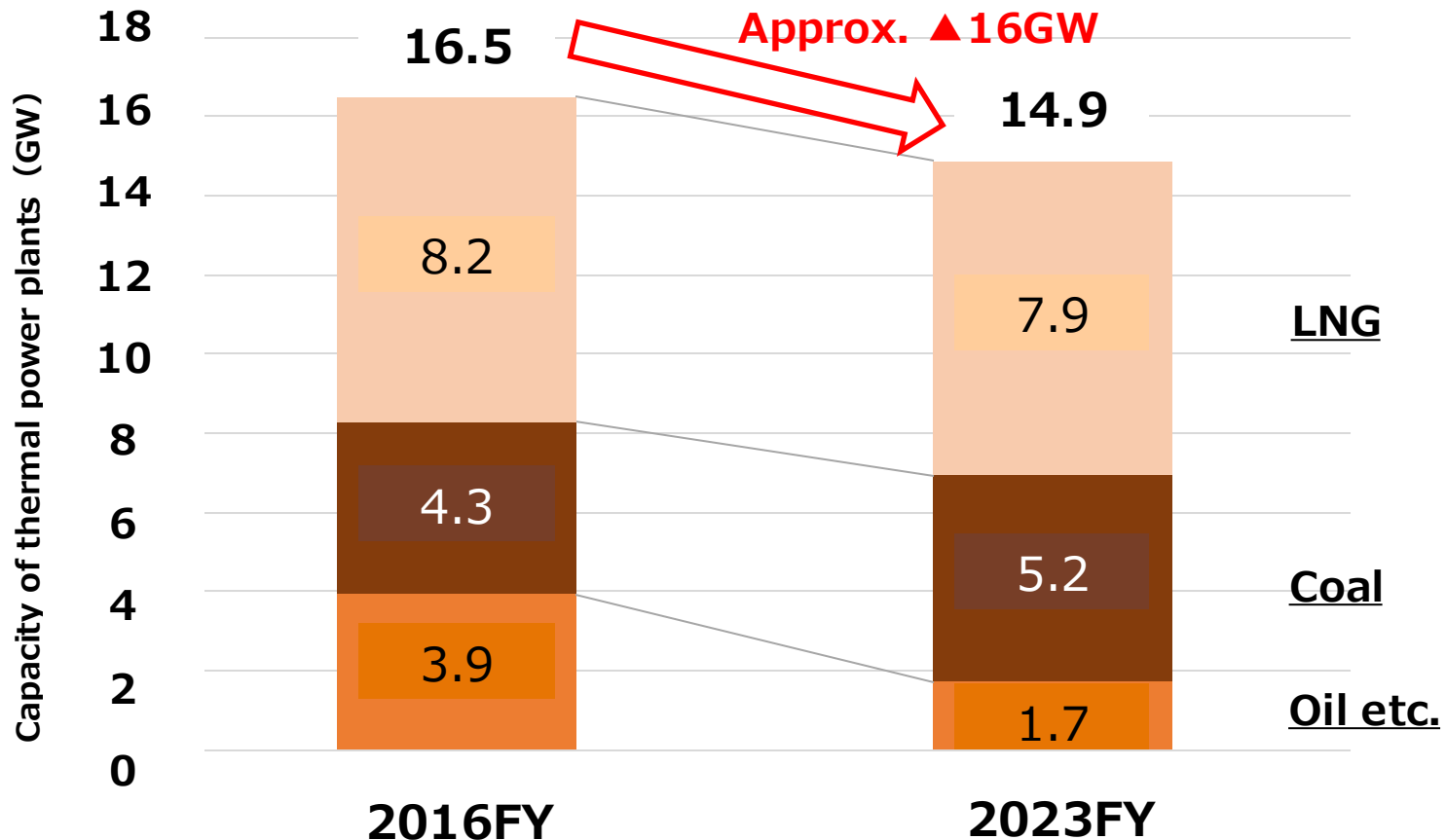
- As of the end of December 2023, the number of new installations that have started operation since the start of the FIT program was 77GW (78% of the total certified capacity). Of this total, solar power generation accounted for about 88%.
- The total FIT/FIP certified capacity was 99GW, of which solar power generation accounted for about 75%.

Amount of equipment installed than has started operation								Certified amount
	Before FIT	After the start of FIT/FIP program						
	Cumulative to June 2012	2019FY	2020FY	2021FY	2022FY	2023FY (~Dec.)	Total after the program	July 2012~ end of Dec. 2024
Solar (residential)	4.7GW	0.769GW (152,225case)	0.759GW (141,534case)	8.57GW (153,169case)	1.059GW (190,306case)	0.665GW (125,692case)	10.263GW (2,088,725case)	10.481GW (2,132,481case)
Solar (not residential)	0.9GW	4.878GW (49,167case)	4.996GW (33,301case)	3.728GW (20,574case)	3.541GW (13,674case)	1.753GW (6,330case)	57.277GW (696,116case)	63.723GW (732,130case)
Wind	2.6GW	4.49GW (302case)	0.363GW (267case)	0.295GW (241case)	0.231GW (306case)	0.49GW (181case)	3.017GW (2,323case)	13.9GW (6,474case)
Geothermal	0.5GW	0.04.8GW (6case)	0.014GW (8case)	0.000GW (4case)	0.002GW (2case)	0.021GW (8case)	0.116GW (88case)	0.212GW (119case)
Small or medium hydro	9.6GW	0.126GW (87case)	0.155GW (78case)	0.128GW (96case)	0.241GW (69case)	0.0202GW (70case)	1.25GW (854case)	2.467GW (1,159case)
Biomass	2.3GW	0.486GkW (62case)	0.445GW (56case)	0.678GW (69case)	1.315GW (60case)	0.295GW (45case)	5.049GW (656case)	8.416GW (1,026case)
Total	20.6GW	6.755GW (201,849case)	6.733GW (175,245case)	5.688GW (174,155case)	6.39GW (204,417case)	3.426GW (132,326case)	76.973GW (2,788,762case)	99.198GW (2,873,389case)

78%

6. Decrease capacity of thermal power plants

- Looking at transition of thermal power capacity from 2017FY to 2023FY, the capacity has decreased by about 16GW.
- By fuel type, oil-fired thermal power decreased by 22GW and LNG –fired thermal power by 3GW. Coal-fired power generation have increased as of 9GW.

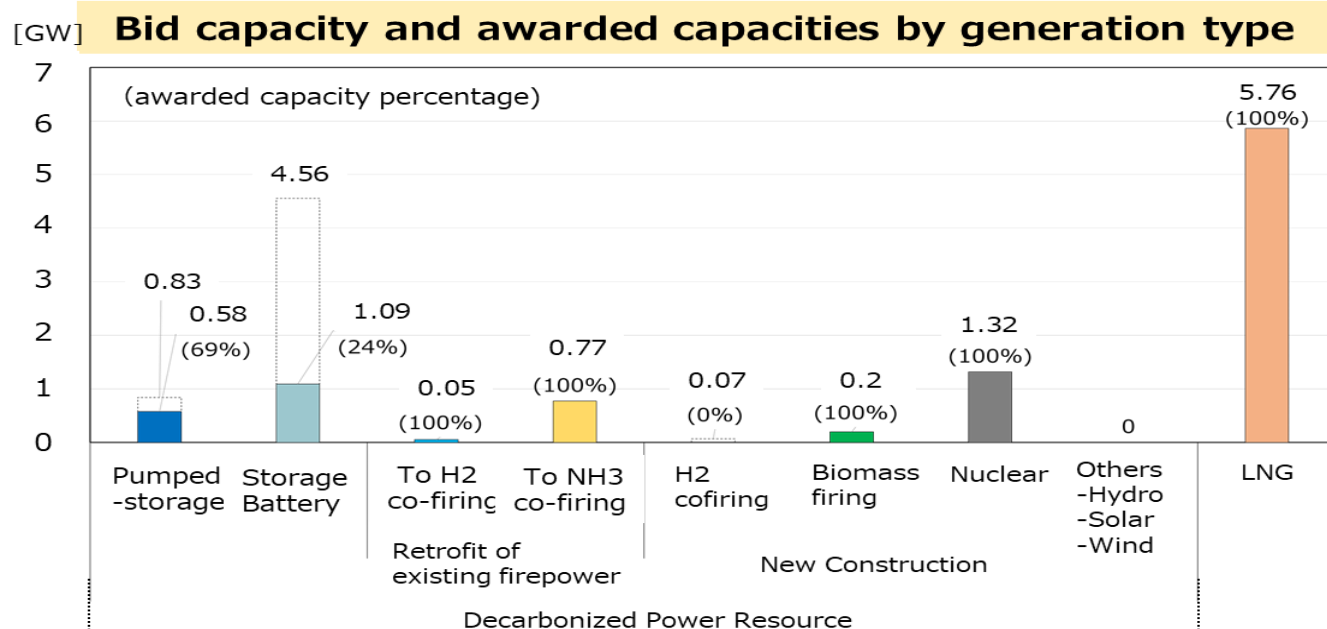


7. Japan's challenges and approaches

- 1. Underinvestment in the power generation sector and retirement of thermal power plants** in a competitive environment and increased renewable energy
 - ✓ FIT and FIP introduced (2012)
 - ✓ Establish Capacity Market (2020)
 - ✓ Establish “**Long-Term Decarbonized Power Resource Auction**”(2023)
- 2. Increase of congestion management, and insufficient flexibility** to increase renewable energy
 - ✓ Drawing up of **Nationwide Masterplan of Transmission System Expansion** (2024)
 - ✓ New wheeling service system such as **Revenue Cap** (2023) and **G-charge** (2024)
 - ✓ Establish **Balancing Market** (2024)
 - ✓ Study for **Co-optimized market of kwh and ΔkW** (Now!)
- 3. Maintaining competitive electricity market price**
 - ✓ Non-discriminatory access to generation facilities (2020)
 - ✓ Facilitation of long-term contracts (2023)

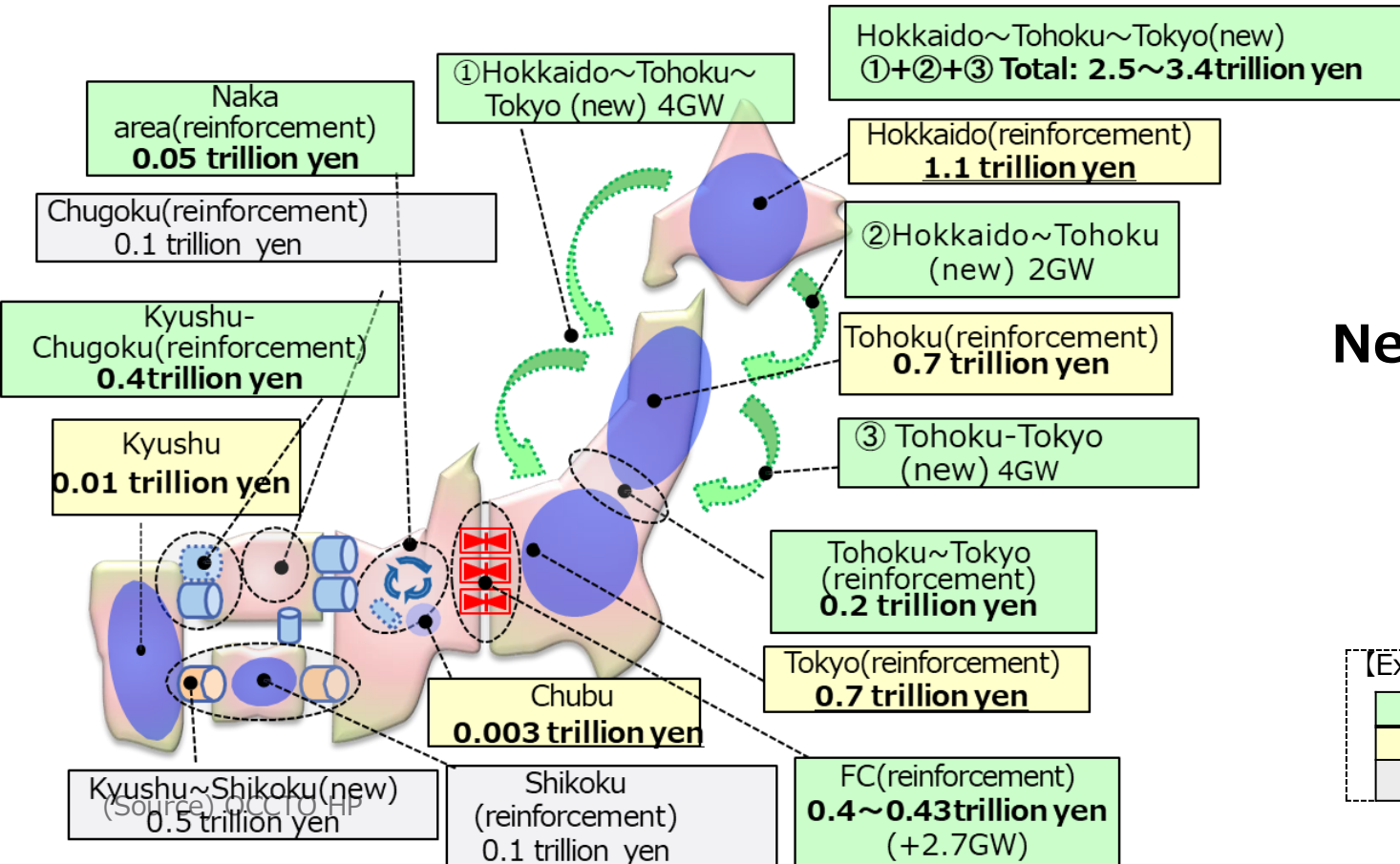
8. Long-Term Decarbonized Power Resource Auction

- The 1st auction result was released in April 2024.
- The bids were for (1) new construction or replacement of decarbonized power sources, (2) refurbishment of existing thermal power plants that will contribute to decarbonization, and (3) new construction or replacement of LNG-fired thermal power plants, based on the assumption that they will be decarbonized in the future. This auction process was conducted as part of the capacity market. The successful bidder will receive capacity revenues at the fixed cost level for 20 years in principle, and approximately 90% of the revenues from other markets will be refunded retroactively.



9. Nationwide Masterplan of Transmission System

- In March 2023, OCCTO draws up the master plan of transmission system expansion called “long-term vision of cross-regional network development”.
- It expects approximately 7 trillion-yen(46 billion USD) investments will be necessary according to their base scenario based on the cost-benefit analysis.



**Necessary investment
6-7 trillion yen**
(Base scenario)

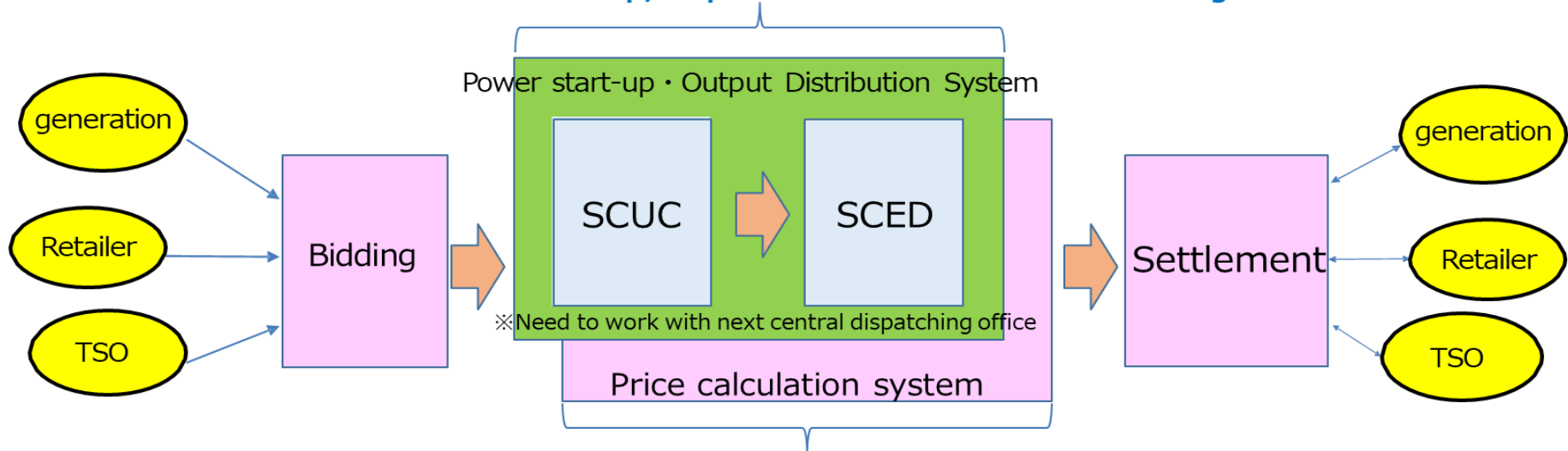
【Explanatory note】

	Gird reinforcement
	Internal reinforcement
	Future options

10. Study for Co-optimized Market of kWh and ΔkW

- Currently, Japan operates the kWh-market (wholesale market and intra-day market) and the ΔkW-market (balancing market) separately.
- However, the introduction of a large amount of VRE may increase the challenges of (1) mitigating market price spikes and instability, (2) securing and operating supply and balancing capacity, (3) efficient and stable operation of the supply-demand balance and grid management
- Studies for introducing a co-optimized market have been initiated with the aim of integrating the kWh market and the ΔkW market, establishing a market execution logic based on three-part offers, centralized information management and generation planning that takes into account grid constraints.

A) Power start up/output distribution (SCUC · SCED) logic



B) Impact of price calculation methods on market price, etc.

(Source : partially processed data of ANRE)

**Taking All-efforts
to expand
renewable energy
and
2050 Carbon Neutrality**

