Overview of OCCTO And Its Roles In Ensuring Stable Power Supply and Achieving Carbon Neutrality

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Organization for **C**ross-regional **C**oordination of **T**ransmission **O**perators

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Current status of Japan's electric power system

Japan's power generation mix (FY2025 Plan)

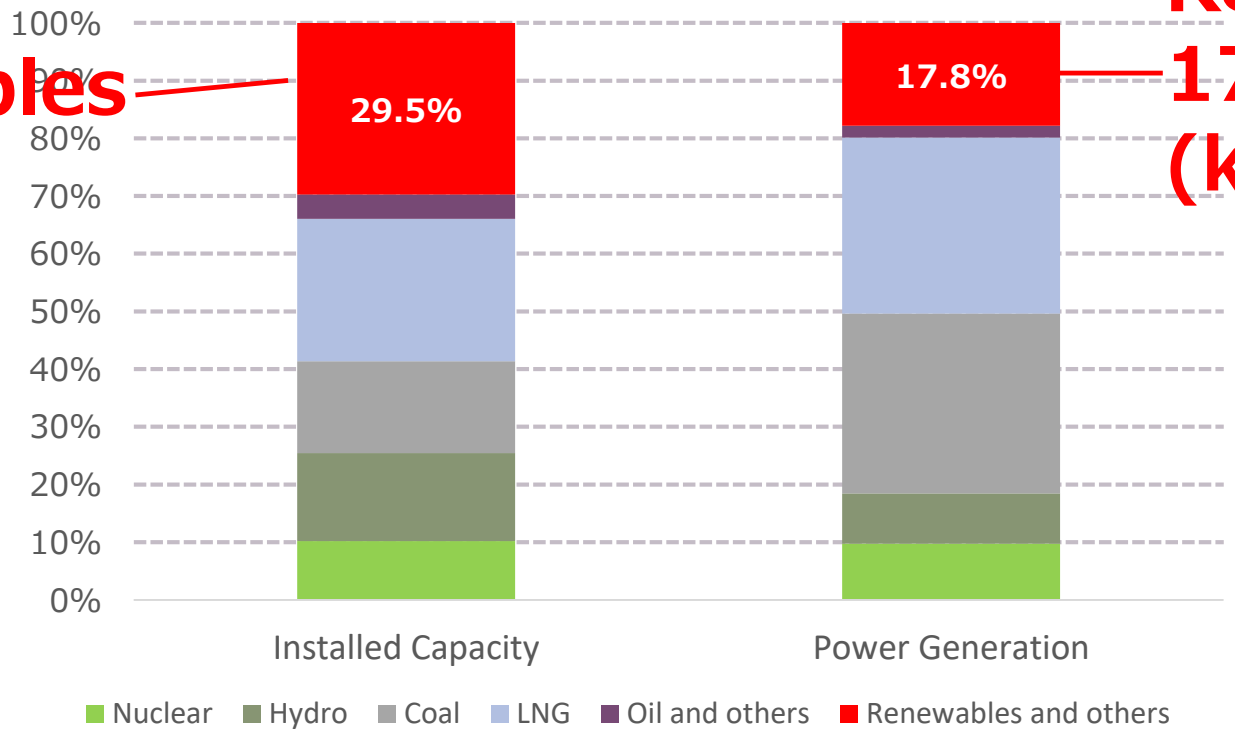
- Renewable energy accounts for 29.5% in kW and 17.8% in energy production basis.

Generation Capacities
327.27 GW

Energy Production
895.3 TWh

Renewables 29.5% (kW)

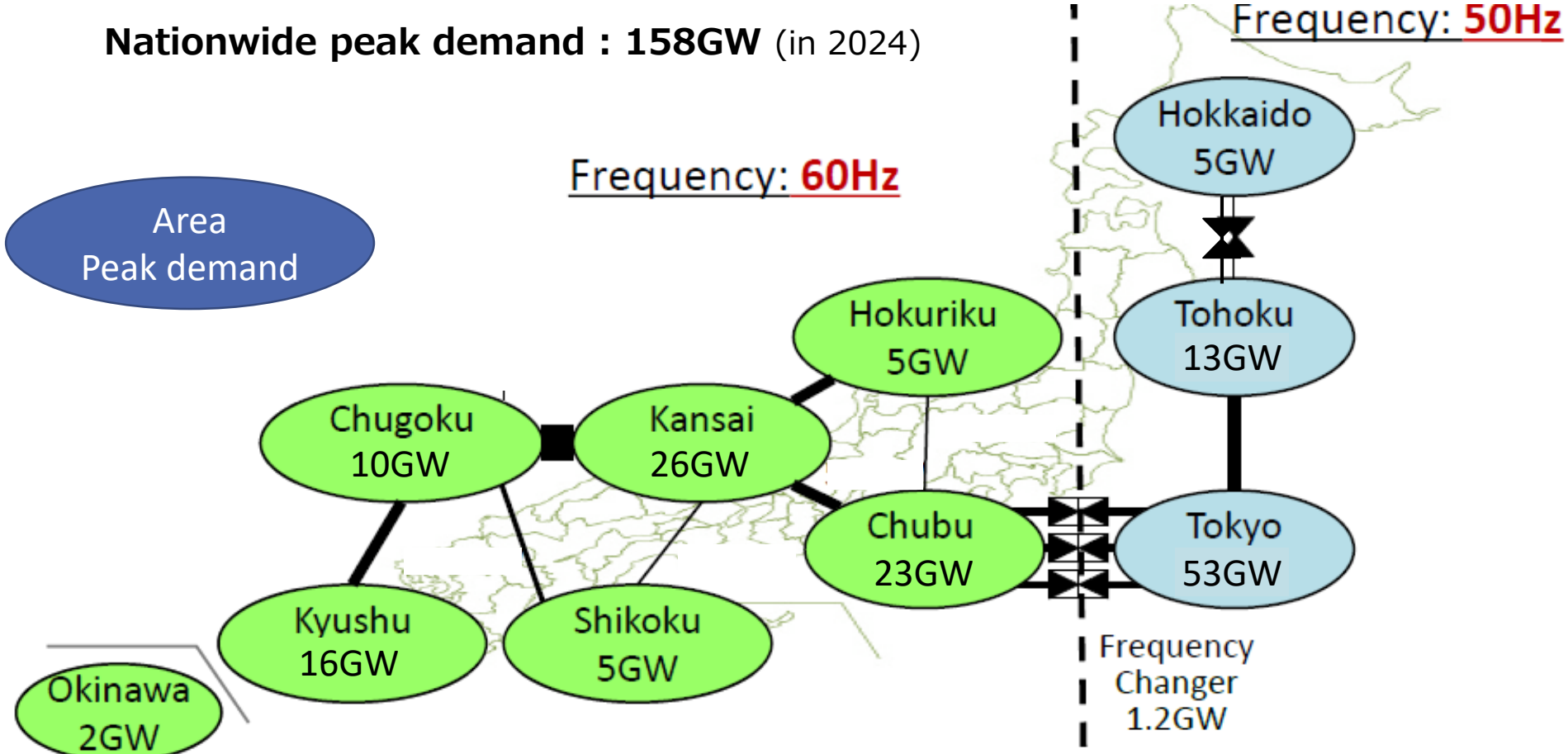
Renewables 17.8% (kWh)



Source: Kyokyuukeikaku no torimatome (for FY 2025)
https://www.occto.or.jp/en/information_disclosure/supply_plan/files/2025_Aggregation_of_Electricity_Supply_Plan.pdf

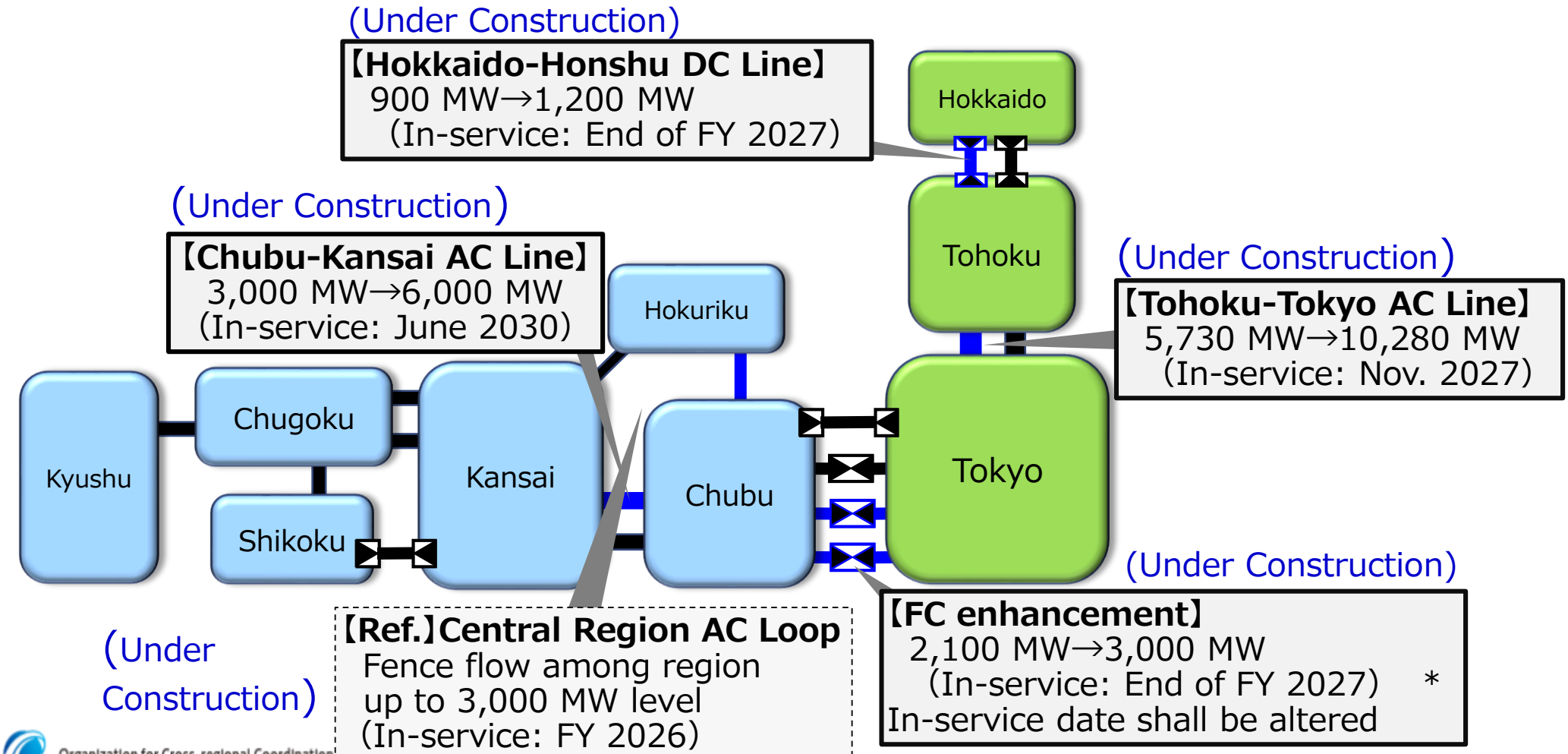
Electric Utilities and Interconnections in Japan

- There are 10 TSOs, and Cross-regional interconnections are connected between TSO's control areas(excluding Okinawa Area).
- Two different frequencies (50Hz & 60Hz) exist.



Cross-regional Network Development Projects under construction

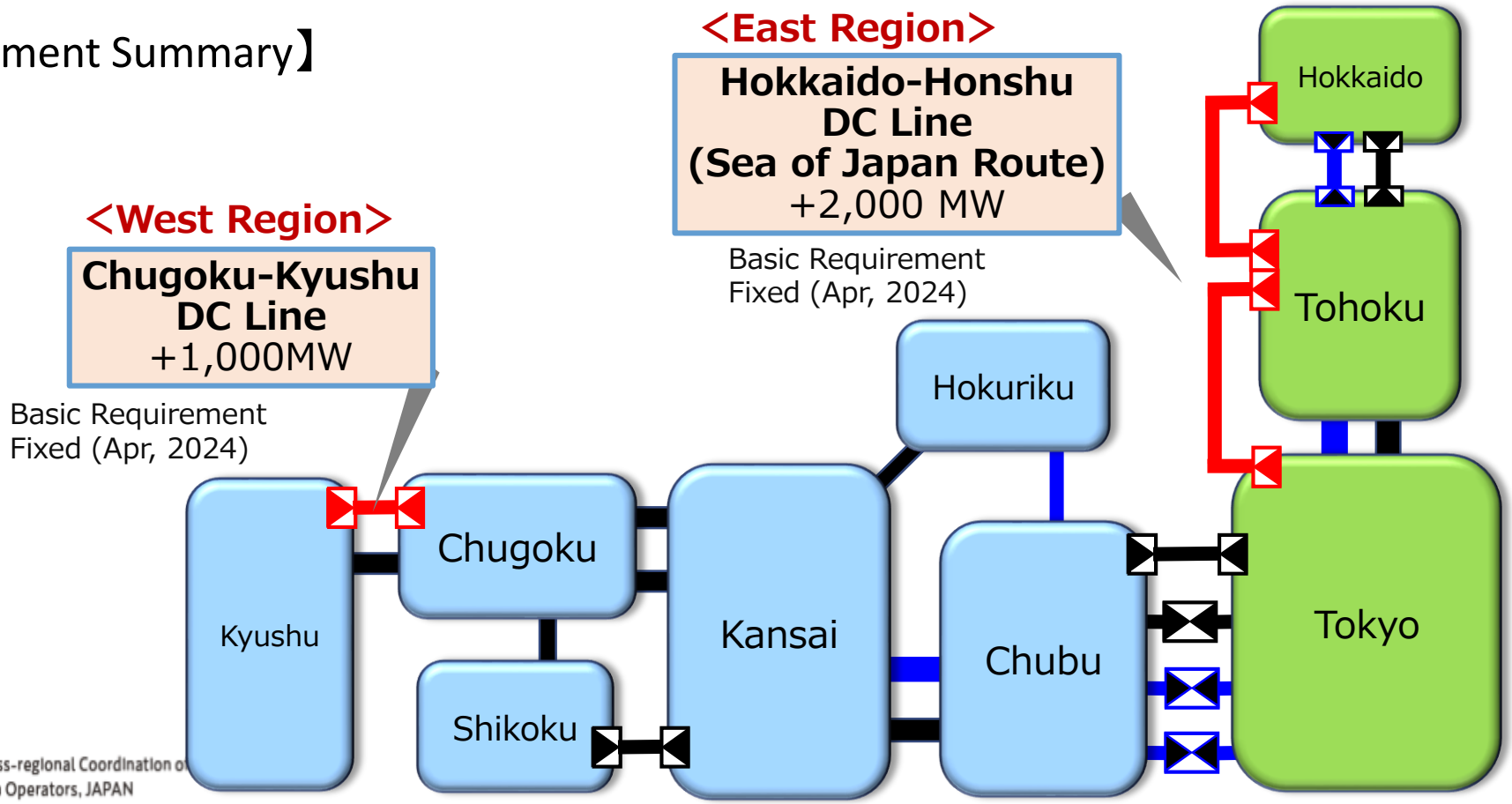
- 4 cross-regional network development projects are currently under construction.



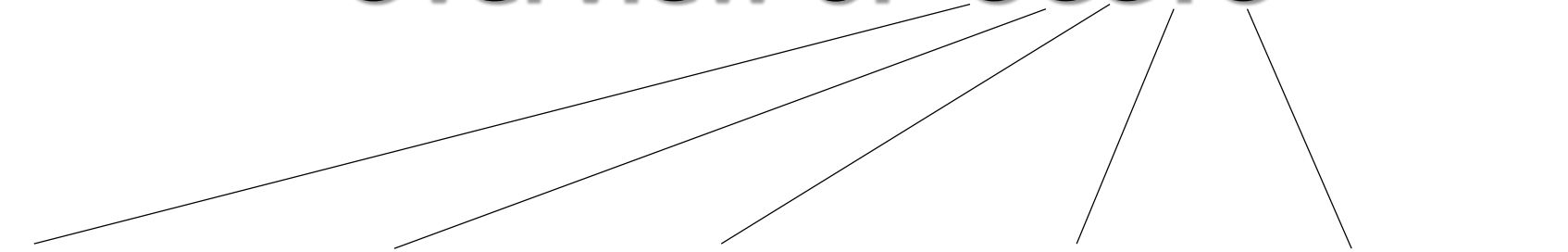
Development Plans Now In Processing

- Additionally, future network development plans are currently being considered in the East and West regions.
  - Hokkaido-Honshu DC Line (Sea of Japan Route)
  - Chugoku-Kyushu DC Line

【Enhancement Summary】

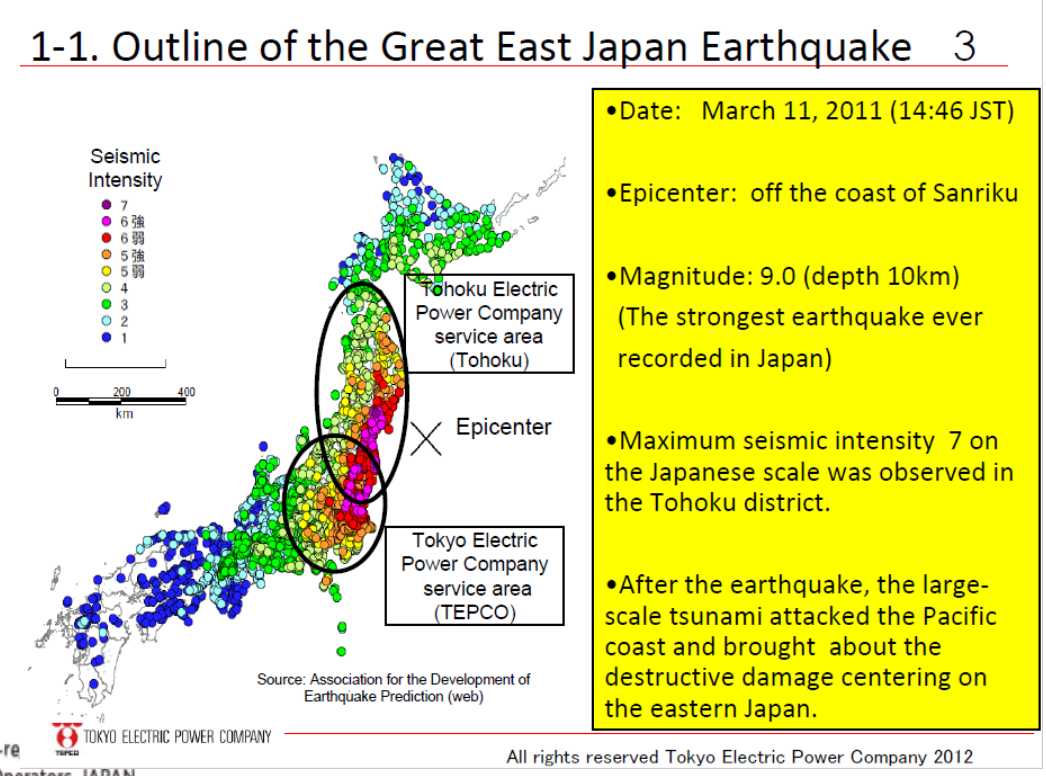


Overview of OCCTO



Background of OCCTO's Establishment

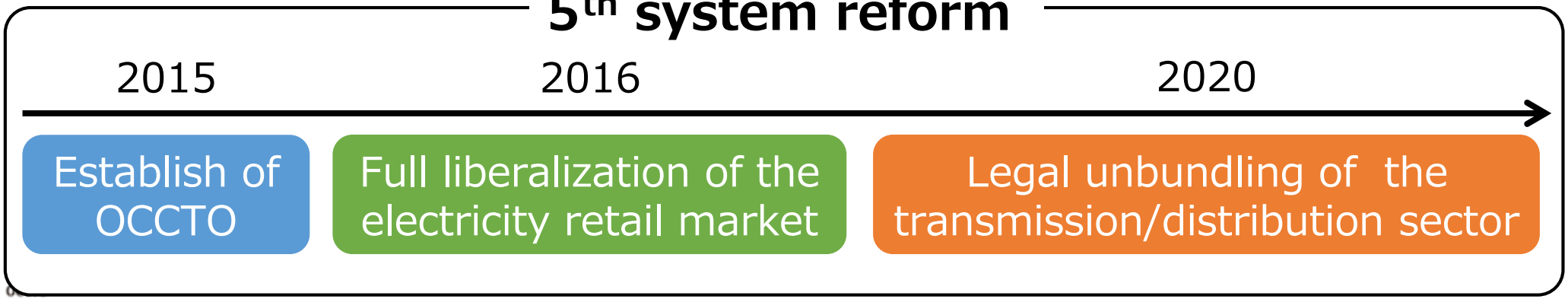
- In 2011, the Great East Japan Earthquake caused massive power outages and exposed the insufficient capacity of interconnection lines, leading to a severe power shortage.
- This crisis highlighted the urgent need for a centralized entity to oversee and manage electricity supply and demand on a nationwide basis.



Source:2012 Japan-Korea Joint Symposium
On Power System and Technology
Power Supply and Demand
after the Great East Japan Earthquake
(October 26,2012)

Electricity System Reform Timeline

- In 2013, the Japanese government approved the Electricity System Reform.
- Objectives of the reform:
  - **Ensure a stable supply of electricity**
  - Suppress electricity costs
  - Expand choices and business opportunities for service providers
- OCCTO was established in April 2015 as the first step of the 5th System Reform. See reference sheet23
- OCCTO has reached its 10th anniversary this year.



Key Functions of OCCTO
~Shifting Planning & Operations from Area-Based to "Cross-Regional" ~

① Real-time Cross-regional Supply-Demand Coordination

- 24/7 nation-wide grid monitoring ➡ See reference sheet24
- Supply instructions in case of contingency

②Expansion and Strengthening of the Power Grid

- Formulation of "Master Plan" for the Cross-regional Power Network Development ➡ See reference sheet25
- Progress management of individual projects

③Ensuring Supply Capacity ⇒Today's Main Focus

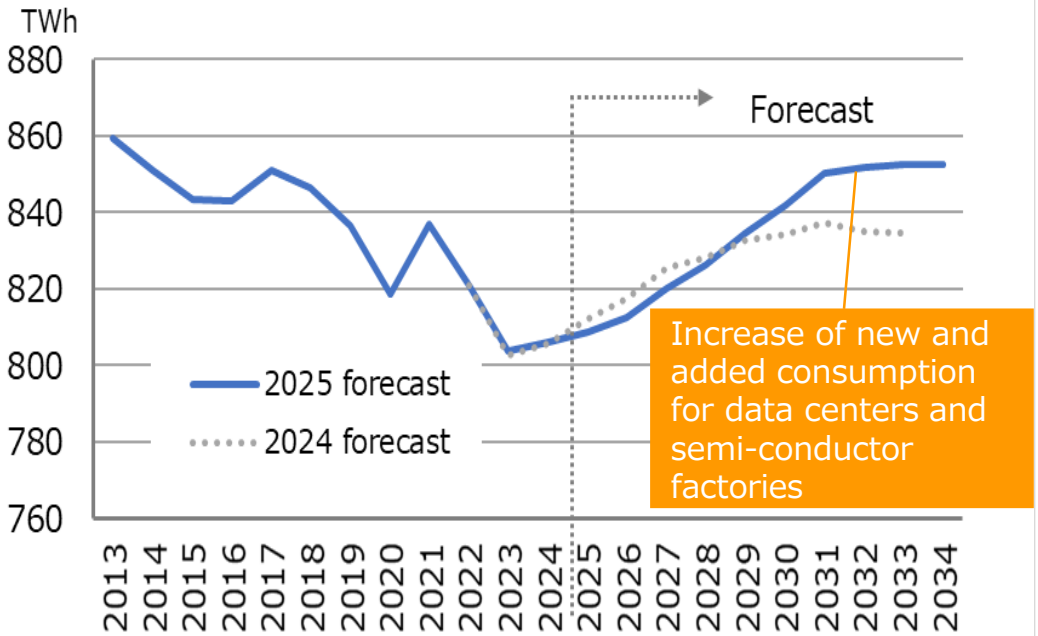
- Compiling 10 year Supply-Demand Outlook
- Examination of Future Power Supply-Demand Scenarios for 2040 and 2050

Main Focus:
For Ensuring Stable Power Supply and Achieving Carbon Neutrality

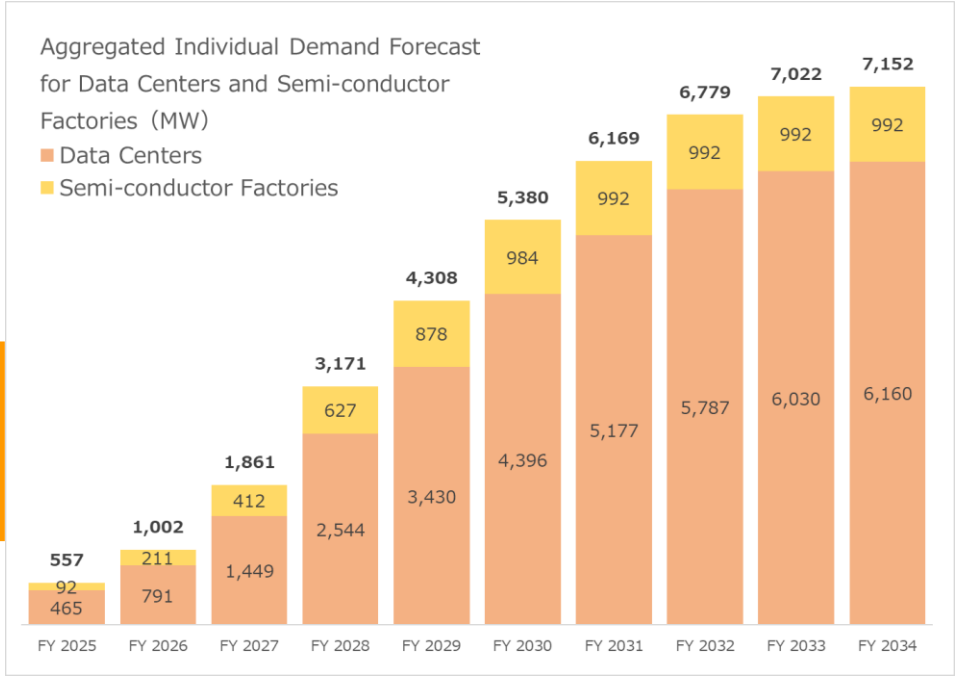
10 year Supply-Demand Outlook
～Rising Electricity Demand By DC & Semiconductor Expansion～

- Japan is entering a phase of rising electricity demand, driven by the rapid expansion of data centres and semiconductor factories.

Forecast of Nationwide Energy Consumption



Aggregation of Demand for New and Added Data Centers and Semi-conductor Factories*



- Forecast is based on the recent interconnection application of data centers and semi-conductor factories. Forecasted growth becomes stagnant after FY 2031, but it may increase again due to future application of interconnection.

10 year Supply-Demand Outlook
～Supply Reliability Risks Identified through EUE Analysis～

- In the supply reliability assessment using the Expected Unserved Energy (EUE) method, some years and areas are projected to exceed the target outage level due to the phase-out of coal-fired power plants and the shutdowns for the newly replacement of the aging LNG-fired power plants.
- For the years and areas where the target outage level is exceeded, we will consider appropriate countermeasures as needed.

Table 2-4 Calculated Supply Capacity Results Using the Annual EUE

(kWh/kW-year)

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Hokkaido	0.007	0.003	0.035	0.006	0.008	0.002	0.000	0.000	0.000	0.000
Tohoku	0.001	0.004	0.003	0.049	0.060	0.034	0.021	0.018	0.021	0.020
Tokyo	0.028	0.104	0.113	0.050	0.061	0.034	0.022	0.021	0.024	0.023
Chubu	0.017	0.002	0.003	0.007	0.007	0.002	0.003	0.002	0.002	0.001
Hokuriku	0.000	0.000	0.002	0.005	0.006	0.002	0.002	0.002	0.001	0.001
Kanasai	0.000	0.000	0.003	0.006	0.008	0.004	0.003	0.002	0.002	0.001
Chugoku	0.000	0.000	0.003	0.006	0.008	0.004	0.003	0.002	0.002	0.001
Shikoku	0.000	0.000	0.002	0.006	0.008	0.004	0.003	0.002	0.001	0.001
Kyushu	0.021	0.005	0.140	0.449	0.440	0.868	0.986	0.884	0.904	0.777
Interconnected areas	0.015	0.038	0.056	0.069	0.073	0.102	0.107	0.096	0.099	0.086
Okinawa	0.346	0.121	1.983	1.509	1.583	1.672	1.735	1.827	1.660	1.756
<Target outage volume aimed by capacity market and electricity supply plan>										
Interconnected areas	0.018	0.015	0.017	0.010	0.010	0.009	0.010	0.009	0.009	0.009
Okinawa	1.996	1.996	1.996	1.996	1.996	1.996	1.996	1.996	1.996	1.996

[Ref] The 7th Strategic Energy Plan in 2025
～ Policy Direction toward 2040 ～

- Key phrases excerpted from the summary version
  https://www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/7th_outline.pdf

✓ ･･･from the perspective of **achieving both stable energy supply and decarbonization**, we will **maximize the use of renewable energy as our major power source** …

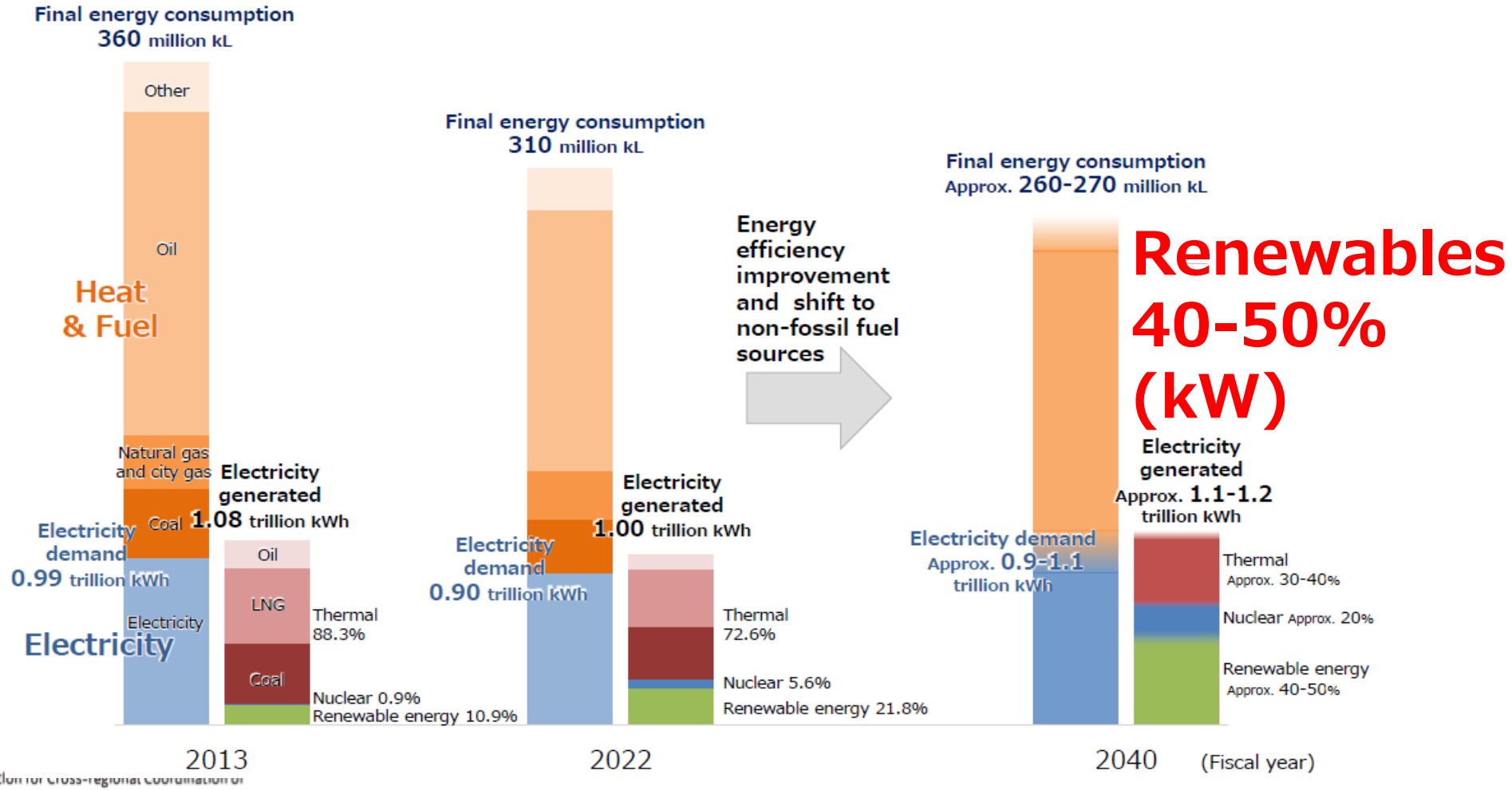
✓ ･･･**while maximizing the use of decarbonized power sources such as renewables and nuclear power,** both of which contribute to energy security.

✓ ･･･, we will
- ✓ (1) **improve the market and business environment and financing environment** to **secure investment in decarbonized electricity**,
- ✓ (2) **build an electricity network with a view to efficient use of power sources and location of large-scale demand**, and
- ✓ (3) **ensure institutional development and discipline for a stable electricity supply in terms of quantity and price**.

Source : METI

[Ref] The 7th Strategic Energy Plan in 2025
～ 2040 Outlook for Energy Supply and Demand ～

- The plan emphasizes **a transition away from fossil fuel dependency** while **maximizing the use of renewables and nuclear power** in response to increasing electricity demand.



Organization for Cross-regional Coordination of Transmission Operators, JAPAN

Source : METI

Examination of Future Power Supply-Demand Scenarios ～Background and Purpose of the Review～

Background

- At the GX Implementation Council in 2022, a directive was issued to review the entire electricity system framework for ensuring stable power supply into the future.
- In 2023, OCCTO established a study panel composed of experts and launched the development of possible power supply-demand scenarios for 2040 and 2050.

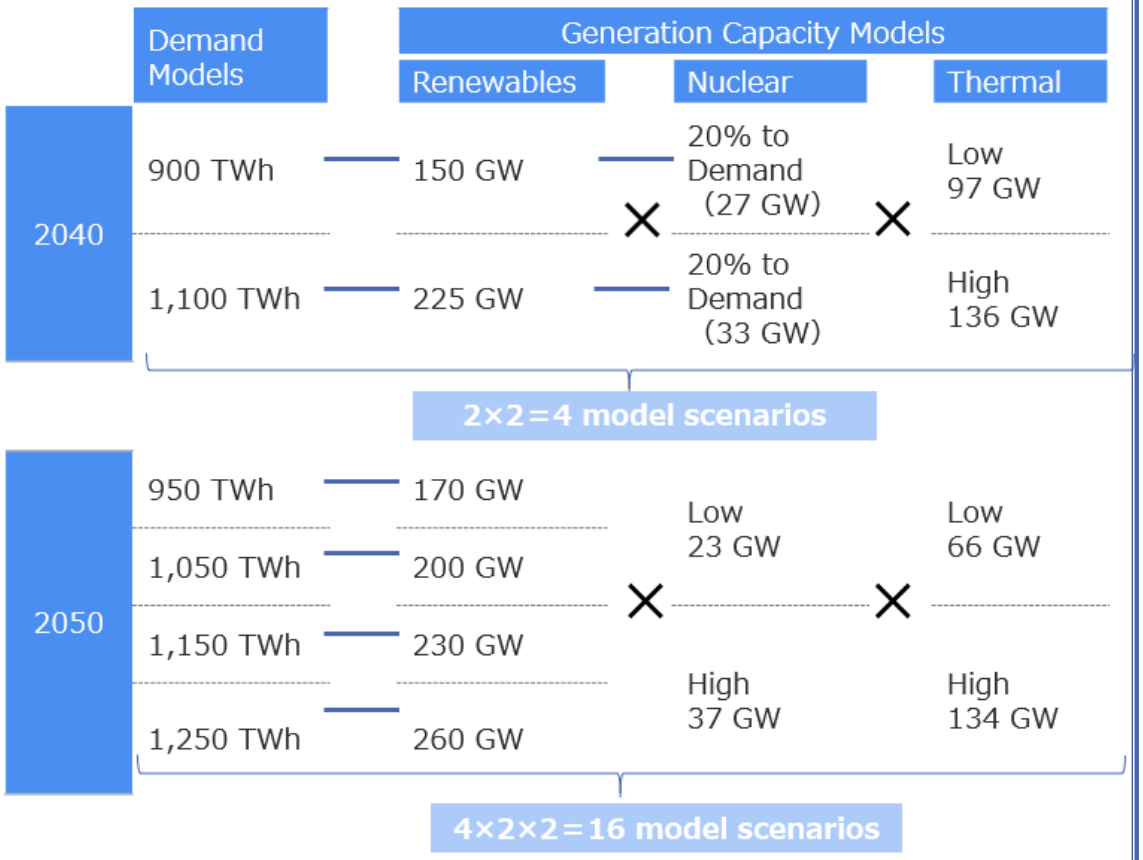
Purpose

- The purpose of this study is to share the scenarios among relevant stakeholders – including the government, OCCTO and power companies – as a common reference for promoting well-planned power generation development and smooth implementation of capacity auctions.

See reference sheet26,27

Examination of Future Power Supply-Demand Scenarios ～Setting of Model Scenarios for Electricity Supply and Demand～

- We developed 4 model scenarios for 2040 and 16 scenarios for 2050 by combining different cases for Electricity demand, Renewables, Nuclear, and Thermal.



[Symbolic Factors Affecting the Outcomes of each Scenario]

- **Electricity demand**

⇒Degree of Progress in DX & GX

- **Renewables**

⇒ Progress in solar and wind power development linked to DX demand etc

- **Nuclear**

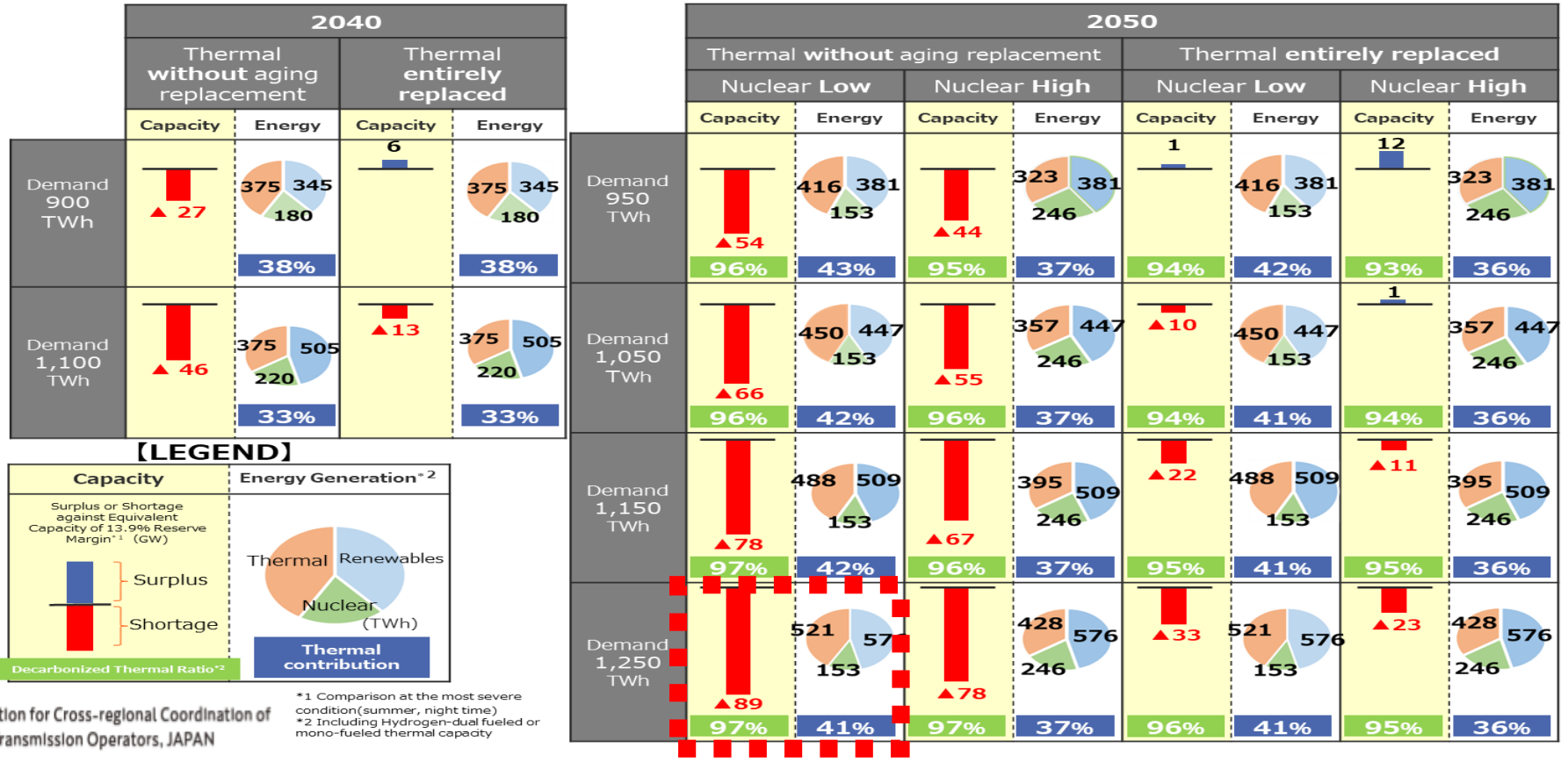
⇒Operation Beyond the 60-Year Limit

- **Thermal**

⇒ Replacement of Aging Plants with decarbonization

Examination of Future Power Supply-Demand Scenarios ～Assessment Results for kW Balance and kWh Balance～

- Scenarios with relatively high demand or insufficient replacement of aging power plants suggest a potential supply shortage in the supply-demand balance.
- In the most severe scenario, a potential supply shortage of around 90 GW could occur in 2050.



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*1 Comparison at the most severe condition(summer, night time)
*2 Including Hydrogen-dual fueled or mono-fueled thermal capacity

[Ref] Examination of Future Power Supply-Demand Scenarios ～ (Image) Calculation and study results ～

- Examining each scenario, we not only evaluate the annual energy production by each source, but also set the load curve and check the amount of reserve capacity.

Evaluation of Supply-Demand Balance for Capacity (kW) and Energy (kWh) 2

Capacity (kW) balances are made for each scenario and surplus/shortage against required reserve margin is assessed. In addition, energy (kWh) balance is reviewed assuming that shortage, if any, is supplemented by thermal generation.

2050 1,250 TWh Demand/Nulear High/Thermal Entirely Replaced

Capacity Balance

Most Severe Supply-Demand Balance of Each Model Scenario

Unit: GW

		2050 Summer Night time Coefficient	
Demand		Evening Peak	187.0
Generation Sources	Capacity	Contribution	190.4
Solar (except onsite generation)	90.0	0%	0
Wind	42.5	10%	4.3
Hydro	27.0	44%	11.9
Biomass	9.0	80%	7.2
Geothermal	1.5	85%	1.3
Nuclear	37.0	76%	28.1
Pumped Storage	20.0	100%	20.0
Battery	13.0	81%	10.5
Thermal: Coal (CCS)	30.2	82%	24.8
Thermal: Coal (except CCS)	7.5	90%	6.8
Thermal: LNG (CCS)	41.5	74%	30.7
Thermal: LNG (except CCS)	46.1	82%	37.8
Thermal: LNG	0	82%	0
Thermal: Oil (CCS)	8.3	83%	6.9
Thermal: Oil	0	91%	0
Thermal: By-product Gas (CCS)	0.1	82%	0.1
Thermal: By-product Gas (without CCS)	0	90%	0
Reserve Margin		–	1.8%
Surplus/shortage against required reserve margin		–	▲ 23
Thermal capacity necessary for the supplementation above		–	29
(参考) Subtotal of decarbonized thermal capacity	154.7	–	123.9
Subtotal of non-decarbonized thermal capacity	8.0	–	6.2
Ratio of decarbonized thermal capacity	–	–	95%

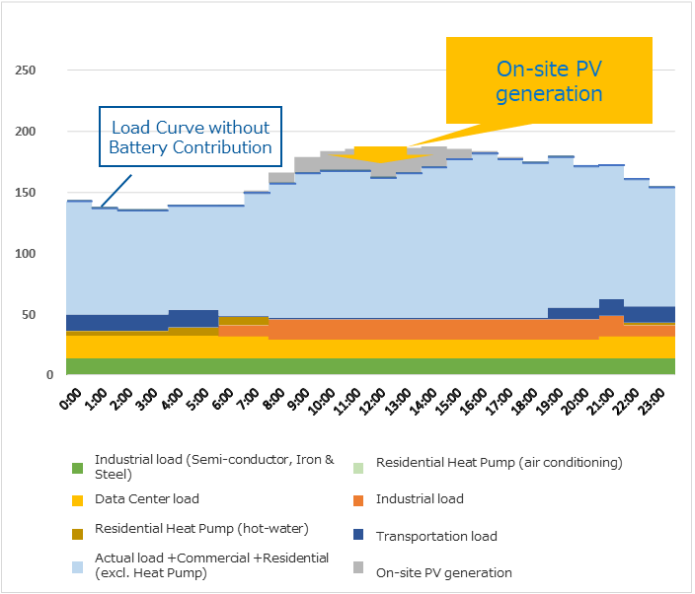
Energy Balance

Necessary energy is supplemented by thermal generation

Unit: GW, TWh

	2050 Capacity	2050 Capacity Factor	2050 Energy Generated
Energy Demand	–	–	1,250
Generation sources	460.0	–	1,250
Solar (incl. onsite generation)	180.0	17%	268
Wind	42.5	30%	112
Hydro	27.0	54%	128
Biomass	9.0	73%	58
Geothermal	1.5	73%	10
Nuclear	37.0	76%	246
Thermal	162.7	36%	428

Weekday in August (excl. on-site PV generation)



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Examination of Future Power Supply-Demand Scenarios ～Use of Scenarios and Future Updates～

- The scenarios developed this time are expected to be utilized by a wide range of stakeholders, who will select scenarios according to their respective purposes.
- Moreover, changes in assumptions and other conditions will be continuously observed and the scenarios will be updated every three to five years

Example of Scenario Utilization:

- Examination of policy measures encouraging generation development
- Consideration of ensuring Balancing Capacity needed for the long-term future (e.g., 2040 and 2050)
- Development of interconnection lines taking into account the balance of demand and power supply across regions
- Assessment of demand forecasts and supply management frameworks

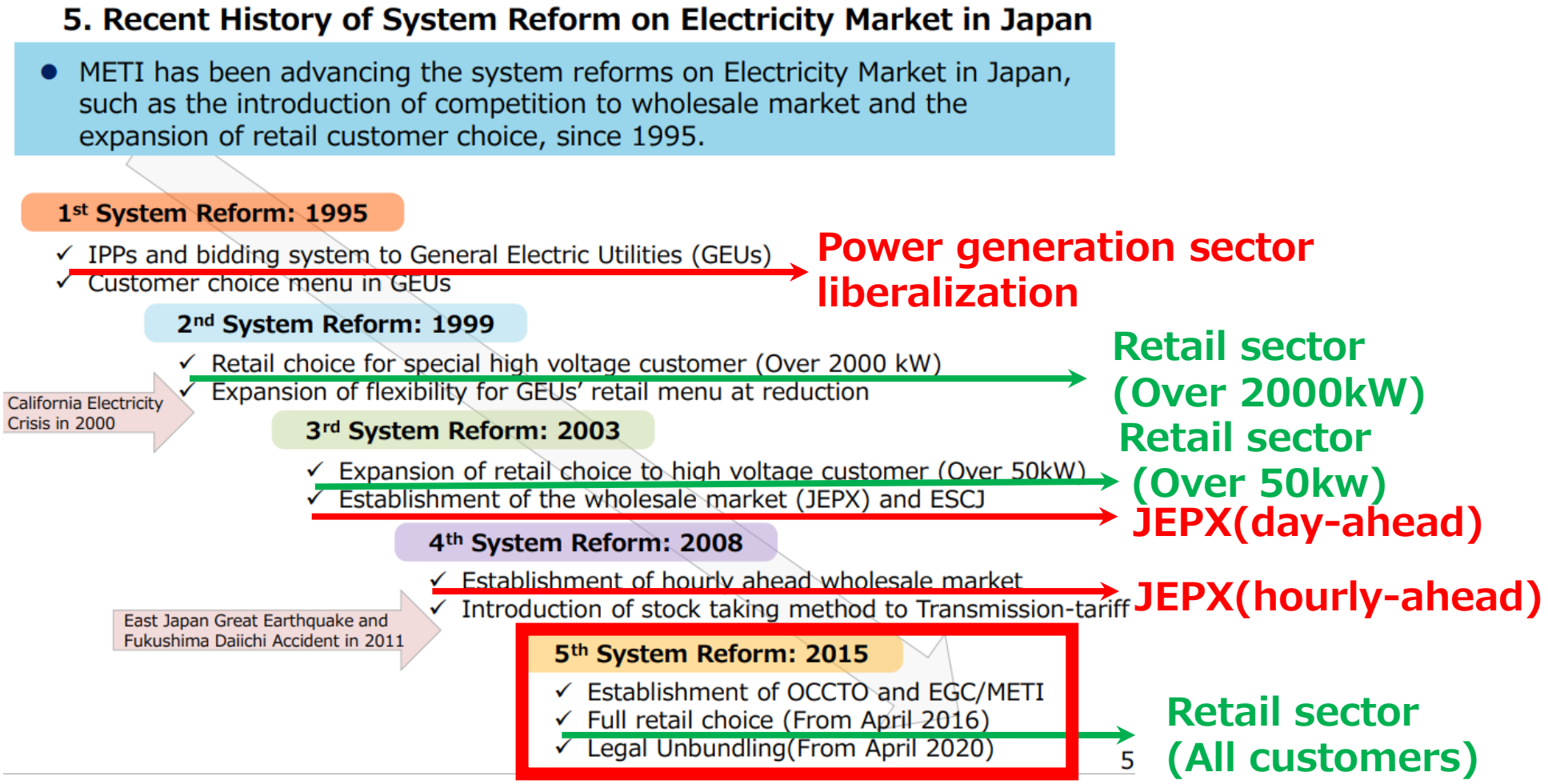
Conclusion

- OCCTO will continue to play a central role in ensuring a stable supply of electricity and achieving carbon neutrality under Japan's electricity system reform.
- Securing long-term supply capacity and related issues are among the most important challenges.
- OCCTO will continue to contribute to the realization of Japan’s national policy goals by ensuring practical feasibility in implementation.
- Thank you for your attention
- 들어 주셔서 감사합니다.

Reference Sheet

[Ref] History of System Reform on Electricity Market in Japan

- In Japan, the system reforms have been carried out step by step since 1995.



Source Electricity System and Market in Japan, 22 January 2018
Electricity and Gas Market Surveillance Commission

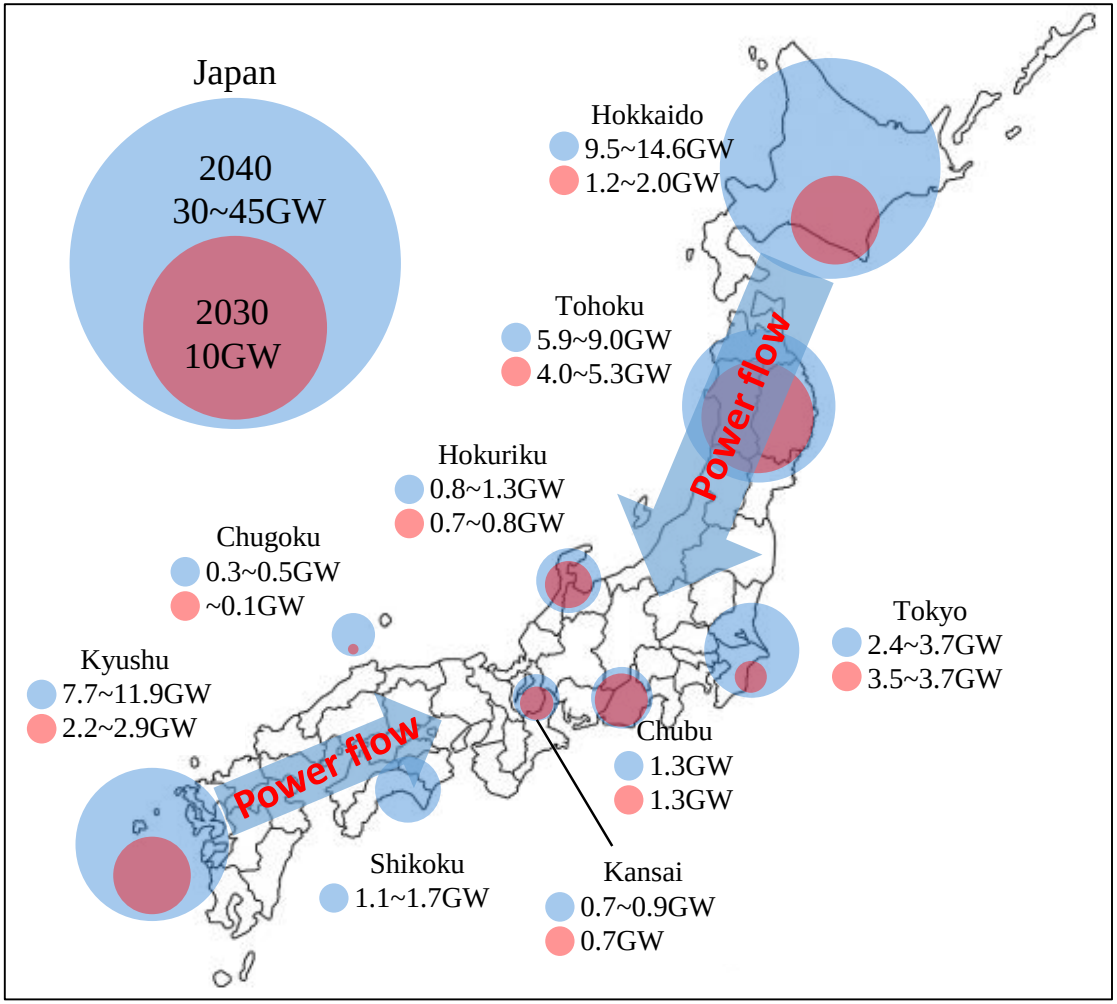
[Ref]24 X 365 Grid Monitoring

- OCCTO is in charge of nation-wide grid monitoring, covering loads, power generations, frequencies, and the power flows among the independent 10 TSOs.
- OCCTO gathers the grid related data from respective TSOs and monitors the data at its monitoring center (called 'Un-yoh-Center'), 24 X 365 basis.
- Not only conducting the grid monitoring, the OCCTO's monitoring center is also in charge of managing power supply and flow among TSOs in case of unexpected load serge by severe weathers and unplanned outage by natural disasters.
- Besides, OCCTO also deals with surplus power flow management among TSOs, in case renewable power exceeds consumption in a certain area.

Scan this code to see Cross-regional reserve margin

[Ref] The Long-term Electrical Power Transmission Network Expansion Plan (“Master Plan”) for decarbonization in Japan

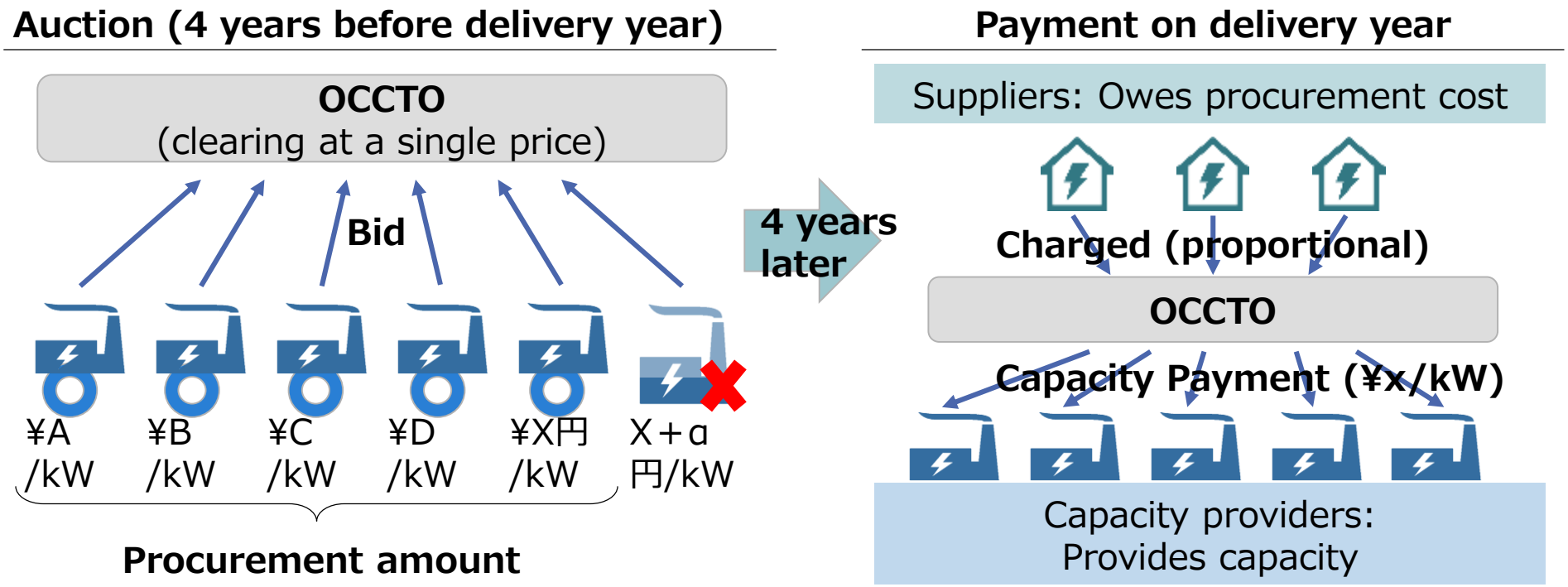
- OCCTO's role includes formulating long-term policies and cross-regional network plans. In 2023, it created the Long-Term Electrical Power Transmission Network Expansion Plan to maximize renewable energy sources(RES) use for carbon neutrality by 2050.
- Northern and western Japan have significant RES potential but are far from demand centers, creating a bottleneck in transmission. Therefore, OCCTO formulated this plan to guide the reinforcement of existing grids.



Targets for offshore wind in Japan for 2030 to 2040

【Ref.】 Japan's Capacity Market

- OCCTO Capacity Procurement
  - Procures total capacity through a **single-price auction**, via a **single-year contract**.
  - The **first auction** was held in 2020, for **delivery in 2024**.
  - Acts as the settlement body, distributing procurement costs to suppliers on a proportional basis.
  - Introduced the Long-Term Decarbonised Capacity Auction in 2023, as part of the Capacity Market, to enhance investment predictability by offering long-term fixed incomes to providers



[Ref] Outline of Long-term Decarbonized Capacity Auction

- Generation types which can participate are **new construction** or **replacement** of decarbonized power sources (including pomp-storage hydro and battery), **upgrade of existing** thermal plant into decarbonized sources by **co-firing** and new LNG thermal power **on the premise of being decarbonized** by 2050.
- Procurement volume is **approx. 10 GW in 2023 and 7GW in 2024** auction.

	Investment support for Decarbonized Power Sources
Purpose	In order to promote new investment in decarbonized power resources
Type of generation	① New construction/Replacement of decarbonized power sources (including pomp-storage hydro and battery) ② Investment to upgrade existing thermal power plants to decarbonized power sources ③ New construction of LNG thermal power on the premise of being decarbonized by 2050
Major Requirement	-Hydrogen co-firing, Ammonia co-firing; Being decarbonized by 2050 -Newly construction or replacement of LNG thermal power; Being decarbonized by 2050 -ALL; meeting the deadlines for commercial operation date stipulated for each technology -ALL; requirement same as main auction for each delivery year
Auction implementation	From FY 2023 (Target actual supply and demand year is after FY2027)
Procurement volume	4GW at 2023 auction, 5GW at 2024 auction （for ① and ②） 6GW during 2023~2025, 2GW at 2024, 2GW at 2025 auction（for ③）