Organization for Cross-regional Coordination of Transmission Operators, Japan

Annual Report

- Fiscal Year 2024 -

December 2024

電力広域的運営推進機関
Organization for Cross-regional Coordination of Transmission Operators,JAPAN

Introduction

The Organization for Cross-regional Coordination of Transmission Operators, Japan (OCCTO), is responsible for promoting cross-regional coordination of electric power business, and in charge of broad range of business, including securing stable electricity supply, and fostering the utilization environment of the electric power network in a fair and effective manner. Among the business stated above, OCCTO aggregates and publishes the respective reports as an “Annual Report” according to the provisions of Article 181 of the Operational Rules of the Organization.

With regards to securing a stable electricity supply in both normal and abnormal conditions, the annual report contains “Outlook for Electricity Supply and Demand (Data for FY 2023)”, “Report on the Quality of Electricity Supply (Data for FY 2023)”, and “Outlook for Cross-regional Interconnection Lines (Data for FY 2023)”.
With regards to fostering the utilization environment of the electric power network in a fair and effective manner, the Report covers “Actual Data of Preliminary Consultation, System Impact Study and Contract Applications in FY 2023”.
With regards to the mid to long-term security of a stable electricity supply, the report includes “Projection and Challenges Regarding Electricity Supply-Demand and Network based on the Aggregation of the Electricity Supply Plan for the Period FY 2024 to 2033” and “Review of the Adequate Level of Balancing Capacity in Each Regional Service Area” (Evaluation of Proper Standard of Soliciting Balancing Capacity for FY 2025).

OCCTO considers that this report could assist the electricity business concerned or be used as a reference by those who have interests in the electric power business or a stable supply of electricity.

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I. Actual Electric Supply and Demand

Outlook for Electricity Supply and Demand

- Actual Data for FY 2023 -

November 2024

Organization for Cross-regional Coordination of Transmission Operators, Japan

FOREWORD

The Organization for Cross-regional Coordination of Transmission Operators, Japan (hereinafter, the Organization), prepares and publishes its annual report according to the provisions of Article 181 of the Operational Rules regarding the matters specified below.

i. Actual electric supply and demand (including evaluation and analysis of quality of electricity in light of frequency, voltage, and blackouts of each regional service area)
ii. State of electric network
iii. Actual Network Access Business until the previous year.
iv. Forecast on electric demand and electric network (including forecast of improvement of restriction on network interconnection of generation facilities) for the next fiscal year and a mid- and long-term period based on a result of compiling of electricity supply plans and their issues.
v. Evaluation and verification of proper standards of reserve margin and balancing capacities of each regional service area based on the next article, as well as contents of review as needed

The Organization published the actual data for electricity supply–demand and network system utilization ahead of the annual report because of the compilation of actual data collection up to the 2023 fiscal year.

SUMMARY

This report reviews the outlook for electricity supply–demand and cross-regional interconnection lines in the 2023 fiscal year according to the provisions of Article 181 of the Operational Rules the Organization for Cross-regional Coordination of Transmission Operators, Japan (hereinafter, the Organization).

This report comprises two parts the electricity supply and demand situation and, the interconnection lines situation.

Regarding supply and demand, the peak demand nationwide (16,090 $\times 10^4$ kW) was recorded in July, and the monthly peak electric energy requirement nationwide (83,695 GWh) was recorded in August.

The reserve margin against the summer and winter peak demands was 13.5% and 14.3%, respectively.

Power exchange instructions were issued by the Organization 8 times, with 5 of them being issued for insufficient ability to reduce power supply caused by unexpected demand decrease and solar output increase.
In Addition, long-cycle frequency control was implemented 377 times in the year.

Instructions for output shedding of the renewable-energy generating facilities were issued 305 times in FY 2023, increasing from 136 times of issuance in the previous year. The actual output shed in a day totaled 431,961 MW in FY 2023.

We hope that this report will be useful.

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Note:
Data for Chapter I include figures at the sending end, i.e., the electricity supplied to the public network system from power plants with energy deducted for station services from FY 2016 beyond. As for the data before FY 2015 which include figures at the generating and receiving end, please see 2016 Annual Report.
https://www.occto.or.jp/en/information_disclosure/annual_report/files/annual_report_FY2016.pdf

CHAPTER I: ACTUAL ELECTRICITY SUPPLY AND DEMAND

1. Regional Service Areas for 10 General Transmission and Distribution (GT&D) Companies and the Definition of a Season

(1) Regional Service Areas for 10 GT&D Companies

A regional service area is a specific area to which a GT&D company supplies electricity through cross-regional interconnection lines. Japan is divided into 10 regional service areas, as depicted in Figure 1-1. The regional service areas served by GT&D companies other than the Okinawa Electric Power Company (EPCO) are connected by cross-regional interconnection lines.

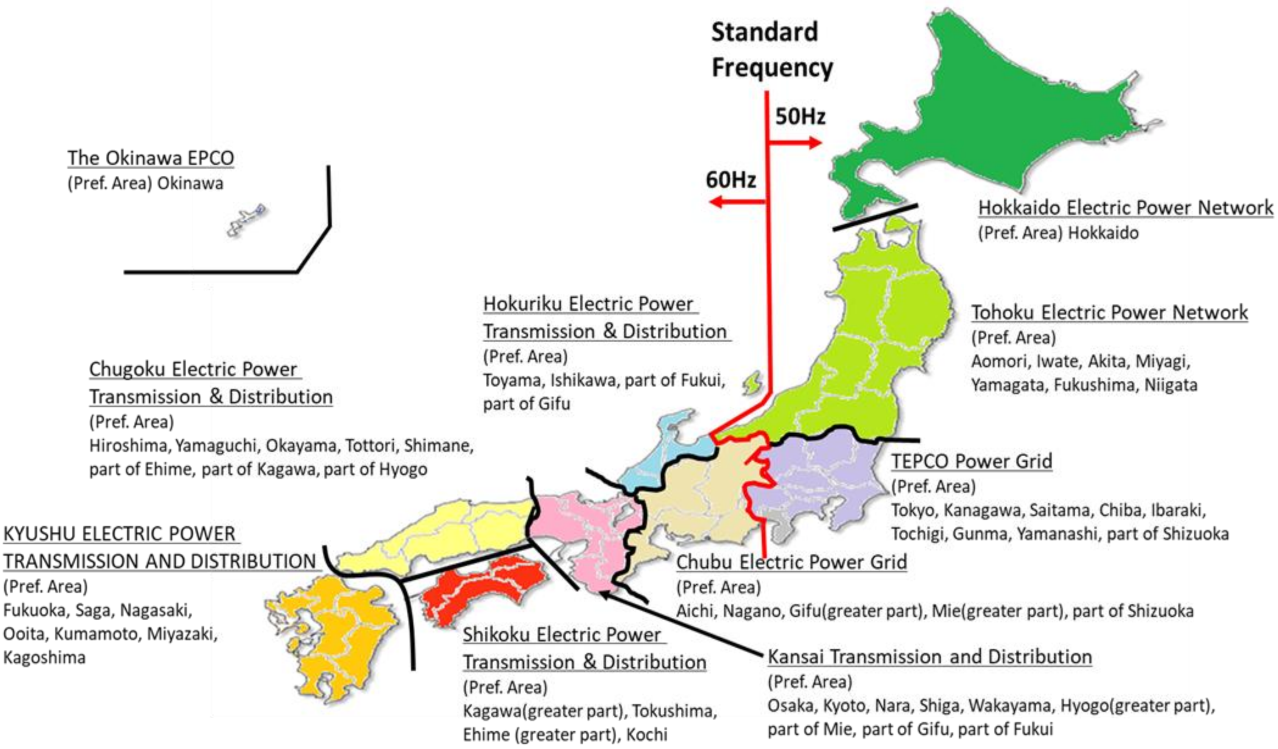


Figure 1-1: The 10 Regional Service Areas in Japan and their Prefectural Distribution

(2) Definition of Seasons

This report divides the seasons into summer and winter. Summer is from July to September, and winter is from December to February. This report compares the outlook of actual weather for the previous year to the Seasonal Climate Report of Japan prepared by the Japan Meteorological Agency (JMA). JMA defines the summer and winter periods as June–August and December–February, respectively. The definitions of the summer period by this report and the JMA differ.

2. Outlook for Actual Weather Nationwide

(1) Weather During the Summer Period (from June to August 2023)

The characteristics of the actual weather from June to August 2023 were published on the website of the JMA. Table 1-1 presents the anomalies in the temperature and precipitation ratios of the period.

- Seasonal mean temperatures were significantly above normal in northern/eastern/western Japan because the regions were covered by warm-air and affected by southerly warm air advection. The regional average of seasonal mean temperature anomalies was the highest on record for summer since 1946 in northern/eastern Japan, and tied with 2013, 2018 and 2022 as the highest on record for summer since 1946 in western Japan. The seasonal anomaly of the average temperature over Japan was +1.76°C (the warmest for the season since 1898).
- Seasonal sunshine durations were significantly above normal in northern/eastern Japan, and seasonal precipitation amounts were below normal in the Pacific side of northern Japan, because the regions were frequently covered by high-pressure systems.
- Meanwhile, seasonal precipitation amounts were significantly above normal on the Pacific side of eastern/western Japan and in Okinawa/Amami, and seasonal sunshine durations were below normal in Okinawa/Amami, because the regions were affected by the Baiu rainy season front in June and two Typhoons KHANUN (T2306) and LAN (T2307) in August.

Table 1-1: Anomalies in temperature, precipitation, and sunshine duration by weather region from June to August 2023

Weather Region	Mean Temperature Anomaly[°C]	Precipitation Ratio[%]	Sunshine Duration Ratio[%]
Northern	+3.0	94	120
Eastern	+1.7	112	126
Western	+0.9	109	101
Okinawa/Amami	+0.1	137	93

Source: Japan Meteorological Agency (JMA), Tokyo Climate Center.
Seasonal Climate Report over Japan for Summer (FY 2023).
https://ds.data.jma.go.jp/tcc/tcc/products/japan/climate/index.php?kikan=3mon&month=8&year=2023
https://www.data.jma.go.jp/gmd/cpd/cgi-bin/view/kikohyo/en.php?kikan=3mon&month=8&year=2023

(2) Weather During the Winter Period (from December 2023 to February 2024)

The characteristics of the actual weather from December 2023 to February 2024 were published on the website of the JMA. Table 1-2 presents the anomalies in temperature and the ratios of rainfall and snowfall during the period.

- Seasonal temperatures were significantly above normal nationwide due to weaker-than-normal winter monsoon, and warm air inflow mainly in February. The seasonal anomaly of the average temperature over Japan was +1.27 **°C** (the second highest for the season since 1898).
- Seasonal precipitation amounts were above normal on the Sea of Japan side of eastern Japan due to stronger influences of winter monsoon and low-pressure systems mainly in December, and on the Sea of Japan side and on the Pacific side of western Japan due to stronger influences of low-pressure systems and fronts in February. On the other hand, they were below normal in Okinawa/Amami due to weaker influences of low-pressure systems and fronts.
- Seasonal sunshine durations were above normal on the Sea of Japan side of northern/eastern Japan, on the Pacific side of northern Japan, and Okinawa/Amami, due to weaker-than-normal winter monsoon and so on.

Table 1-2: Anomalies in temperature, precipitation, sunshine duration and snowfall by weather region from December 2023 to February 2024

Weather Region	Mean Temperature Anomaly[°C]	Precipitation Ratio[%]	Sunshine Duration Ratio[%]	Snowfall Ratio[%]
Northern	+1.1	106	109	82
Eastern	+1.6	109	103	53
Western	+1.5	117	100	36
Okinawa/Amami	+1.0	86	124	-

Source：Japan Meteorological Agency, Tokyo Climate Center.
Seasonal Climate Report over Japan for Winter (FY 2024).
https://ds.data.jma.go.jp/tcc/tcc/products/japan/climate/index.php?kikan=3mon&month=2&year=2024
https://www.data.jma.go.jp/gmd/cpd/cgi-bin/view/kikohyo/en.php?kikan=3mon&month=2&year=2024

3. Actual Nationwide Peak Demand

Peak demand refers to the highest consumption of electricity in a period, and it is expressed hourly in this report.[1] Table 1-3 presents the monthly peak demand for regional service areas in FY 2023. Figures 1-2 and 1-3 depict the nationwide monthly peak demand for FY 2023 and the actual annual peak demand from FY 2016 to FY 2023, respectively. Table 1-4 presents the actual nationwide peak demand since FY 2016 at the sending end. In this report, peak demand refers to the maximum hourly value of the electric energy requirement.

The values in red are the maximum monthly peak demand (i.e., the annual peak demand), and those in blue are the minimum monthly peak demand for each regional service area. The names of the regional service areas are indicated in the names of the GT&D companies.

The maximum monthly peak demand nationwide for FY 2023 was 16,090 × 10^4 kW in July, which was only lower than that of the previous year by 518 × 10^4 kW or 3.1% and lower than the FY 2020's peak demand by 3.3% during the 8 years since they were recorded at the sending end. This decrease is attributable to factors such as falling residential demand accompanied by a decrease in remote work, as well as energy conservation and savings, despite the record-breaking highest summer mean temperature.

Table 1-3: Monthly peak demand for regional service areas[2]

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	385	355	376	455	488	406	363	454	500	522	488	459
Tohoku	1,002	1,040	1,115	1,367	1,449	1,376	947	1,216	1,328	1,423	1,337	1,278
Tokyo	3,393	3,805	4,658	5,525	5,475	5,238	3,730	3,791	4,335	4,675	4,990	4,789
Chubu	1,674	1,804	2,151	2,465	2,433	2,357	1,760	1,862	2,153	2,311	2,172	2,084
Hokuriku	353	361	422	491	507	465	348	397	501	497	478	447
Kansai	1,725	1,831	2,262	2,708	2,671	2,522	1,810	1,885	2,304	2,503	2,345	2,233
Chugoku	720	696	839	1,027	1,026	955	718	794	1,006	1,047	935	881
Shikoku	319	341	424	488	491	464	356	356	450	464	422	392
Kyushu	1,005	1,162	1,294	1,574	1,578	1,504	1,137	1,193	1,500	1,529	1,240	1,183
Okinawa	104	124	143	155	155	151	147	116	98	103	103	101
Nationwide	10,355	11,074	13,490	16,090	15,992	15,032	11,014	11,756	13,940	14,462	14,018	13,389

[1] In this report, the demand includes connection to the network of the GT&D company and excludes connection to the specified transmission and distribution system or consumption of the privately-owned generating facility.

[2] "Nationwide peak demand" refers the maximum aggregated demand in a period for the regional service areas of the 10 GT&D companies but not the addition of each regional peak demand.

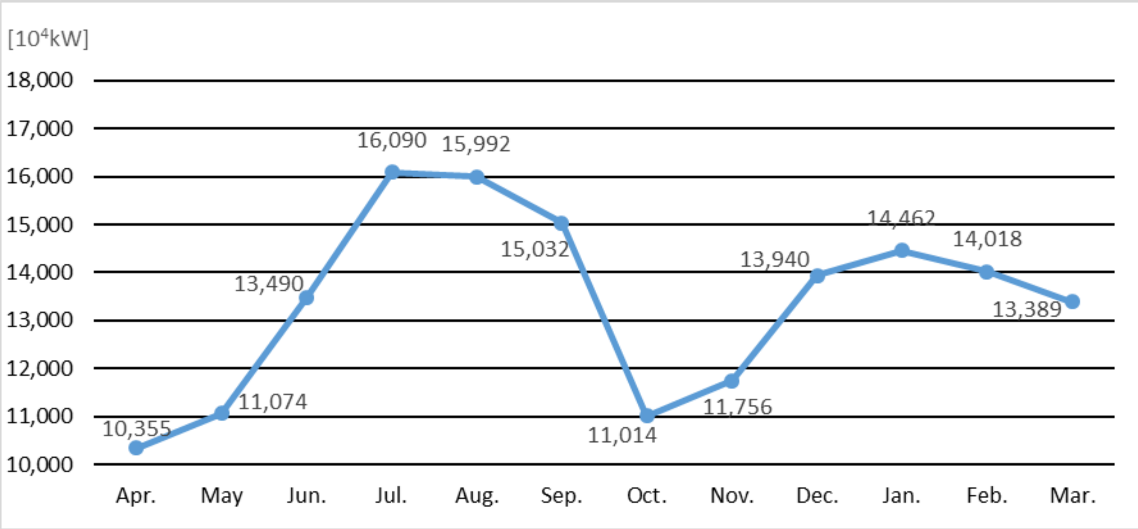


Figure 1-2: Nationwide monthly peak demand

Table 1-4: Actual annual peak demand (FY 2016–2023, sending-end data)

[10^4kW]

FY	2016	2017	2018	2019	2020	2021	2022	2023
Nationwide	15,589	15,577	16,482	16,461	16,645	16,460	16,608	16,090

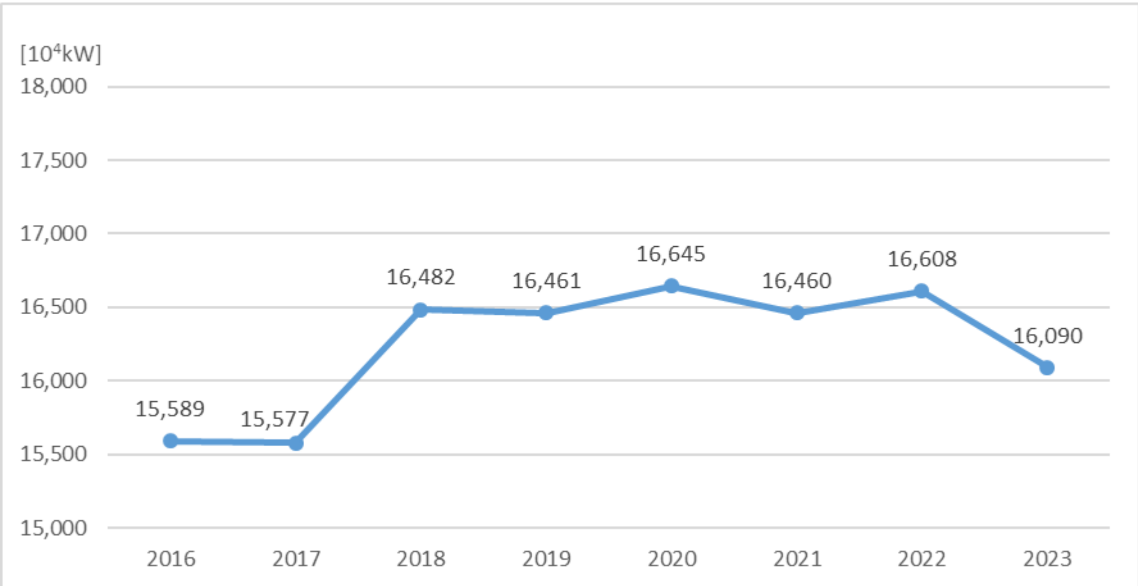


Figure 1-3: Actual annual peak demand (Nationwide)

4. Actual Nationwide Electric Energy Requirements

Table 1-5 presents the monthly electric energy requirements for the regional service areas in FY 2023. Figures 1-4 and 1-5 depict the nationwide monthly and actual annual electric energy requirements from FY 2016 to 2023, respectively. Table 1-6 presents the actual annual electric energy requirement since FY 2016 at the sending end.

The values in red are the maximum monthly energy requirement, and those in blue are the minimum monthly energy requirement for each regional service area.

The actual annual nationwide electric energy requirement for FY 2023 was 862,572 GWh, which was lower than that for the previous year by 7,477 GWh or 0.9% and the FY 2017's electric energy requirement by 4.3% (the highest in the 8 years since they were recorded at the sending end). This decrease is attributable to factors such as falling residential demand accompanied by a decrease in remote work, as well as energy conservation and savings, despite the record-breaking highest summer mean temperature.

Table 1-5: Monthly and annual electric energy requirements for the regional service areas[3]

[GWh]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
Hokkaido	2,254	2,140	2,088	2,340	2,520	2,224	2,198	2,448	3,015	3,115	2,878	2,832	30,052
Tohoku	5,827	5,741	5,844	6,768	7,520	6,444	5,741	6,219	7,435	7,657	7,149	7,314	79,658
Tokyo	19,335	19,473	21,240	27,194	28,083	24,971	20,321	20,866	24,159	25,518	23,953	24,193	279,308
Chubu	9,322	9,320	10,157	12,193	12,189	11,491	9,775	10,092	11,286	11,724	10,985	11,392	129,925
Hokuriku	2,056	1,959	2,083	2,449	2,612	2,286	2,011	2,155	2,553	2,602	2,457	2,535	27,758
Kansai	9,852	9,982	10,732	13,274	13,727	12,353	10,090	10,504	12,219	12,899	11,938	12,301	139,871
Chugoku	4,127	4,028	4,287	5,159	5,379	4,848	4,253	4,376	5,215	5,396	4,940	4,942	56,950
Shikoku	1,884	1,892	1,995	2,408	2,473	2,273	1,915	1,987	2,330	2,415	2,225	2,245	26,041
Kyushu	5,971	6,153	6,634	8,071	8,354	7,513	6,270	6,388	7,647	7,824	7,005	7,034	84,864
Okinawa	573	636	760	903	838	840	714	584	583	585	549	579	8,144
Nationwide	61,201	61,323	65,819	80,760	83,695	75,242	63,288	65,620	76,443	79,735	74,080	75,366	862,572

3 Here and elsewhere, the annual total may not equal the sum of the 12 months due to independent rounding.

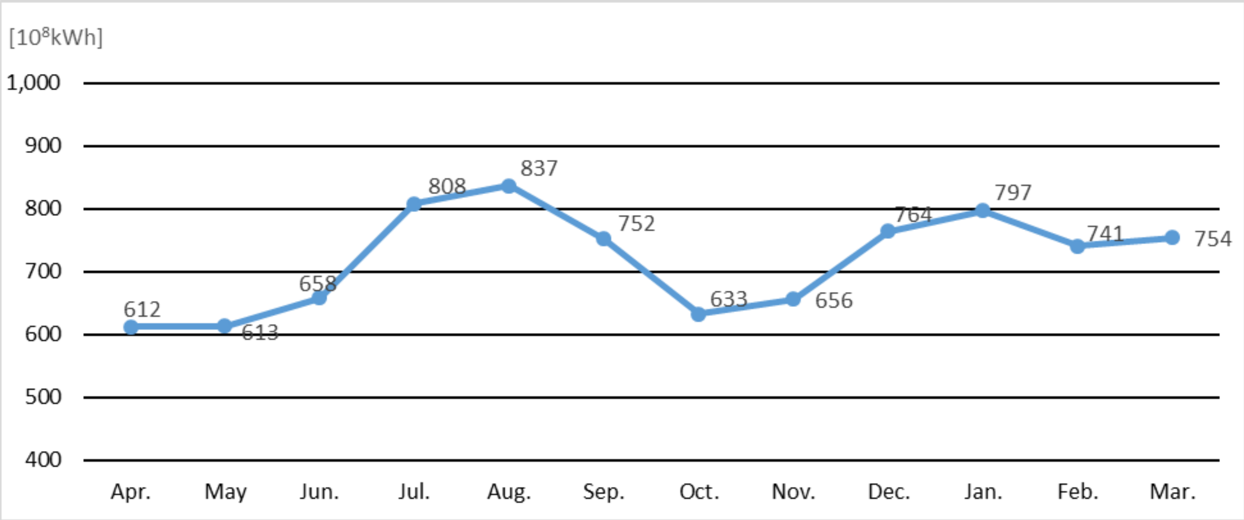


Figure 1-4: Nationwide monthly electric energy requirements

Table 1-6: Actual annual electric energy requirement (FY 2016–2023, sending-end data)

[GWh]

FY	2016	2017	2018	2019	2020	2021	2022	2023
Nationwide	890,451	900,902	896,473	878,383	867,842	885,171	870,849	862,572

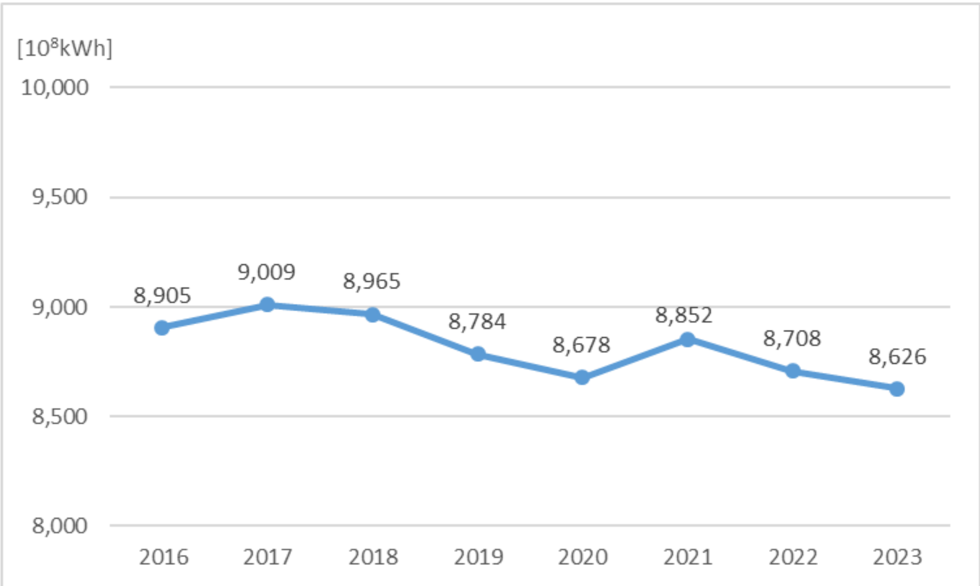


Figure 1-5: Actual annual electric energy requirements (Nationwide)

5. Nationwide Load Factor

The load factor is the ratio of average demand to peak demand for a period. Table 1-7 presents the monthly load factor for the regional service areas in FY 2023, while Figures 1-6 and 1-7 depict the nationwide monthly and annual load factors, respectively. Table 1-8 presents the actual annual load factor since FY 2016 at the sending end.

The values in red and blue are the highest and lowest load factors for each regional service area, respectively.

The nationwide annual load factor for FY 2023 was 61.0%, which was higher than that for the previous year by 1.2 points but lower than the FY 2017's load factor by 5.0 points (the maximum figure for 8 years since they were recorded at the sending end).

Table 1-7: Monthly and annual load factors for the regional service areas[4]

[%]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
Hokkaido	81.4	81.0	77.2	69.2	69.4	76.0	81.5	75.0	81.1	80.3	84.7	83.0	65.6
Tohoku	80.7	74.2	72.8	66.5	69.7	65.0	81.5	71.1	75.3	72.3	76.8	76.9	62.6
Tokyo	79.1	68.8	63.3	66.2	68.9	66.2	73.2	76.4	74.9	73.4	69.0	67.9	57.6
Chubu	77.4	69.5	65.6	66.5	67.3	67.7	74.7	75.3	70.5	68.2	72.7	73.5	60.0
Hokuriku	80.9	72.9	68.5	67.1	69.2	68.2	77.6	75.4	68.5	70.3	73.8	76.2	62.3
Kansai	79.3	73.3	65.9	65.9	69.1	68.0	74.9	77.4	71.3	69.3	73.1	74.0	58.8
Chugoku	80.3	78.2	71.4	67.6	71.5	70.3	79.8	76.6	69.4	69.1	76.2	76.3	62.1
Shikoku	82.0	74.5	65.3	66.3	67.7	68.0	72.2	77.5	69.6	69.9	75.7	76.9	60.4
Kyushu	82.5	71.2	71.2	68.9	71.1	69.4	74.2	74.4	68.5	68.8	81.2	79.9	61.2
Okinawa	76.7	68.9	74.0	78.2	72.8	77.2	65.1	69.9	80.2	76.6	76.6	77.0	59.8
Nationwide	82.1	74.4	67.8	67.5	70.3	69.5	77.2	77.5	73.7	74.1	75.9	75.7	61.0

4 "Nationwide load factor" refers to the load factor calculated for all Japan. It is not simply the average of each regional load factor.

$$\text{Monthly Load Factor (\%)} = \frac{\text{Monthly Energy Requirement}}{\text{Monthly Peak Demand} \cdot \text{Calendar Hours (24H} \cdot \text{Monthly Days)}}$$

$$\text{Annual Load Factor (\%)} = \frac{\text{Annual Energy Requirement}}{\text{Annual Peak Demand} \cdot \text{Calendar Hours (24H} \cdot \text{Annual Days)}}$$

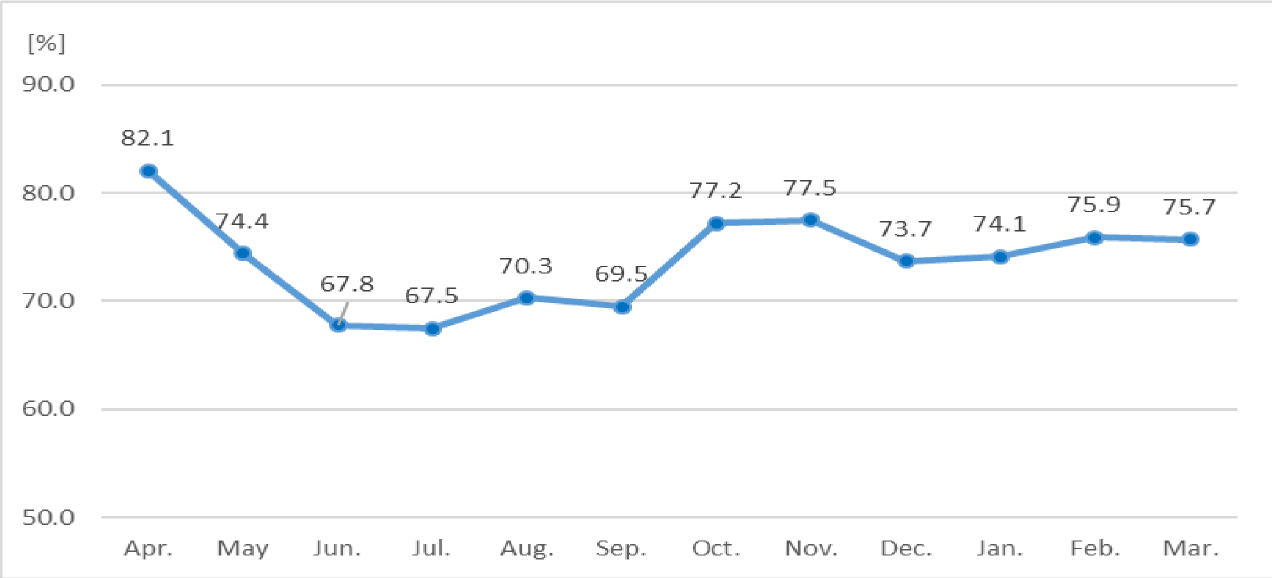


Figure 1-6: Nationwide monthly load factor

Table 1-8: Actual annual load factor (FY 2016–2023)

[%]

FY	2016	2017	2018	2019	2020	2021	2022	2023
Nationwide	65.8	66.0	62.1	60.7	59.5	61.4	59.8	61.0

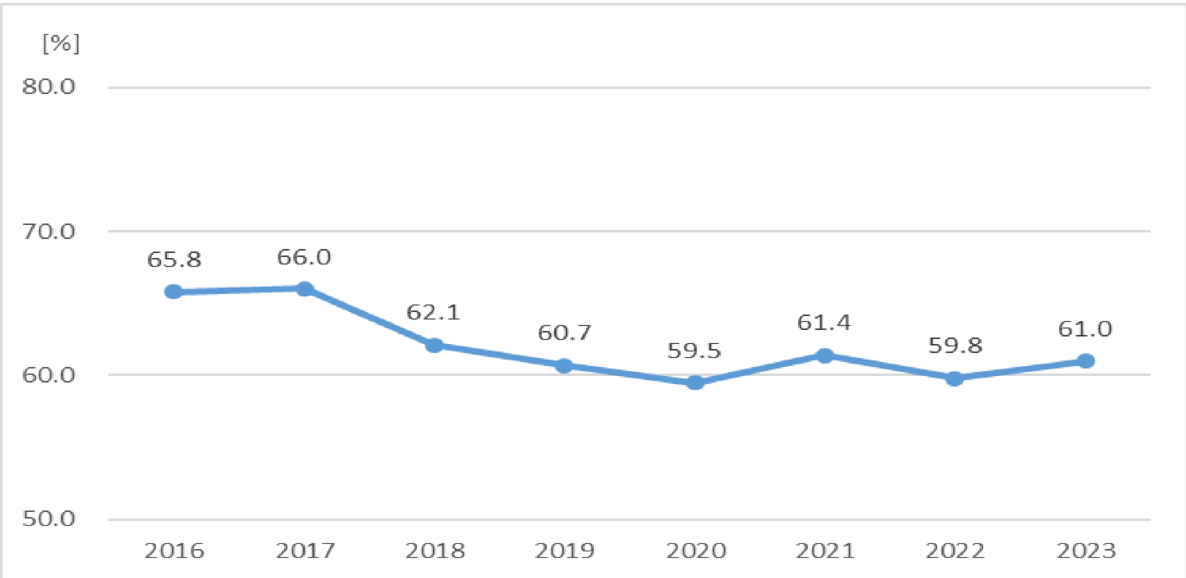


Figure 1-7: Actual annual load factor (Nationwide)

6. Nationwide Supply–Demand Status During the Peak Demand

(1) Nationwide Supply–Demand Status During the Summer Peak Demand Period (July–September)

Table 1-9 presents the supply–demand status during the summer peak demand period for regional service areas in FY 2023. Table 1-10 presents the summer peak supply–demand status data since FY 2016.

The actual nationwide summer peak demand for FY 2023 was 16,090 × 10^4 kW, which was registered at 15:00 on July 27, against the supply capacity of 18,267 × 10^4 kW, having a reserve margin of 13.5%.

The least reserve margin for the summer peak demand was 6.8%, which was registered at 15:00 on August 3 in the Hokuriku area.

Table 1-9: Supply–demand status during the summer peak demand period for nationwide and regional service areas[5]

Area	Peak Demand [10^4kW]	Occurrence Date & Time			Daily Maximum Temperature [℃]	Supply Capacity [10^4kW]	Reserve Capacity [10^4kW]	Reserve Margin [%]	Daily Energy Supply [10^4kWh]	Daily Load Facter [%]
Hokkaido	488	8/25	Fri.	11:00~12:00	34.7	543	55	11.3	9,385	80.2
Tohoku	1,448	8/23	Wed.	14:00~15:00	33.6	1,692	244	16.8	27,200	78.3
Tokyo	5,525	7/18	Tue.	14:00~15:00	37.5	6,188	663	12.0	101,456	76.5
Chubu	2,465	7/18	Tue.	14:00~15:00	37.1	2,757	292	11.8	46,116	77.9
Hokuriku	507	8/3	Thur.	14:00~15:00	38.2	542	34	6.8	9,566	78.6
Kansai	2,708	7/27	Thur.	14:00~15:00	38.1	2,999	291	10.7	49,713	76.5
Chugoku	1,027	7/28	Fri.	15:00~16:00	36.1	1,123	96	9.3	19,507	79.1
Shikoku	491	8/21	Mon.	13:00~14:00	35.7	545	54	11.0	9,002	76.4
Kyushu	1,578	8/21	Mon.	14:00~15:00	34.1	1,703	125	7.9	29,291	77.3
Okinawa	155	7/7	Fri.	14:00~15:00	33.3	212	57	36.7	3,087	82.9
Nationwide	16,090	7/27	Thur.	14:00~15:00	-	18,267	2,177	13.5	299,164	77.5

[5] The daily maximum and mean temperatures are provided by the JMA based on the data for the cities where the headquarters of the GT&D companies (except for the Okinawa EPCO) are located. For the regional service area of the Okinawa EPCO, the data from Naha, the prefectural capital of Okinawa, were used instead.

$$\text{Daily Load Factor (\%)} = \frac{\text{Daily Energy Requirement}}{\text{Daily Peak Demand} \times 24\text{H}}$$

"Supply capacity" in the table above refers to the maximum power that can be generated during the peak demand. This capacity is the addition of the installed generating capacity including the deducted portion, such as generator suspension for maintenance work, derating with a decrease in river flow, and unplanned generator outages.

Table 1-10: Actual supply–demand status for summer peak demand (FY 2016–2023)

FY	Peak Demand [10^4kW]	Occurrence Date & Time			Daily Maximum Temperature [℃]	Supply Capacity [10^4kW]	Reserve Capacity [10^4kW]	Reserve Margin [%]	Daily Energy Supply [10^4kWh]	Daily Load Facter [%]
2016	15,589	8/9	Tue.	14:00～15:00	-	17,764	2,176	14.0	297,969	79.6
2017	15,550	8/24	Thur.	14:00～15:00	-	17,716	2,165	13.9	300,493	80.5
2018	16,482	8/3	Fri.	14:00～15:00	-	18,749	2,267	13.8	315,434	79.7
2019	16,461	8/2	Fri.	14:00～15:00	-	18,584	2,122	12.9	314,988	79.7
2020	16,645	8/20	Thur.	14:00～15:00	-	18,608	1,964	11.8	310,303	77.7
2021	16,460	8/5	Thur.	13:00～14:00	-	18,804	2,344	14.2	308,249	78.0
2022	16,608	8/2	Tue.	13:00～14:00	-	18,561	1,956	11.8	314,861	79.0
2023	16,090	7/27	Thur.	14:00～15:00	-	18,267	2,177	13.5	299,164	77.5

(2) Nationwide Supply–Demand Status During the Winter Peak Demand Period (December–February)

Table 1-11 presents the supply–demand status during the winter peak demand period for regional service areas in FY 2023. Table 1-12 presents the winter peak supply–demand status data since FY 2016.

The actual nationwide winter peak demand for FY 2023 was 14,462 × 10^4 kW, which occurred at 10:00 on January 24, against a supply capacity of 16,527× 10^4 kW, with a reserve margin of 14.3%. The least reserve margin at the winter peak demand was 8.1%, which was registered at 10:00 on January 24 in the Kyushu area.

Table 1-11: Supply–demand status during the winter peak demand period for the regional service areas[6]

Area	Peak Demand [10^4kW]	Occurrence Date & Time			Daily Mean Temperature [℃]	Supply Capacity [10^4kW]	Reserve Capacity [10^4kW]	Reserve Margin [%]	Daily Energy Supply [10^4kWh]	Daily Load Facter [%]
Hokkaido	522	1/16	Tue.	09:00～10:00	-5.7	571	49	9.4	11,367	90.8
Tohoku	1,423	1/16	Tue.	09:00～10:00	-1.1	1,627	204	14.3	30,084	88.1
Tokyo	4,990	2/5	Mon.	14:00～15:00	3.0	5,655	665	13.3	99,477	83.1
Chubu	2,311	1/24	Wed.	09:00～10:00	0.1	2,528	217	9.4	47,352	85.4
Hokuriku	501	12/22	Fri.	09:00～10:00	0.4	575	74	14.8	10,869	90.3
Kansai	2,503	1/24	Wed.	09:00～10:00	2.4	2,727	224	8.9	50,281	83.7
Chugoku	1,047	1/24	Wed.	09:00～10:00	0.2	1,153	106	10.1	21,741	86.5
Shikoku	464	1/24	Wed.	09:00～10:00	1.5	504	40	8.6	9,725	87.3
Kyushu	1,529	1/24	Wed.	09:00～10:00	2.9	1,653	124	8.1	31,729	86.5
Okinawa	103	2/22	Thur.	13:00～14:00	23.0	163	60	58.2	2,028	82.0
Nationwide	14,462	1/24	Wed.	09:00～10:00	-	16,527	2,065	14.3	304,378	87.7

[6] See footnote 5.

Table 1-12: Actual supply–demand status for winter peak demand (FY 2016–2023)

FY	Peak Demand [10^4kW]	Occurrence Date & Time			Daily Mean Temperature [℃]	Supply Capacity [10^4kW]	Reserve Capacity [10^4kW]	Reserve Margin [%]	Daily Energy Supply [10^4kWh]	Daily Load Facter [%]
2016	14,914	1/24	Tue.	18:00～19:00	-	16,354	1,440	9.7	314,968	88.0
2017	15,577	1/25	Thur.	18:00～19:00	-	16,915	1,339	8.6	330,605	88.4
2018	14,603	1/10	Thur.	09:00～10:00	-	16,104	1,501	10.3	308,436	88.0
2019	14,619	2/7	Fri.	09:00～10:00	-	16,808	2,189	15.0	303,347	86.5
2020	15,607	1/8	Fri.	09:00～10:00	-	17,012	1,406	9.0	329,833	88.1
2021	15,119	1/14	Fri.	09:00～10:00	-	16,783	1,665	11.0	317,617	87.5
2022	15,967	1/25	Wed.	09:00～10:00	-	17,587	1,620	10.1	332,978	86.9
2023	14,462	1/24	Wed.	09:00～10:00	-	16,527	2,065	14.3	304,378	87.7

7. Supply–Demand Status During the Actual Least Cross-regiional Reserve Margin Period

The cross-regional reserve margin is calculated to level the reserve margin within the total transfer capacity of the interconnection lines around adjacent areas. During the calculation, within the volume of the available transfer capacity (ATC) of the interconnection lines, the supply capacity of a certain area is transferred to another area for them to be at the same level. If the ATC of an interconnection line becomes zero and the constraint of the line emerges, the cross-regional reserve margin becomes different from the adjacent area.

Regarding the review of the imbalance clearing scheme implemented since FY 2022, the Organization started publishing the cross-regional reserve margin on the cross-regional network system and the cross-regional reserve margin system on March 24, 2023.[7]

Tables 1-13 and 1-14 present the supply–demand status during occurrences at the actual least cross-reserve margin,[8] and the cross-reserve margin of 3% during the summer and winter peak periods, respectively. Moreover, no case was under 3% of the cross-reserve margin.

Table 1-13 Supply–demand status during occurrences at the actual least cross-regional reserve margin in the summer peak period

FY	Occurrence Date & Time	Block	Block			Cross-regional
			Demand(MW)	Supply capacity(MW)	Reserve capacity(MW)	Reserve margin(%)
2023	2023/7/19 11:30~12:00	Tokyo	51,842	54,998	3,156	6.09

Table 1-14 Supply–demand status during occurrences at the actual least cross-regional reserve margin in the winter peak period

FY	Occurrence Date & Time	Block	Block			Cross-regional
			Demand(MW)	Supply capacity(MW)	Reserve capacity(MW)	Reserve margin(%)
2023	2024/2/26 4:00~4:30	Hokkaido	4,433	4,829	396	8.93

7 https://web-kohyo.occto.or.jp/kks-web-public/ (written only in Japanese)

8 The actual least cross-regional reserve margin refers to the figure of gate closure (one hour before actual supply–demand) and not the actual supply–demand figure.

8. Nationwide Lowest Demand Period

Tables 1-15 and 1-16 present the status of the lowest demand period for nationwide and regional service areas in FY 2023 and the actual annual lowest demands at the sending end from FY 2016 to FY 2023, respectively. The lowest demand in FY 2023 was 5,944 × 10^4 kW, which was the lowest for the past 8 years since data were recorded at the sending end, and it is lower than the previous year's by 4.7% and lower than FY 2016's highest demand by 8.6%.

T able 1-15: Lowest demand period for the nationwide and regional service areas[9]

	Least Demand [10^4kW]	Occurrence Date & Time			Daily Mean Temperature [℃]	Daily Energy Supply [10^4kWh]
Hokkaido	223	9/25	Mon.	01:00～02:00	17.9	7,080
Tohoku	569	5/5	Fri.	00:00～01:00	18.9	15,859
Tokyo	1,888	5/4	Thur.	01:00～02:00	19.7	53,466
Chubu	804	5/5	Fri.	01:00～02:00	20.1	22,316
Hokuriku	178	5/5	Fri.	00:00～01:00	21.0	4,813
Kansai	952	5/4	Thur.	01:00～02:00	20.1	26,476
Chugoku	409	5/5	Fri.	00:00～01:00	20.3	11,050
Shikoku	187	5/5	Fri.	01:00～02:00	19.9	5,124
Kyushu	632	10/16	Mon.	01:00～02:00	20.8	20,304
Okinawa	59	11/20	Mon.	01:00～02:00	20.4	1,814
Nationwide	5,944	5/5	Fri.	01:00～02:00	-	165,990

Table 1-16: Actual annual lowest demand (FY 2016–2023, sending-end data)

[10^4kW]

FY	2016	2017	2018	2019	2020	2021	2022	2023
Nationwide	6,516	6,477	6,496	6,398	6,065	6,332	6,239	5,944

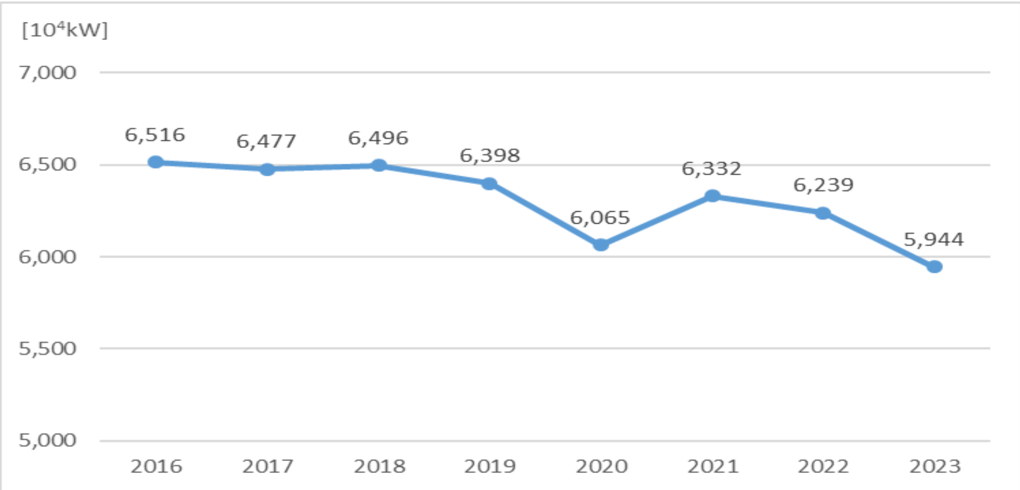


Figure 1-8: Actual annual lowest demand (Nationwide)

[9] See Footnote 5.

9. Nationwide Peak Daily Energy Supply

Tables 1-17 and 1-18 present the summer peak daily energy supply for nationwide and regional service areas in FY 2023 (July–September 2023) and the winter peak daily energy supply for nationwide and regional service areas in FY 2023 (December 2023–February 2024), respectively.[10]

Table 1-17: Summer peak daily energy supply for the nationwide and regional service areas

Area	Peak Daily Energy Supply [10^4kWh]	Occurrence Date		Daily Mean Temperature [˚C]
Hokkaido	9,385	8/25	Fri.	29.7
Tohoku	27,216	8/24	Thur.	29.3
Tokyo	101,456	7/18	Tue.	31.8
Chubu	46,116	7/18	Tue.	31.9
Hokuriku	9,593	8/4	Fri.	31.9
Kansai	49,918	7/28	Fri.	31.1
Chugoku	19,803	8/3	Thur.	30.9
Shikoku	9,020	7/27	Thur.	31.3
Kyushu	29,933	8/4	Fri.	31.9
Okinawa	3,096	7/6	Thur.	30.1
Nationwide	300,714	8/4	Fri.	-

Table 1-18: Winter peak daily energy supply for the nationwide and regional service areas

Area	Peak Daily Energy Supply [10^4kWh]	Occurrence Date		Daily Mean Temperature [˚C]
Hokkaido	11,367	1/16	Tue.	-5.7
Tohoku	30,084	1/16	Tue.	-1.1
Tokyo	99,728	2/6	Tue.	3.4
Chubu	47,352	1/24	Wed.	0.1
Hokuriku	10,869	12/22	Fri.	0.4
Kansai	50,281	1/24	Wed.	2.4
Chugoku	21,741	1/24	Wed.	0.2
Shikoku	9,725	1/24	Wed.	1.5
Kyushu	32,114	12/22	Fri.	3.0
Okinawa	2,144	1/24	Wed.	13.3
Nationwide	304,378	1/24	Wed.	-

[10] See Footnote 5.

10. Instructions, Requests Issued and Controls Implemented by the Organization

Instructions and Requests

According to the provisions of Paragraph 1 of Article 28–44 of the Electricity Business Act (hereinafter, the Act), if the Organization finds it necessary to improve the electricity supply–demand status, the Organization may require members such as EPCOs to undertake certain necessary actions if the status of the electricity supply–demand from an electricity business conducted by a member has worsened or is likely to worsen.

In FY 2023, the Organization issued instructions to GT&D companies on eight occasions for them to exchange power according to the provisions of Items 1–3 of Paragraph 1 of Article 111 of the Operational Rules (Table 1-19). Specifically, the Organization issued instructions to the GT&D companies that the supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of the shortage of supply capacity in a corresponding area, following a decrease in solar power output and unexpected demand growth caused by higher temperatures. However, the instructions for reducing the power supply were also issued due to the unexpected demand decrease and the solar power output increase.

The specific instructions are as follows (for details, please refer to <Reference> Details of Actual Power Exchange Instructions Issued by the Organization):[11]

(1) Instruction for resolving tight supply–demand from Kansai T&D to Hokuriku T&D
January 1, 2024: 600 MW at most following supply capacity shortage caused by the occurrence of the Hokuriku Peninsular Earthquake (three instructions)

(2) Instruction for absorbing excessive energy from Kansai T&D to TEPCO PG and Hokuriku T&D
June 3, 2023: 500 MW at most following unexpected demand decrease and solar power output increase (five instructions)

Table 1-19: Actual instructions to GT&D companies issued by the Organization (FY 2015–2023)

[Instructions]

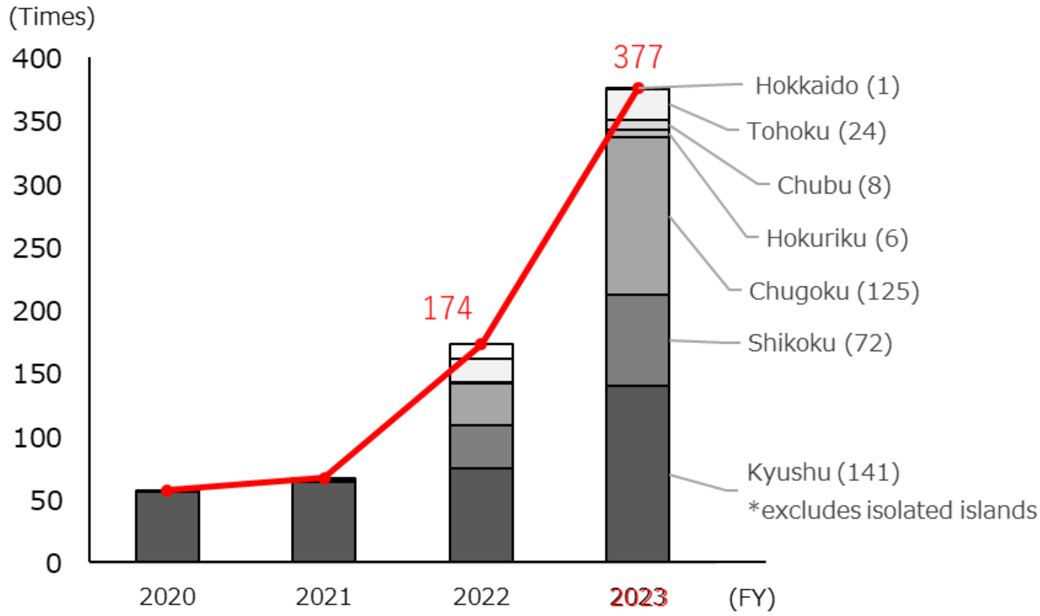
FY	2015	2016	2017	2018	2019	2020	2021	2022	2023
Tight supply-demand	2	2	10	25	6	226	21	24	3
Insufficient ability of reducing power supply	–	–	–	–	–	–	–	–	5

[11] https://www.occto.or.jp/oshirase/shiji/2023.html (in Japanese only)

Long-cycle Cross-regional Frequency Controls

The Organization implemented long-cycle cross-regional frequency controls[12] to send surplus electric energy generated from renewable energy generating facilities in the Hokkaido NW, Tohoku NW, Chubu PG, Hokuriku T&D, Kansai T&D, Chugoku NW, Shikoku T&D, and Kyushu T&D to other areas through cross-regional interconnection lines by utilizing their ATC, according to the provisions of Article 132 of the Operational Rules. The Organization received the request from each EPCO to control the inability to reduce the power supply.[13] Such controls were implemented on 377 occasions in FY 2023.

<Reference> Transition of Long-cycle Cross-regional Frequency Controls



[12] This refers to frequency control through the utilization of the balancing capacity of other regional service areas of member GT&D companies via interconnection lines. This is used when the balancing capacity for redundancy becomes or might become insufficient in a regional service area

[13] This refers to the ability to decrease the power supply from generators, such as thermal power generators. The output of renewable energy can fluctuate over a short period. Thus, controlling the output of the thermal power generators according to such fluctuations is essential. Among such output controls, the capacity to vary the output of the generators is generally called the "balancing capacity for redundancy."

11. Output Shedding of Renewable Energy Generating Facilities Operated by EPCOs Other than GT&D Companies

GT&D companies may order renewable energy generating facilities owned by other EPCOs to shed their output in cases of expected oversupply of demand for their regional service areas after shedding the output of generators other than the renewable energy generating facilities of the GT&D companies, according to the provisions of the Ministerial Ordinance of Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electric Utilities.

Tables 1-20 to 1-28 present the actual output shedding of the renewable energy generating facilities in FY 2023 from the Hokkaido to Okinawa areas.[14] Table 1-29 presents the nationwide results. Output shedding of renewable energy generating facilities was implemented in each regional service area of Hokkaido, Tohoku, Chugoku, Shikoku, Kyushu, and Okinawa in FY 2022. In FY 2023, the regional service areas of Chubu, Hokuriku, and Kansai were added.

Output shedding of renewable energy generating facilities was implemented when the balancing capacity for redundancy might become insufficient. The shedding period was from 8:00 to 16:00 in each area, except for a few cases.

Amid the increasing capacity of variable renewable energy, such as solar and wind power, output shedding of renewable energy generating facilities was implemented 305 times in FY 2023, increasing from 136 times in the previous year. The actual output shed on a day totaled 431,961 MW in FY 2023, increasing from 147,166 MW in FY 2022.

The Organization confirms and verifies whether the output shedding of the renewable energy generating facilities by GT&D company to facilities of EPCOs is according to the provisions of Article 180 of the Operational Rules. The confirmation and verification revealed that it was appropriate.

[14] http://www.occto.or.jp/oshirase/shutsuryokuyokusei/index.html (in Japanese only).

Table 1-20: Actual output shedding of the renewable energy generating facilities (Hokkaido, times, 10^4 kW)

Hokkaido				
Month	Numbers of shedding [times]	Shed capacity [MW]	Maximum of shed capacty [MW]	Implemented on
Apr. 2023	0	0.0	0.0	
May 2023	0	0.0	0.0	
Jun. 2023	0	0.0	0.0	
Jul. 2023	0	0.0	0.0	
Aug. 2023	0	0.0	0.0	
Sep. 2023	0	0.0	0.0	
Oct. 2023	2	24.5	12.6	Oct. 13
Nov. 2023	0	0.0	0.0	
Dec. 2023	0	0.0	0.0	
Jan. 2024	0	0.0	0.0	
Feb. 2024	0	0.0	0.0	
Mar. 2024	0	0.0	0.0	
FY 2023 total	2	24.5		

Table 1-21: Actual output shedding of the renewable energy generating facilities (Tohoku, times, 10^4 kW)

Tohoku				
Month	Numbers of shedding	Shed capacity	Maximum of shed capacty	Implemented on
Apr. 2023	5	916.1	246.5	Apr. 22
May 2023	4	522.4	215.2	May 4
Jun. 2023	2	289.3	252.1	Jun. 4
Jul. 2023	0	0.0	0.0	
Aug. 2023	0	0.0	0.0	
Sep. 2023	0	0.0	0.0	
Oct. 2023	0	0.0	0.0	
Nov. 2023	0	0.0	0.0	
Dec. 2023	0	0.0	0.0	
Jan. 2024	0	0.0	0.0	
Feb. 2024	0	0.0	0.0	
Mar. 2024	3	515.2	240.2	Mar. 30
FY 2023 total	14	2,243.0		

Table 1-22: Actual output shedding of the renewable energy generating facilities (Chubu, times, 10^4 kW)

Chubu				
Month	Numbers of shedding	Shed capacity	Maximum of shed capacty	Implemented on
Apr. 2023	5	235.7	90.8	Apr. 23
May 2023	5	344.6	100.9	May 21
Jun. 2023	2	418.5	223.3	Jun. 4
Jul. 2023	0	0.0	0.0	
Aug. 2023	0	0.0	0.0	
Sep. 2023	0	0.0	0.0	
Oct. 2023	0	0.0	0.0	
Nov. 2023	0	0.0	0.0	
Dec. 2023	0	0.0	0.0	
Jan. 2024	0	0.0	0.0	
Feb. 2024	0	0.0	0.0	
Mar. 2024	2	134.2	109.0	Mar. 31
FY 2023 total	14	1,133.0		

Table 1-23: Actual output shedding of the renewable energy generating facilities (Hokuriku, times, 10^4 kW)

Hokuriku				
Month	Numbers of shedding	Shed capacity	Maximum of shed capacty	Implemented on
Apr. 2023	5	103.2	33.7	Apr. 9
May 2023	5	68.2	24.9	May 4
Jun. 2023	2	51.0	32.5	Jun. 3
Jul. 2023	0	0.0	0.0	
Aug. 2023	0	0.0	0.0	
Sep. 2023	0	0.0	0.0	
Oct. 2023	0	0.0	0.0	
Nov. 2023	0	0.0	0.0	
Dec. 2023	0	0.0	0.0	
Jan. 2024	0	0.0	0.0	
Feb. 2024	0	0.0	0.0	
Mar. 2024	1	0.4	0.4	Mar. 31
FY 2023 total	13	222.8		

Table 1-24: Actual output shedding of the renewable energy generating facilities (Kansai, times, 10^4 kW)

Kansai				
Month	Numbers of shedding	Shed capacity	Maximum of shed capacty	Implemented on
Apr. 2023	0	0.0	0.0	
May 2023	0	0.0	0.0	
Jun. 2023	1	57.6	57.6	Jun. 4
Jul. 2023	0	0.0	0.0	
Aug. 2023	0	0.0	0.0	
Sep. 2023	0	0.0	0.0	
Oct. 2023	0	0.0	0.0	
Nov. 2023	0	0.0	0.0	
Dec. 2023	0	0.0	0.0	
Jan. 2024	0	0.0	0.0	
Feb. 2024	0	0.0	0.0	
Mar. 2024	2	190.3	143.9	Mar. 31
FY 2023 total	3	247.9		

Table 1-25: Actual output shedding of the renewable energy generating facilities (Chugoku, times, 10^4 kW)

Chugoku				
Month	Numbers of shedding	Shed capacity	Maximum of shed capacty	Implemented on
Apr. 2023	18	3,086.6	346.7	Apr. 23
May 2023	18	2,275.6	254.4	May 4
Jun. 2023	5	562.6	221.3	Jun. 3
Jul. 2023	0	0.0	0.0	
Aug. 2023	0	0.0	0.0	
Sep. 2023	0	0.0	0.0	
Oct. 2023	4	202.2	120.9	Oct. 22
Nov. 2023	1	35.8	35.8	Nov. 5
Dec. 2023	1	41.2	41.2	Dec. 10
Jan. 2024	2	49.7	33.1	Jan. 1
Feb. 2024	5	371.6	189.8	Feb. 18
Mar. 2024	8	946.3	237.5	Mar. 30
FY 2023 total	62	7,571.6		

Table 1-26: Actual output shedding of the renewable energy generating facilities (Shikoku, times, 10^4 kW)

Shikoku				
Month	Numbers of shedding	Shed capacity	Maximum of shed capacty	Implemented on
Apr. 2023	15	756.6	86.3	Apr. 9
May 2023	13	501.0	64.8	May 21
Jun. 2023	4	341.5	158.2	Jun. 3
Jul. 2023	1	42.1	42.1	Jul. 2
Aug. 2023	0	0.0	0.0	
Sep. 2023	0	0.0	0.0	
Oct. 2023	2	74.7	42.4	Oct. 29
Nov. 2023	0	0.0	0.0	
Dec. 2023	1	15.1	15.1	Dec. 10
Jan. 2024	1	28.4	28.4	Jan. 1
Feb. 2024	0	0.0	0.0	
Mar. 2024	5	412.6	146.7	Mar. 30
FY 2023 total	42	2,172.0		

Table 1-27: Actual output shedding of the renewable energy generating facilities
(Kyushu mainland, times, 10^4kW)

Kyushu				
Month	Numbers of shedding	Shed capacity	Maximum of shed capacty	Implemented on
Apr. 2023	20	7,607.0	588.0	Apr. 9
May 2023	24	7,617.0	583.0	May 3
Jun. 2023	9	1,310.0	389.0	Jun. 3
Jul. 2023	0	0.0	0.0	
Aug. 2023	1	132.0	132.0	Aug. 13
Sep. 2023	6	537.0	319.0	Sep. 24
Oct. 2023	24	4,010.0	370.0	Oct. 22
Nov. 2023	15	2,057.0	249.0	Nov. 3
Dec. 2023	3	158.0	128.0	Dec. 10
Jan. 2024	4	351.0	144.0	Jan. 2
Feb. 2024	8	1,070.0	328.0	Feb. 18
Mar. 2024	22	4,698.0	409.0	Mar. 16
FY 2023 total	136	29,547.0		

Table 1-28: Actual output shedding of the renewable energy generating facilities (Okinawa, times, 10^4 kW)

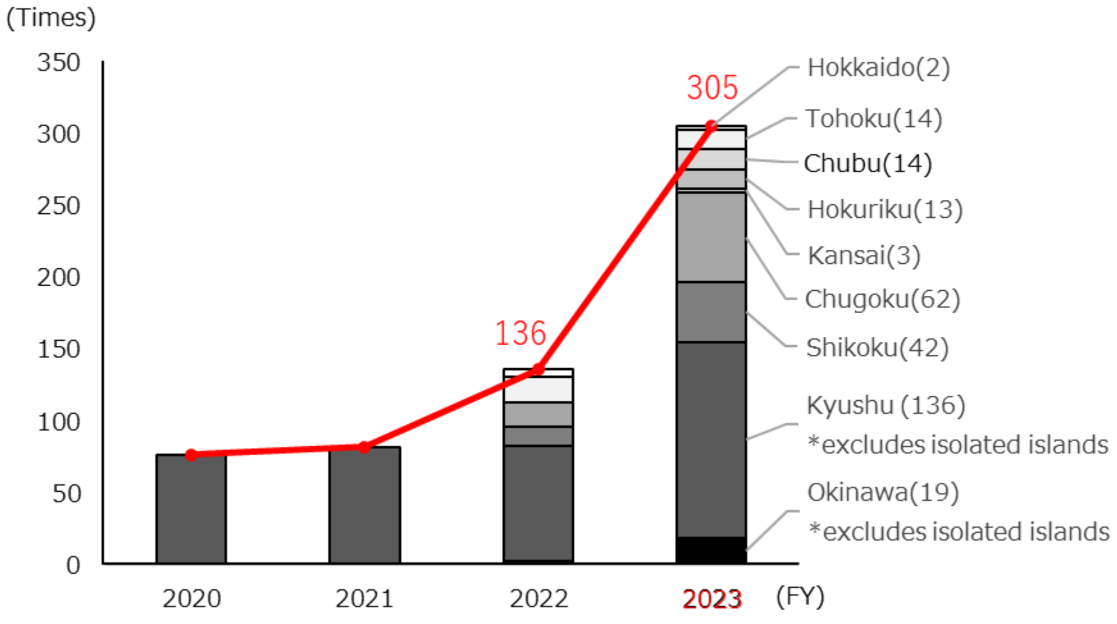
Okinawa				
Month	Numbers of shedding	Shed capacity	Maximum of shed capacty	Implemented on
Apr. 2023	3	6.9	3.4	Apr. 9
May 2023	0	0.0	0.0	
Jun. 2023	0	0.0	0.0	
Jul. 2023	0	0.0	0.0	
Aug. 2023	0	0.0	0.0	
Sep. 2023	0	0.0	0.0	
Oct. 2023	0	0.0	0.0	
Nov. 2023	1	1.3	1.3	Nov. 19
Dec. 2023	2	3.1	1.6	Dec. 17
Jan. 2024	4	7.5	3.3	Jan. 14
Feb. 2024	7	12.5	4.0	Feb. 11
Mar. 2024	2	3.0	1.9	Mar. 17
FY 2023 total	19	34.3		

Table 1-29: Actual output shedding of the renewable energy generating facilities
(Nationwide, times, 10^4 kW)

Service area	Numbers of shedding [times]	Shed capacity [MW]
Hokkaido	2	24.5
Tohoku	14	2,243.0
Tokyo	0	0.0
Chubu	14	1,133.0
Hokuriku	13	222.8
Kansai	3	247.9
Chugoku	62	7,571.6
Shikoku	42	2,172.0
Kyushu	136	29,547.0
(isolated isilands)	(*)	(*)
Okinawa	19	34.3
(isolated islands)	(*)	(*)
Nationwide	305	43,196.1

*Isolated islands of Kyushu and Okinawa do not count actual shedding times and shed capacity.

<Reference> Transition of the Annual Output Shedding of Renewable Energy Sources



CONCLUSION

Actual Electricity Supply–Demand

To determine the actual electricity supply and demand, data on peak demand, electric energy requirement, load factor, supply–demand status during the peak and lowest demand periods, and the peak daily energy supply were collected. Additionally, instructions about power exchanges (according to the provisions of Paragraph 1 of Article 28–44 of the Electricity Business Act) and the actual output shedding of renewable energy generating facilities (according to the provisions of the Ministerial Ordinance of the Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electric Utilities) were aggregated. Furthermore, instructions regarding the tight supply–demand balance in the summer and winter of FY 2023 are described in detail.

<Reference> Details of Actual Power Exchange Instructions and, Instructions and Requests to Generation Companies and Retail Companies Issued by the Oraganization.

The details of the actual power exchange instructions issued by the Organization in FY 2023 are listed below. They include measures for reducing power supply in June 2023.

Actual power exchange instructions by the Organization

1	Issued at	11:40 on June 3, 2023
	Instruction	・Kansai T&D shall supply 500 MW of electricity at most to TEPCO PG from 12:00 to 12:30 on June 3. ・TEPCO PG shall be supplied 500 MW of electricity by Kansai T&D from 12:00 to 12:30 on June 3. (The transmission margin of an interconnection line was reviewed and partly utilized to the power exchange for TEPCO PG.)
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of the insufficient ability to reduce the power supply in the regional service area of Kansai T&D due to unexpected demand decrease and solar power output increase.
2	Issued at	12:07 on June 3, 2023
	Instruction	・Kansai T&D shall supply 500 MW of electricity at most to TEPCO PG and Hokuriku T&D from 12:30 to 15:00 June 3. ・TEPCO PG shall be supplied 490 MW of electricity at most by Kansai T&D from 12:30 to 15:00 on June 3. (The transmission margin of an interconnection line was partly utilized to the power exchange for TEPCO PG.) ・Hokuriku T&D shall be supplied 50 MW of electricity at most by Kansai T&D from 12:30 to 15:00 on June 3.
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of the insufficient ability to reduce the power supply in the regional service area of Kansai T&D due to unexpected demand decrease and solar power output increase.
3	Issued at	14:00 on June 3, 2023
	Instruction	・Kansai T&D shall supply 110 MW of electricity at most to TEPCO PG from 14:30 to 15:00 June 3. ・TEPCO PG shall be supplied 110 MW of electricity at most by Kansai T&D from 14:30 to 15:00 on June 3. (The transmission margin of an interconnection line was partly utilized to the power exchange for TEPCO PG.)
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of the insufficient ability to reduce the power supply in the regional service area of Kansai T&D due to unexpected demand decrease and solar power output increase.
4	Issued at	14:13 on June 3, 2023
	Instruction	・Kansai T&D shall supply 600 MW of electricity to TEPCO PG from 15:00 to 15:30 on June 3. ・TEPCO PG shall be supplied 600 MW of electricity by Kansai T&D from 15:00 to 15:30 on June 3. (The transmission margin of an interconnection line was partly utilized to the power exchange for TEPCO PG.)
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of the insufficient ability to reduce the power supply in the regional service area of Kansai T&D due to unexpected demand decrease and solar power output increase.
5	Issued at	14:38 on June 3, 2023
	Instruction	・Kansai T&D shall supply 78 MW of electricity to TEPCO PG from 15:30 to 16:00 on June 3. ・TEPCO PG shall be supplied 78 MW of electricity by Kansai T&D from 15:30 to 16:00 on June 3.
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of the insufficient ability to reduce the power supply in the regional service area of Kansai T&D due to unexpected demand decrease and solar power output increase.

6	Issued at	16:37 on January 1, 2023
	Instruction	・Kanasai T&D shall supply 600 MW of electricity to Hokuriku T&D from 17:00 to 18:00 on January 1. ・Hokuriku T&D shall be supplied 600 MW of electricity by Kansai T&D from 17:00 to 18:00 on January 1.
	Background	The supply–demand status may degrade without power exchanges through the cross-regional interconnection lines because of a shortage of supply capacity in the regional service area of Hokuriku T&D due to an earthquake.
7	Issued at	17:20 on January 1, 2024 (This instruction changed at **bold character writing** in 18:07 on January 1)
	Instruction	・Kanasai T&D shall supply 600 MW of electricity to Hokuriku T&D from 18:00 to 22:30 on January 1. ・Hokuriku T&D shall be supplied 600 MW of electricity by Kansai T&D from 18:00 to 22:30 on January 1.
		・Kanasai T&D shall supply 600 MW of electricity **at most** to Hokuriku T&D from 18:00 to 22:30 on January 1. ・Hokuriku T&D shall be supplied 600 MW of electricity **at most** by Kansai T&D from 18:00 to 22:30 on January 1.
	Background	The supply–demand status may degrade without power exchanges through the cross-regional interconnection lines because of a shortage of supply capacity in the regional service area of Hokuriku T&D due to an earthquake.
8	Issued at	19:48 on January 1, 2024
	Instruction	・Kanasai T&D shall supply 550 MW of electricity at most to Hokuriku T&D from 22:30 to 24:00 on January 1. ・Hokuriku T&D shall be supplied 550 MW of electricity at most by Kansai T&D from 22:30 to 24:00 on January 1.
	Background	The supply–demand status may degrade without power exchanges through the cross-regional interconnection lines because of a shortage of supply capacity in the regional service area of Hokuriku T&D due to an earthquake.

Organization for Cross-regional Coordination of
Transmission Operators, Japan
http://www.occto.or.jp/en/index.html

Report on the Quality of the Electricity Supply

- Data for Fiscal Year 2023 -

December 2024

Organization for Cross-regional Coordination of Transmission Operators, Japan

Introduction

The Organization for Cross-regional Coordination of Transmission Operators, Japan (OCCTO) evaluates supply reliability conditions to secure a stable electricity supply. To meet this objective, the OCCTO continuously gathers and publishes real data on the electricity supply quality according to the provisions of Article 181 of its Operational Rules.

This report aggregates real data for frequency, voltage, and interruptions in a report titled "Quality of the Electricity Supply" and presents the data evaluation. These data are collected from each regional service area for the 2023 fiscal year (FY 2023). On the basis of these data, the OCCTO evaluates and analyzes whether frequencies or voltages have been maintained within certain parameters or whether there have been frequent supply interruptions. Additionally, although the data conditions regarding supply interruption are not uniform, data were compared with the leading states in the United States (U.S.) as a reference.
The OCCTO's goal is to facilitate the use of aggregated data, evaluations, and analyses by the electricity sector as a reference.

The data presented in the report were submitted by general transmission and distribution companies and aggregated by the OCCTO according to the provisions of Article 268 of the OCCTO's Network Codes.

SUMMARY

In this report, the quality of the nationwide electricity supply in FY 2023 was reviewed on the basis of the provisions of Article 181 of the OCCTO's Operational Rules.
This report evaluated three aspects of the electricity supply's quality: frequency, standard voltage, and interruption.
Although different indices are available for evaluating each aspect, this report used the same indices published in previous years to allow for historical comparison.

Frequency
The frequency time-kept ratio was used to analyze the frequency, which is the ratio of time that the metered frequency is maintained within a given target control range. Four areas were grouped by synchronized frequency: Hokkaido, Eastern Japan, Central and Western Japan, and Okinawa. Transmission operators in Japan's Eastern and Western areas use 50 and 60 Hz, respectively.
This study reviewed the frequency time-kept ratios in these four synchronized areas, and reported the challenge to the Central and Western areas.

Standard Voltage
The evaluation of the standard voltage considered the points at which the standard voltage did not satisfy the target values, as defined by the enforcement regulations of the Electricity Business Act (hereafter, the Act). The Act sets targets for transmission operators to ensure a standard voltage supply within a certain range.
At the request of the OCCTO, the transmission operators submitted their data. Nationwide, there was no violation of standard voltage among 6,681 points for 100 V and 6,574 points for 200 V.

Interruption
Interruptions were monitored from three perspectives: 1) the number of supply disturbances by the place of occurrence, 2) the number of supply disturbances by cause, i.e., beyond the given standards in duration and lost capacity, and 3) system average interruption frequency index (SAIFI) and system average interruption duration index (SAIDI) values for low-voltage (LV) customers.
In the first analysis, the total number of supply disturbances was 15,132, 2.3% higher than the recorded number in the previous fiscal year. Natural disasters caused the rise of supply disturbances, such as the Noto Peninsular Earthquake in January 2024, which increased the supply disturbances in the Hokuriku area by 70.1%, and Typhoon No. 6 of 2023, which increased the number of supply disturbances in the Okinawa area by 80.2%.
The second analysis categorizes the causes of supply disturbances by two factors: maintenance problems and natural disasters, with the latter being irrelevant to maintenance problems.

These analyses indicate 17 cases of supply disturbances, an increase of five cases over the previous year. Regarding the causes of disturbances, five cases were triggered by natural disasters, one fewer than the previous year. However, nine disturbances were caused by the fault of the facility or maintenance, such as physical contact, an increase of four cases over the previous year. Additionally, the number of supply disturbances above a certain scale for FY 2023 was lower than the 5-year average.

In the final analysis, the SAIFI and SAIDI values were historically monitored. The data for FY 2023 indicate there were 0.15 interruptions of 36 min. per customer. The SAIFI value was lower than the corresponding data from the previous year by 0.1 point, whereas the SAIDI value was 11 min. higher than the previous year. The values of supply interruptions in the Hokuriku area also increased: SAIFI increased from 0.16 to 0.55, while SAIDI increased from 26 to 510 compared with the previous year. These increases were attributed to the major disaster caused by the Noto Peninsular Earthquake.

The number of supply interruptions in the Okinawa area also increased due to the major disaster caused by Typhoon No.6 of 2023: SAIFI increased from 1.03 to 2.34, and SAIDI increased from 61 to 1,278.

This report also compares SAIFI and SAIDI values with European countries and the major U.S. states, even though the comparison is not direct given that index definitions are not identical across European countries and the U.S. states.

We believe this report will help to understand the quality of Japan's electricity supply.

CONTENTS

I. Frequency Data

1. Standard Frequency in Japan

GT&D companies are required to maintain the frequency value of the electricity supply at the levels specified by the Ordinance of the Ministry of Economy, Trade and Industry, i.e., according to the provisions of Article 26 of the Electricity Business Act. Figure 1 illustrates the regional service areas of the 10 GT&D companies considered in this report and their standard frequencies.

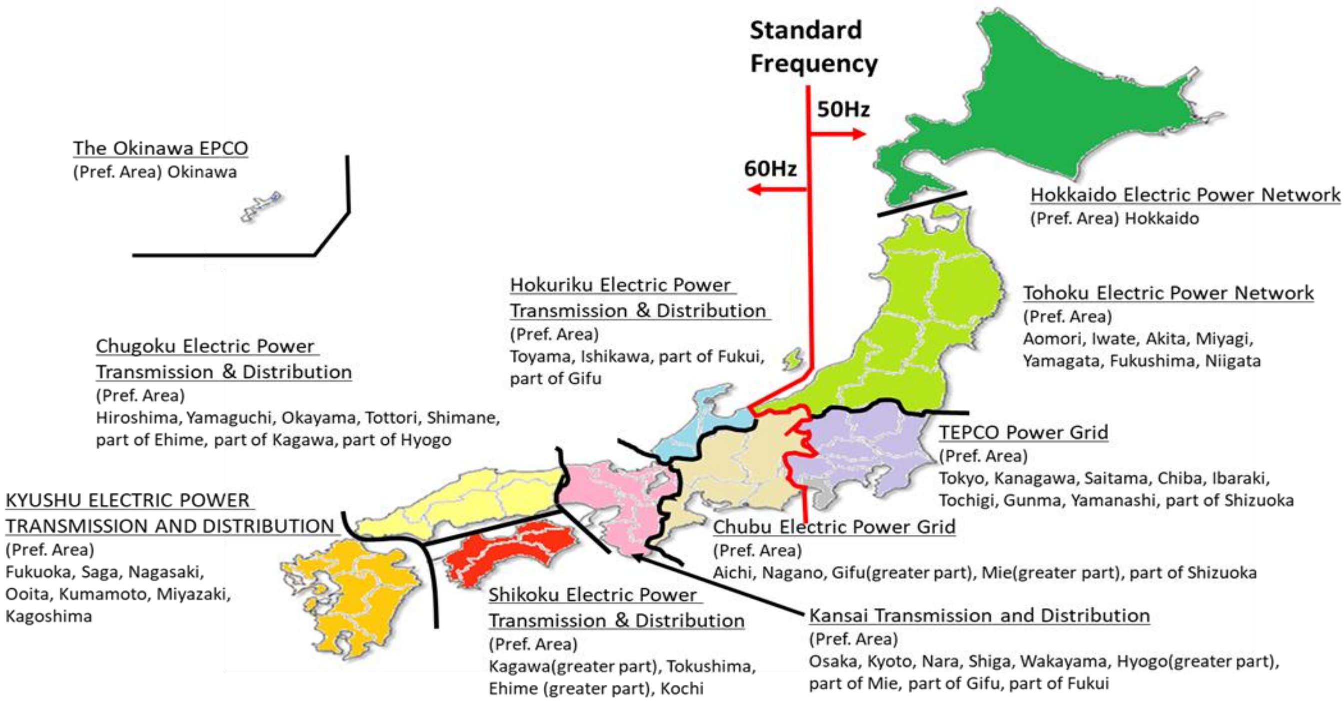


Figure 1　Regional Service Areas of 10 GT&D Companies and Their Standard Frequencies

2. Frequency Time-Kept Ratio

The maintained frequency was examined using the frequency time-kept ratio, which is the ratio of time that the metered frequency is maintained within a given variance of the standard. The following formula calculates the frequency time-kept ratio:

$$\text{Frequency time} - \text{kept ratio }(\%) = \frac{\text{time that the metered frequency is maintained within a given variance of the standard}}{\text{total time in a given period}} \times 100$$

3. Frequency Control Rule

The frequency control rule under normal conditions for the regional service areas according to the indices of the time-kept ratio formula is shown in Table 1.[1]

Table 1 Frequency Control Rule under Normal Condition for Each Regional Service Areas

Areas	Hokkaido	Tohoku, Tokyo	Chubu, Hokuriku, Kansai, Chugoku, Shikoku, Kyushu	Okinawa
Frequency Standard	50 Hz	50 Hz	60 Hz	60 Hz
Control Target (for the standard)	±0.3 Hz	±0.2 Hz	±0.2 Hz	±0.3 Hz
Target Time-Kept Ratio within ± 0.1 Hz	—	—	95% over	—

4. Frequency time-kept ratio by the Frequency-synchronized Area (FY 2019–2023)

The frequency time-kept ratios by frequency-synchronized areas from FY 2019 to 2023 and the trend of maintaining the frequency within 0.1 Hz variance are shown in Tables 2–5.

The frequency time-kept ratio established by the GT&D companies was recorded as 100% throughout the year except in the Central and Western areas for FY 2023. At the 101st meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (September 30, 2024), the GT&D companies in the area reported the following concerns regarding the Central and Western regions[2]: the monthly frequency time-kept ratio sometimes deviated from the control target of ±0.2 Hz, and the ratio decreased and neared the control target of ±0.1 Hz, which is uniquely determined to be 95.00% for the lower limit by the area. These conditions were due to the increase of variable renewable energy and the decrease in synchronized generators in the transmission network, which were apparent during the light load period. The Organization carefully monitors these conditions, continuously cooperating with GT&D companies to secure a stable and quality electricity supply.

[1] According to the provisions of item 2 of Article 38 of the Ministerial Ordinance of the Act, the frequency value defined by the Ministerial Order is deemed to be the same frequency that general transmission and distribution companies supply; general transmission and distribution companies respectively set their frequency control target by their code, standard or manual. https://laws.e-gov.go.jp/law/407M50000400077#Mp-Ch_2-Se_2-Ss_2

[2] https://www.occto.or.jp/iinkai/chouseiryoku/2024/files/chousei_101_05.pdf

【Criteria】

(pink)	Control target	··· 100.00%
(light blue)	Target time-kept ratio within ±0.1 Hz	··· 95.00% Over

Table 2 Frequency Time -Kept Ratio (Hokkaido, FY 2019–2023) [%]

Variance	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Within 0.1 Hz	99.98	99.93	99.87	99.90	99.91
Within 0.2 Hz	100.00	100.00	99.99	99.99	99.99
Within 0.3 Hz	100.00	100.00	100.00	100.00	100.00
Beyond 0.3 Hz	0.00	0.00	0.00	0.00	0.00

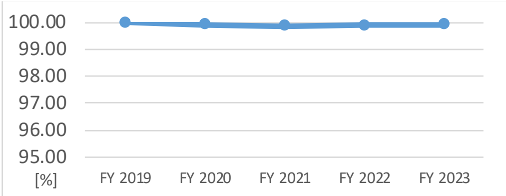


Figure 2 Frequency time kept ratio within 0.1 Hz (Hokkaido, FY 2019-2023)

Table 3 Frequency Time -Kept Ratio (Eastern area,[3] FY 2019–2023) [%]

Variance	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Within 0.1 Hz	99.83	99.71	99.50	99.43	99.01
Within 0.2 Hz	100.00	100.00	100.00	100.00	100.00
Within 0.3 Hz	100.00	100.00	100.00	100.00	100.00
Beyond 0.3 Hz	0.00	0.00	0.00	0.00	100.00

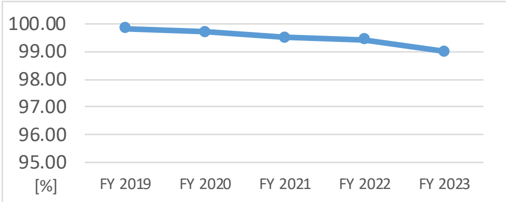


Figure 3 Frequency time kept ratio within 0.1 Hz (Eastern area,[3] FY 2019-2023)

Table 4 Frequency Time -Kept Ratio (Central & Western area,[4] FY 2019–2023 [%]

Variance	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Within 0.1 Hz	99.02	98.50	98.12	98.46	97.68
Within 0.2 Hz	100.00	100.00	100.00	100.00	99.99
Within 0.3 Hz	100.00	100.00	100.00	100.00	100.00
Beyond 0.3 Hz	0.00	0.00	0.00	0.00	100.00

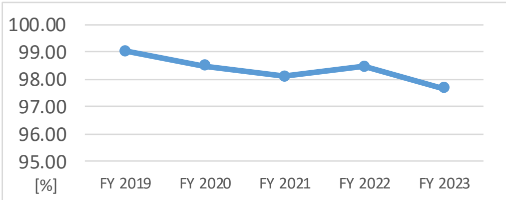


Figure 4 Frequency time kept ratio within 0.1 Hz (Central & Western area,[4] FY 2019–2023)

Table 5 Frequency Time -Kept Ratio (Okinawa, FY 2019–2023) [%]

Variance	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Within 0.1 Hz	99.89	99.92	99.89	99.98	99.97
Within 0.2 Hz	100.00	100.00	100.00	100.00	100.00
Within 0.3 Hz	100.00	100.00	100.00	100.00	100.00
Beyond 0.3 Hz	0.00	0.00	0.00	0.00	0.00

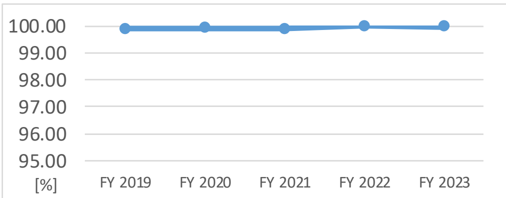


Figure 5 Frequency time kept ratio within 0.1 Hz (Okinawa, FY 2019–2023)

3 The Eastern area includes the regional service areas of the Tohoku Electric Power Network and the TEPCO Power Grid. Actual data were collected from the area of the TEPCO Power Grid.

4 The Central and Western areas of Japan include the regional service areas of the Chubu Electric Power Grid, Hokuriku Electric Power Transmission & Distribution, Kansai Transmission & Distribution, Chugoku Electric Power Transmission & Distribution, Shikoku Electric Power Transmission & Distribution, and Kyushu Electric Power Transmission & Distribution. Actual data were collected from the area of Kansai Transmission and Distribution.

II. Voltage Data

1. Japanese Voltage Standard

GT&D companies should endeavor to maintain the voltage value of the electricity supply at the levels specified by Article 26 provisions of the Act. The voltage standard and the nationwide target voltage control are presented in Table 6.[5]

Table 6 Voltage Standard and Target Voltage Control

Voltage Standard	Target Voltage Control
100 V	within ±6 V of 101 V
200 V	within ±20 V of 202 V

2. Voltage Measurements

According to Article 39 provisions of the Ordinance of the Act, GT&D companies should measure voltage during the period designated by the Director General of the Regional Bureau of Economy, Trade, and Industry.[6] The Director General administers regional service areas or supply points (for Hokuriku Electric Power Transmission & Distribution, this is the Director General of Chubu Bureau of Economy, Trade, and Industry, Electricity and Gas Department Hokuriku) once over 24 consecutive hours at selected measuring points, unless otherwise stated.[7] GT&D companies calculate an average of 30 min., including the maximum and the minimum values, and review whether these values deviate from the average.

3. Nationwide Voltage Deviation Ratio (FY 2019–2023)

The total measured points, deviated measured points, and nationwide deviation ratio from FY 2019 to 2023 are shown in Table 7.

GT&D companies reported that the voltage standard was adequately maintained, with no deviation, according to FY 2023 data.

Table 7 Voltage Deviation Measurement (Nationwide, FY 2019–2023)

Voltage		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
100V	Total measured points	6,567	6,562	6,589	6,578	6,681
	Deviated points	0	0	0	0	0
200V	Total measured points	6,502	6,498	6,523	6,496	6,574
	Deviated points	0	0	0	0	0

[5] As defined in the provisions of Paragraph 1 of Article 38 of the Ministerial Ordinance of the Act

[6] Method for selecting the measuring points of electric voltage defined in the provisions of Item 1, Paragraph 1 of Article 39 of the Ministerial Ordinance (No. 619 of 1995, Ministry of International Trade and Industry)

[7] As defined in the provisions of Item 2, Paragraph 1 of Article 39 of the Ministerial Ordinance of the Act

III. Interruption Data

1. Data on the Number of Supply Disturbances from which Interruption Originated

(1) Indices and Definitions of Supply Disturbances

The criteria for supply interruption include the number of supply disturbances where the interruption originated, indicating where and how many supply disturbances occurred, according to the electric facilities in the system.

A "supply disturbance" is defined as an interruption of the electricity supply or an emergency restriction of electricity use due to a malfunction or misuse of the electric facilities.[8] The case in which the electricity supply is resumed by the automatic reclosing [9] of the transmission line does not apply to supply disturbances.[10]

[8] Electric facilities include machinery, apparatus, dams, conduits, reservoirs, electric lines, and other facilities installed for the generation, storage transformation, transmission, distribution, or consumption of electricity as defined by the provisions of Item 18, Paragraph 1 of Article 2 of the Act.

[9] Automatic reclosing of a transmission line means a transmission line is reconnected by reswitching the circuit breaker after a given period when an accident, such as a lightning strike, occurs on the transmission or distribution line and isolated fault section by opening the circuit breaker due to a protective relay.

[10] According to the provision of Item vii, Paragraph 2 of Article 1 of "Reporting Rules of the Electricity Business," supply disturbance means the interruption of electricity supply or emergency restriction of electricity use for electricity consumers (excluding a person who manages the corresponding electric facility; hereafter, the same shall apply in this article) due to malfunction, misuse, or disoperation of the electric facility. However, the case in which the electricity supply is resumed by the automatic reclosing of the transmission line is not applicable to the supply disturbance.

(2) Data on Number of Supply Disturbances Nationwide and by Regional Service Area (FY 2019–2023)

Table 8 and Figure 6 show the number of supply disturbances nationwide, where the interruptions originated in FY 2019–2023. Tables 9–18 and Figures 7–16 present the number of supply disturbances from the regional service areas. Additionally, the category "Involving Accidents" in the tables indicates the number of supply disturbances caused by accidents at electric facilities other than those at the corresponding GT&D companies. Table columns are blank for zero values or if the data are unavailable. The analysis of FY 2023 data indicates the following.

Regarding FY 2023 data, the total number of supply disturbances was found to be 15,132, which was higher than the record of the previous fiscal year by 2.3%. Natural disasters caused the increase in the number of supply disturbances, such as the Noto Peninsular Earthquake in January 2024, which increased the supply disturbances in the Hokuriku region by 70.1%, as well as Typhoon No. 6 of 2023 has increased the supply disturbances in the Okinawa region by 80.2%.[11]

Table 8 Number of Supply Disturbances where Interruption Originated (Nationwide, FY 2019–2023)

Occurrence at			FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities								
	Substations		56	48	65	57	65	58.2
	Transmission lines & Extra High Voltage Lines	Overhead	246	274	260	308	312	280.0
		Under-ground	13	9	17	9	7	11.0
		Total	259	283	277	317	319	291.0
	High Voltage Lines	Overhead	13,958	13,539	10,775	13,847	14,152	13,254.2
		Under-ground	227	201	201	210	187	205.2
		Total	14,185	13,740	10,976	14,057	14,339	13,459.4
	Demand Facilities					1		0.2
Involvng Accidents			372	277	245	361	409	332.8
Total Disturbances			14,872	14,348	11,563	14,793	15,132	14,141.6

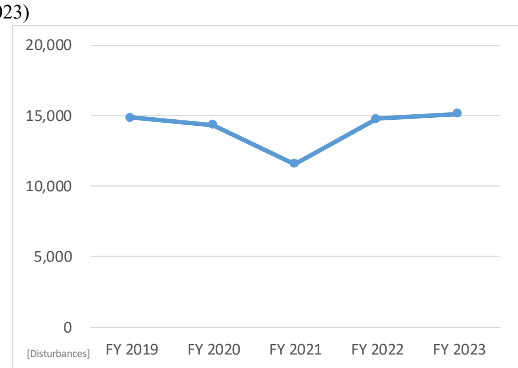


Figure 6 Transition of Supply Disturbances (Nationwide, FY 2019–2023)

[11] Although they are only written in Japanese, information on supply interruptions and facility damages due to natural disasters in FY 2023 is shown in the following links: https://www.bousai.go.jp/updates/#r6
For the Hokuriku area, please refer to
https://www.bousai.go.jp/updates/r60101notojishin/r60101notojishin/pdf/r60101notojishin_47.pdf
For the Okinawa area, please refer to https://www.bousai.go.jp/updates/r5typhoon6/pdf/r5typhoon6_03.pdf

Table 9 Number of Supply Disturbances where Interruption Originated (Hokkaido, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		2	2	3	3	3	2.6
Transmission lines & Extra High Voltage Lines	Overhead	12	21	20	20	13	17.2
	Under-ground	1	1				0.4
	Total	13	22	20	20	13	17.6
High Voltage Lines	Overhead	600	801	848	973	859	816.2
	Under-ground	15	15	12	15	18	15.0
	Total	615	816	860	988	877	831.2
Demand Facilities							
Involvng Accidents		11	10	14	16	18	13.8
Total Disturbances		641	850	897	1,027	911	865.2

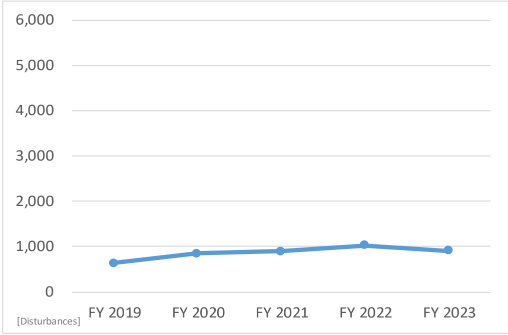


Figure 7 Transition of Supply Disturbances (Hokkaido, FY 2019–2023)

Table 10 Number of Supply Disturbances where Interruption Originated (Tohoku, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		8	9	9	8	17	10.2
Transmission lines & Extra High Voltage Lines	Overhead	16	31	31	20	10	21.6
	Under-ground						
	Total	16	31	31	20	10	21.6
High Voltage Lines	Overhead	1,646	2,528	1,686	2,036	1,855	1,950.2
	Under-ground	7	13	7	19	11	11.4
	Total	1,653	2,541	1,693	2,055	1,866	1,961.6
Demand Facilities					1		0.2
Involvng Accidents		29	17	18	27	35	25.2
Total Disturbances		1,706	2,598	1,751	2,111	1,928	2,018.8

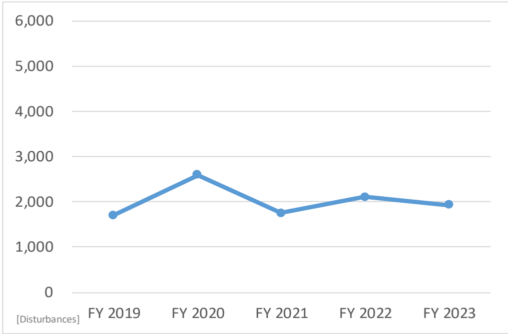


Figure 8 Transition of Supply Disturbances (Tohoku, FY 2019–2023)

Table 11 Number of Supply Disturbances where Interruption Originated (Tokyo, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		17	5	10	8	12	10.4
Transmission lines & Extra High Voltage Lines	Overhead	21	10	10	20	24	17.0
	Under-ground	4	3	5	3	1	3.2
	Total	25	13	15	23	25	20.2
High Voltage Lines	Overhead	5,186	2,472	2,316	2,309	2,994	3,055.4
	Under-ground	97	75	87	73	61	78.6
	Total	5,283	2,547	2,403	2,382	3,055	3,134.0
Demand Facilities							
Involvng Accidents		134	74		67	81	71.2
Total Disturbances		5,459	2,639	2,428	2,480	3,173	3,235.8

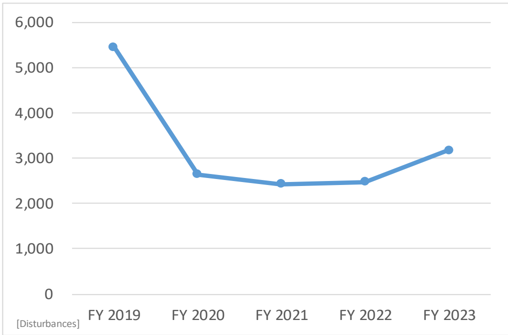


Figure 9 Transition of Supply Disturbances (Tokyo, FY 2019–2023)

Table 12 Number of Supply Disturbances where Interruption Originated (Chubu, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		10	4	7	7	5	6.6
Transmission lines & Extra High Voltage Lines	Overhead	19	15	9	13	23	15.8
	Under-ground		1		1	2	0.8
	Total	19	16	9	14	25	16.6
High Voltage Lines	Overhead	1,570	1,359	1,338	1,397	1,914	1,515.6
	Under-ground	6	4	10	9	5	6.8
	Total	1,576	1,363	1,348	1,406	1,919	1,522.4
Demand Facilities							
Involvng Accidents		60	71	64	69	76	68.0
Total Disturbances		1,665	1,454	1,428	1,496	2,025	1,613.6

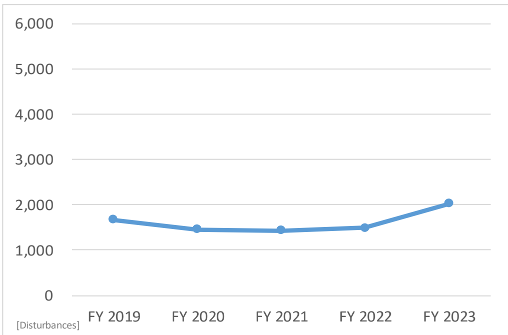


Figure 10 Transition of Supply Disturbances (Chubu, FY 2019–2023)

Table 13 Number of Supply Disturbances where Interruption Originated (Hokuriku, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		2	3	4	2	8	3.8
Transmission lines & Extra High Voltage Lines	Overhead	2	3		5	11	4.2
	Under-ground	2					0.4
	Total	4	3		5	11	4.6
High Voltage Lines	Overhead	199	444	215	567	962	477.4
	Under-ground	1	4	1	2	8	3.2
	Total	200	448	216	569	970	480.6
Demand Facilities							
Involvng Accidents		10	10	14	16	18	13.6
Total Disturbances		216	464	234	592	1,007	502.6

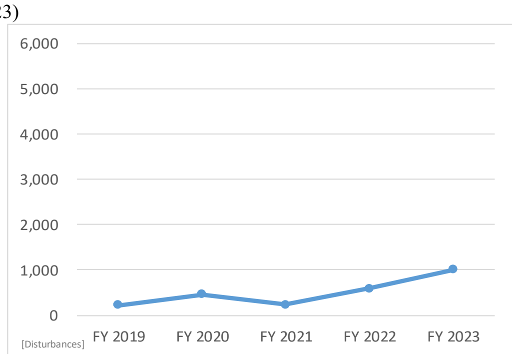


Figure 11 Transition of Supply Disturbances (Hokuriku, FY 2019–2023)

Table 14 Number of Supply Disturbances where Interruption Originated (Kansai, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		3	6	10	9	6	6.8
Transmission lines & Extra High Voltage Lines	Overhead	82	84	86	99	116	93.4
	Under-ground	3	4	8	2	3	4.0
	Total	85	88	94	101	119	97.4
High Voltage Lines	Overhead	1,300	1,254	1,384	1,480	1,723	1,428.2
	Under-ground	50	50	33	37	35	41.0
	Total	1,350	1,304	1,417	1,517	1,758	1,469.2
Demand Facilities							
Involvng Accidents		64	44	56	79	82	65.0
Total Disturbances		1,502	1,442	1,577	1,706	1,965	1,638.4

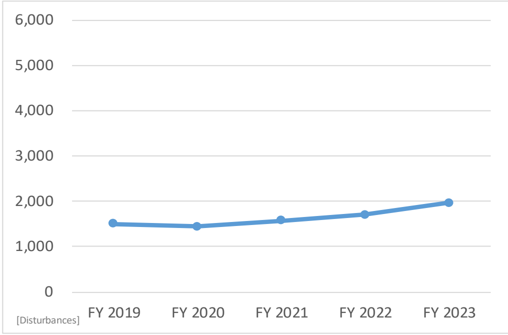


Figure 12 Transition of Supply Disturbances (Kansai, FY 2019–2023)

Table 15 Number of Supply Disturbances where Interruption Originated (Chugoku, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		6	3	6	11	8	6.8
Transmission lines & Extra High Voltage Lines	Overhead	17	11	25	11	14	15.6
	Under-ground	1		1	3	1	1.2
	Total	18	11	26	14	15	16.8
High Voltage Lines	Overhead	1,015	1,163	1,193	1,449	981	1,160.2
	Under-ground	16	12	15	20	16	15.8
	Total	1,031	1,175	1,208	1,469	997	1,176.0
Demand Facilities							
Involvng Accidents		35	32	37	32	34	34.0
Total Disturbances		1,090	1,221	1,277	1,526	1,054	1,233.6

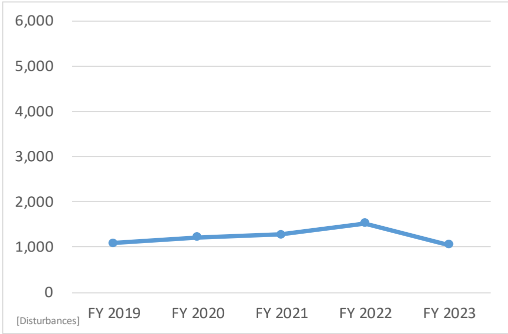


Figure 13 Transition of Supply Disturbances (Chugoku, FY 2019–2023)

Table 16 Number of Supply Disturbances where Interruption Originated (Shikoku, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		2	5	3		1	2.2
Transmission lines & Extra High Voltage Lines	Overhead	4	1	10	16	6	7.4
	Under-ground						
	Total	4	1	10	16	6	7.4
High Voltage Lines	Overhead	439	447	393	673	478	486.0
	Under-ground	6	6	10	3	6	6.2
	Total	445	453	403	676	484	492.2
Demand Facilities							
Involvng Accidents		7	6	10	10	21	10.8
Total Disturbances		458	465	426	702	512	512.6

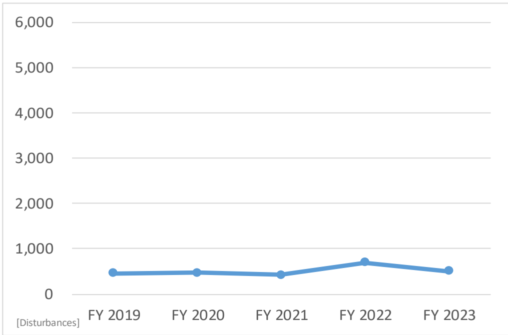


Figure 14 Transition of Supply Disturbances (Shikoku, FY 2019–2023)

Table 17 Number of Supply Disturbances where Interruption Originated (Kyushu, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		4	7	11	8	4	6.8
Transmission lines & Extra High Voltage Lines	Overhead	38	42	24	48	38	38.0
	Under-ground			1			0.2
	Total	38	42	25	48	38	38.2
High Voltage Lines	Overhead	1,547	2,614	1,088	2,605	1,677	1,906.2
	Under-ground	22	17	22	25	22	21.6
	Total	1,569	2,631	1,110	2,630	1,699	1,927.8
Demand Facilities							
Involvng Accidents		19	13	18	32	32	22.8
Total Disturbances		1,630	2,693	1,164	2,718	1,773	1,995.6

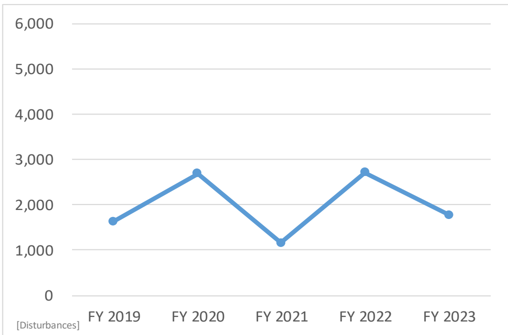


Figure 15 Transition of Supply Disturbances (Kyushu, FY 2019–2023)

Table 18 Number of Supply Disturbances where Interruption Originated (Okinawa, FY 2019–2023)

Occurrence at		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		2	4	2	1	1	2.0
Transmission lines & Extra High Voltage Lines	Overhead	35	56	45	56	57	49.8
	Under-ground	2		2			0.8
	Total	37	56	47	56	57	50.6
High Voltage Lines	Overhead	456	457	314	358	709	458.8
	Under-ground	7	5	4	7	5	5.6
	Total	463	462	318	365	714	464.4
Demand Facilities							
Involvng Accidents		3		14	13	12	8.4
Total Disturbances		505	522	381	435	784	525.4

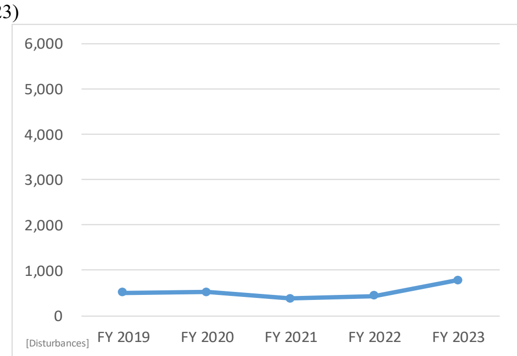


Figure 16 Transition of Supply Disturbances (Okinawa, FY 2019–2023)

2. Number of Supply Disturbances Where Interruptions Originated from Their Causes

(1) Data on Supply Disturbances above a Certain Scale

As described in the previous section, disturbances above a particular scale and their causes were reported for the data on supply disturbances where the interruption originated. This section analyzes these causes. Figure 17 illustrates the number of supply disturbances, indicating where the interruptions originated versus the scale of the interruption. Table 19 shows the nationwide data for FY 2023.[12] The columns in the table were left blank if the value was zero or the data were unavailable. Supply disturbances caused by blackouts are not included in the statistics.

- Capacity lost by disturbance was 7,000–70,000 kW with durations longer than 1 h
- Capacity lost by disturbance was over 70,000 kW with durations longer than 10 min

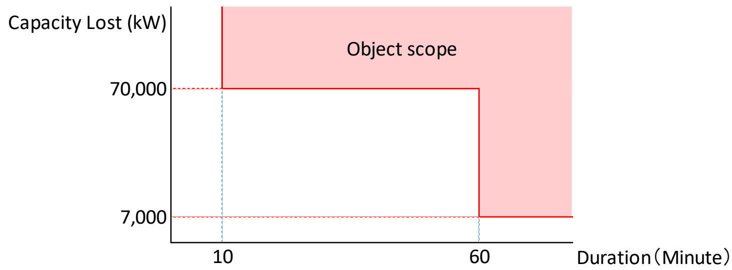


Figure 17 Image of Supply Disturbances above a Certain Scale

Table 19 Number of Supply Disturbances where Interruption Originated by Scale of Interruption (Nationwide, FY 2023) [Disturbances]

Scale of Disturbance [Duration & Capacity lost] / Occurrence at		10 min. till 30 min.		30 min. till 1 hour		1hour till 3 hours			Longer than 3 hours			Total
		70,000kW to 100,000kW under	100,000kW over[8]	70,000kW to 100,000kW under	100,000kW over[8]	7,000kW to 70,000kW under	70,000kW to 100,000kW under	100,000kW over[8]	7,000kW to 70,000kW under	70,000kW to 100,000kW under	100,000kW over[8]	Disturbances
Accidents of Facilities of General Transmission & Distribution Companies												
Substations		1				4			6			11
Transmission lines & Extra High Voltage Lines	Overhead	1				1			3			5
	Under-ground								1			1
	Total	1				1			4			6
High Voltage Distribution Lines	Overhead											
	Under-ground											
	Total											
Demand Facilities												
Involved Accidents												
Total Disturbances		2				5			10			17

[12] Supply disturbances above a certain scale of 10 minutes and longer were reported for different destinations according to the lost capacity under the Article 3 provisions of the Reporting Rules of the Electricity Business. Capacity losses of 70,000–100,000 kW are reported to the Director of Regional Industrial Safety and the Inspection Department, which directs the disturbed electric facility is located. Capacity losses over 100,000 kW are reported to the Ministry of Economy, Trade, and Industry. Thus, the reporting destination varies by lost capacity. Table 19 presents the number of disturbances by lost capacity.

(2) Classification and Description of the Causes of Supply Disturbances above a Certain Scale

Table 20 classifies and describes the causes of the supply disturbances.[13]

Table 20 Classification and description of causes of supply disturbances

Classification of Causes		Description
Facility fault		Flawed production (improper design, fabrication, or material of electric facilities) or installation (improper operation of construction or maintenance work).
Maintenance fault		Flawed maintenance (improper operation of patrols, inspections or cleaning), natural deterioration (deterioration of material or mechanism of electric facilities not due to production, installations or maintenance), or overloading (current above the rated capacity).
Accident/vandalism		Worker accident, intentional act, or accident by public (stone throwing, wire theft, etc.). In the case of an accompanying electric shock, instances are classified under "Electric shock (worker)" or "Electric shock (public)."
Physical contact		Physical contact by trees, wildlife, or others (kite, model airplane).
Corrosion		Corrosion caused by current leakage from DC electric railroad or by chemical action.
Vibration		Vibration from heavy vehicle traffic or construction work.
Involving an accident		Accident involving the electric facilities of another company.
Improper fuel		Accident with improper fuel of notably different ingredients from that designated.
Electric fire		Electric fire accident caused by facility fault, maintenance fault, natural disaster, accident, or work without permission.
Electric shock (worker)		Workers' accident from electric shock caused by misuse of equipment, malfunction of electric facilities, accident by injured or third person, etc.
Electric shock (public)		Electric shock accident to the public due to misuse of equipment, malfunction of electric facilities, accident by injured or third person, etc.
Natural disaster	Thunderbolt	Direct or indirect lightning strike,.
	Rainstorm	Rain, wind, or rainstorm (including contact with fallen branches, etc.)
	Snowstorm	Snow, frazil, hail, sleet, or snowstorm.
	Earthquake	Earthquake.
	Flood	Flood, storm surge, or tsunami
	Landslide	Rock slide, avalanche, landslide, or ground subsidence.
	Dust/gas	Briny air, volcanic dust and ash, fog, offensive gas, or smoke and soot.
Unknown		Unknown causes, despite investigation.
Miscellaneous		Causes not categorized above.

[13] https://www.meti.go.jp/policy/safety_security/industrial_safety/sangyo/electric/files/12hoan-tokei/024.PDF

(3) Number and causes of supply disturbances above a certain scale (FY 2019–2023)

Table 21 and Figure 18 present nationwide data on the number of supply disturbances from which interruption originated above a certain scale. Tables 22–31 show the same data from each regional service region for FY 2019–2023.[14,15]

The number and causes of supply disturbances above a certain scale for FY 2023 data were analyzed. Nationwide, there were 17 cases of supply disturbances, an increase of five cases over the previous year. Five disturbances were caused by natural disasters, one fewer than the previous year. However, nine disturbances were caused by the fault of the facility or maintenance, such as physical contact, four cases higher than the previous year. Additionally, the number of supply disturbances above a certain scale for FY 2023 was below the 5-year average.

Table 21 Causes of Disturbances above a Certain Scale (Nationwide, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault		1	2	1	2	1.5
Maintenance fault		1	1		1	1.0
Accident/vandalism	1	4	1	3	3	2.4
Physical contact	5	6	4	1	3	3.8
Involved accident						
Electric shock(worker)						
Electric shock(public)			1			0.3
Subtotal	6	12	9	5	9	8.2
Natural Disaster						
Thunderbolt	5	2	4	3	2	3.2
Rainstorm	5		2	1	1	1.8
Snowstorm			2	1	1	0.8
Earthquake		3	9		1	4.3
Landslide, avalanche				1		0.3
Dust/Gas	1					0.2
Subtotal	11	5	17	6	5	8.8
Unknown		1	1		2	1.3
Miscellaneous	1	1		1	1	0.8
Total disturbances	18	19	27	12	17	18.6

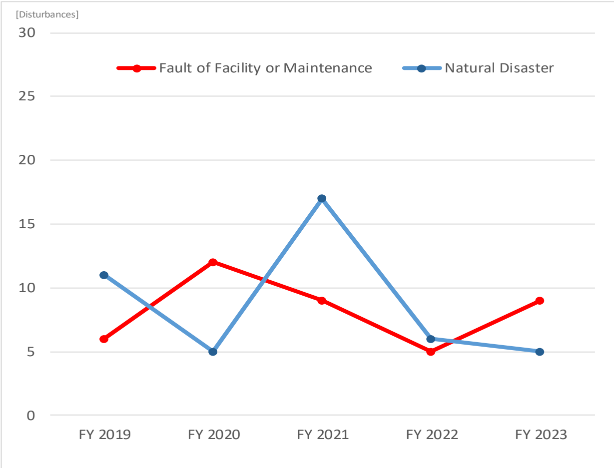


Figure 18 Transition of Disturbances by Cause (Nationwide, FY 2019–2023)

Table 22 Causes of Disturbances above a Certain Scale (Hokkaido, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault		1				0.2
Maintenance fault						
Accident/vandalism						
Physical contact				1	1	0.4
Involved accident						
Electric shock(worker)						
Electric shock(public)						
Subtotal		1		1	1	0.6
Natural Disaster						
Thunderbolt	1					0.2
Rainstorm			1			0.2
Snowstorm				1		0.2
Earthquake						
Landslide, avalanche						
Dust/Gas						
Subtotal	1		1	1		0.6
Unknown			1			0.2
Miscellaneous						
Total disturbances	1	1	2	2	1	1.4

Table 23 Causes of Disturbances above a Certain Scale (Tohoku, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault				1		0.2
Maintenance fault						
Accident/vandalism			1	1	1	0.6
Physical contact			1			0.2
Involved accident						
Electric shock(worker)						
Electric shock(public)						
Subtotal			2	2	1	1.0
Natural Disaster						
Thunderbolt	1					0.2
Rainstorm					1	0.2
Snowstorm						
Earthquake		3	8			2.8
Landslide, avalanche						
Dust/Gas						
Subtotal	1	3	8		1	2.6
Unknown						
Miscellaneous						
Total disturbances	1	3	10	2	2	3.6

14 Tables include the causes of disturbances that most occur.

15 The table columns are left blank if zero or the data are not available.

Table 24 Causes of Disturbances above a Certain Scale (Tokyo, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault						
Maintenance fault			1			0.2
Accident/vandalism	1	2		1	1	1.0
Physical contact	1	1	1		2	1.0
Involved accident						
Electric shock(worker)						
Electric shock(public)			1			0.2
Subtotal	2	3	3	1	3	2.4
Natural Disaster						
Thunderbolt	2		2	2	1	1.4
Rainstorm	3			1		0.8
Snowstorm						
Earthquake						
Landslide, avalanche						
Dust/Gas						
Subtotal	5		2	3	1	2.2
Unknown		1			1	0.4
Miscellaneous		1				0.2
Total disturbances	7	5	5	4	5	5.2

Table 25 Causes of Disturbances above a Certain Scale (Chubu, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault						
Maintenance fault						
Accident/vandalism		1				0.2
Physical contact	2		2			0.8
Involved accident						
Electric shock(worker)						
Electric shock(public)						
Subtotal	2	1	2			1.0
Natural Disaster						
Thunderbolt		1				0.2
Rainstorm						
Snowstorm					1	0.2
Earthquake						
Landslide, avalanche				1		0.2
Dust/Gas						
Subtotal		1		1	1	0.6
Unknown						
Miscellaneous	1					0.2
Total disturbances	3	2	2	1	1	1.8

Table 26 Causes of Disturbances above a Certain Scale (Hokuriku, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault						
Maintenance fault						
Accident/vandalism						
Physical contact						
Involved accident						
Electric shock(worker)						
Electric shock(public)						
Subtotal						
Natural Disaster						
Thunderbolt						
Rainstorm						
Snowstorm						
Earthquake					1	0.2
Landslide, avalanche						
Dust/Gas						
Subtotal					1	0.2
Unknown						
Miscellaneous						
Total disturbances					1	0.2

Table 27 Causes of Disturbances above a Certain Scale (Kansai, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault			2		2	0.8
Maintenance fault		1				0.2
Accident/vandalism		1				0.2
Physical contact	2	4				1.2
Involved accident						
Electric shock(worker)						
Electric shock(public)						
Subtotal	2	6	2		2	2.4
Natural Disaster						
Thunderbolt	1	1	1			0.6
Rainstorm	1		1			0.4
Snowstorm			1			0.2
Earthquake						
Landslide, avalanche						
Dust/Gas						
Subtotal	2	1	3			1.2
Unknown						
Miscellaneous				1		0.2
Total disturbances	4	7	5	1	2	3.8

Table 28 Causes of Disturbances above a Certain Scale (Chugoku, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault						
Maintenance fault						
Accident/vandalism				1	1	0.4
Physical contact						
Involved accident						
Electric shock(worker)						
Electric shock(public)						
Subtotal				1	1	0.4
Natural Disaster						
Thunderbolt			1	1	1	0.6
Rainstorm						
Snowstorm			1			0.2
Earthquake						
Landslide, avalanche						
Dust/Gas	1					0.2
Subtotal	1		2	1	1	1.0
Unknown						
Miscellaneous						
Total disturbances	1		2	2	2	1.4

Table 29 Disturbances above a Certain Scale (Shikoku, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault						
Maintenance fault						
Accident/vandalism						
Physical contact						
Involved accident						
Electric shock(worker)						
Electric shock(public)						
Subtotal						
Natural Disaster						
Thunderbolt						
Rainstorm						
Snowstorm						
Earthquake						
Landslide, avalanche						
Dust/Gas						
Subtotal						
Unknown						
Miscellaneous						
Total disturbances						

Table 30 Causes of Disturbances above a Certain Scale (Kyushu, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault						
Maintenance fault						
Accident/vandalism						
Physical contact						
Involved accident						
Electric shock(worker)						
Electric shock(public)						
Subtotal						
Natural Disaster						
Thunderbolt						
Rainstorm						
Snowstorm						
Earthquake			1			0.2
Landslide, avalanche						
Dust/Gas						
Subtotal			1			0.2
Unknown					1	0.2
Miscellaneous					1	0.2
Total disturbances			1		2	0.6

Table 31 Causes of Disturbances above a Certain Scale (Okinawa, FY 2019–2023) [Disturbances]

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
Fault of Facility or Maintenance						
Facility fault						
Maintenance fault					1	0.2
Accident/vandalism						
Physical contact		1				0.2
Involved accident						
Electric shock(worker)						
Electric shock(public)						
Subtotal		1			1	0.4
Natural Disaster						
Thunderbolt						
Rainstorm	1					0.2
Snowstorm						
Earthquake						
Landslide, avalanche						
Dust/Gas						
Subtotal	1					0.2
Unknown						
Miscellaneous						
Total disturbances	1	1			1	0.6

3. Data of Interruptions for Low-Voltage (LV) Customers

(1) Indices of System Average Interruption for LV Customers

The criteria for customer interruptions include two indices indicating the frequency and duration of forced or planned outages that occurred for one customer and over one year.

System average interruption frequency index (SAIFI/interruptions)

$$= \frac{\text{LV customers affected by interruption}}{\text{LV customers served at the beginning of the fiscal year}}$$

System average interruption duration index (SAIDI/minutes)

$$= \frac{\text{Interruption duration (min)} \times \text{LV customers affected by interruption}}{\text{LV customers served at the beginning of the fiscal year}}$$

Table 32 shows the definitions of terms related to outages.[16]

Table 32 Definition of outage-related terms

Term	Definition
Forced outage	Supply interruptions caused by accident occurred to end-use customers, such as the malfunction of the electric facility, excluding the resumption of electricity supply by automatic reclosing.[17][18]
Planned outage	The electric power company interrupts its electricity supply in a planned manner for construction, improvements and maintenance.

[16] https://www.meti.go.jp/policy/safety_security/industrial_safety/sangyo/electric/files/12hoan-tokei/501.PDF
[17] See footnote 9 for definitions.
[18] See footnote 10 for definitions.

(2) Data on System Average Interruption Nationwide and by Regional Service Area (FY 2019–2023)

The nationwide data for system average interruptions for FY 2019–2023 are presented in Table 33 and Figure 19. The data for each regional service area are presented in Tables 34–43 and Figures 20–29. The nationwide data for system average interruptions for FY 2023 are illustrated in Table 44.[19]

The actual system average interruption data for LV customers is summarized below.
The nationwide SAIFI and SAIDI data for FY 2023 were 0.15 interruptions and 36 minutes, per customer, respectively. The SAIFI value was lower than the previous year by 0.1 points, whereas the SAIDI value was 11 minutes higher than the previous year. The values of supply interruptions in the Hokuriku region increased from the previous year: SAIFI increased from 0.16 to 0.55, while SAIDI increased from 26 to 510. This was attributed to the major disaster caused by the Noto Peninsular Earthquake. The major disaster caused by Typhoon No.6 of 2023 increased the number of supply interruptions in the Okinawa region: SAIFI increased from 1.03 to 2.34, and SAIDI increased from 61 to 1,278.

Table 33 Indices of System Average Interruption (Nationwide, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.19	0.13	0.10	0.14	0.13	0.14
	Planned	0.04	0.04	0.03	0.03	0.02	0.03
	Total ●	0.23	0.17	0.13	0.16	0.15	0.17
SAIDI [Minutes]	Forced	82	24	7	22	34	34
	Planned	3	3	3	3	3	3
	Total ●	86	27	10	25	36	37

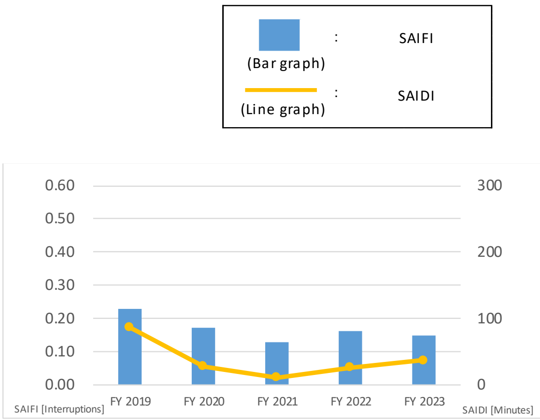


Figure 19 System Average Interruption Indices of LV customers (Nationwide, FY 2019–2023)

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[19] Alpha (α) is shown if the data are a fraction less than a unit. For SAIFI, α falls to 0 <α< 0.005, whereas for SAIDI, α falls to 0 <α< 0.5.

Table 34 Indices of System Average Interruption (Hokkaido, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.11	0.09	0.14	0.12	0.09	0.11
	Planned	α	α	α	α	0.01	0.01
	Total	0.11	0.09	0.14	0.12	0.09	0.11
SAIDI [Minutes]	Forced	4	5	12	20	5	9
	Planned	α	α	α	1	1	1
	Total	4	5	12	21	6	10

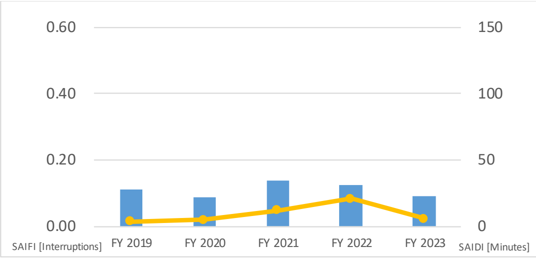

Figure 20 System Average Interruption Indices of LV customers (Hokkaido, FY 2019–2023)

Table 35 Indices of System Average Interruption (Tohoku, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.09	0.11	0.16	0.11	0.12	0.12
	Planned	0.02	0.02	0.02	0.02	0.01	0.02
	Total	0.11	0.12	0.18	0.13	0.13	0.13
SAIDI [Minutes]	Forced	7	15	25	15	12	15
	Planned	2	2	4	2	2	3
	Total	10	17	29	18	14	17

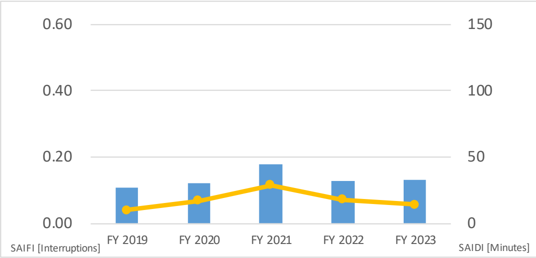

Figure 21 System Average Interruption Indices of LV customers (Tohoku, FY 2019–2023)

Table 36 Indices of System Average Interruption (Tokyo, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.33	0.11	0.10	0.13	0.07	0.15
	Planned	0.03	0.06	0.01	0.01	α	0.02
	Total	0.36	0.17	0.11	0.13	0.08	0.17
SAIDI [Minutes]	Forced	200	7	6	5	5	45
	Planned	1	1	1	1	α	1
	Total	201	8	7	6	5	45

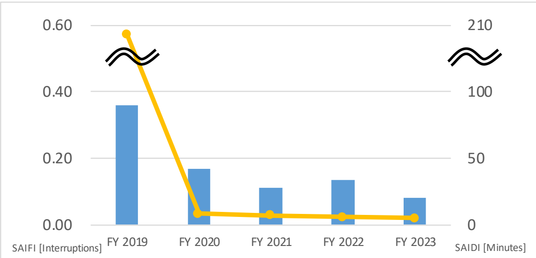

Figure 22 System Average Interruption Indices of LV customers (Tokyo, FY 2019–2023)

Table 37 Indices of System Average Interruption (Chubu, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.11	0.07	0.09	0.14	0.10	0.10
	Planned	0.06	0.05	0.05	0.05	0.05	0.05
	Total	0.17	0.13	0.14	0.19	0.15	0.15
SAIDI [Minutes]	Forced	32	6	5	16	14	15
	Planned	8	7	7	6	7	7
	Total	40	12	12	22	19	21

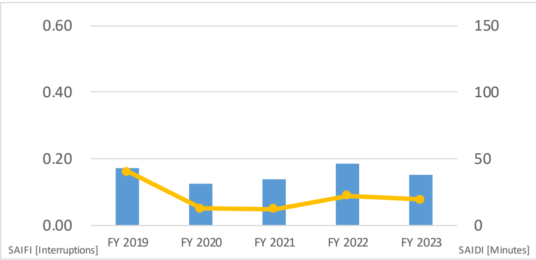

Figure 23 System Average Interruption Indices of LV customers (Chubu, FY 2019–2023)

Table 38 Indices of System Average Interruption (Hokuriku, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.03	0.06	0.04	0.08	0.48	0.14
	Planned	0.09	0.08	0.08	0.08	0.08	0.08
	Total	0.13	0.14	0.12	0.16	0.55	0.22
SAIDI [Minutes]	Forced	3	7	3	12	495	104
	Planned	16	15	14	14	15	15
	Total	19	22	17	26	510	119

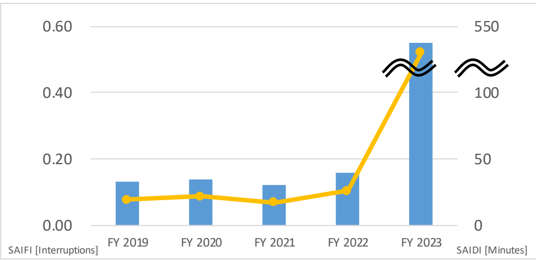

Figure 24 System Average Interruption Indices of LV customers (Hokuriku, FY 2019–2023)

Table 39 Indices of system average interruption (Kansai, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.10	0.09	0.08	0.11	0.12	0.10
	Planned	0.01	0.01	0.01	0.01	0.02	0.01
	Total	0.11	0.10	0.10	0.12	0.13	0.11
SAIDI [Minutes]	Forced	5	7	6	6	8	6
	Planned	1	1	2	1	1	1
	Total	6	8	7	7	9	7

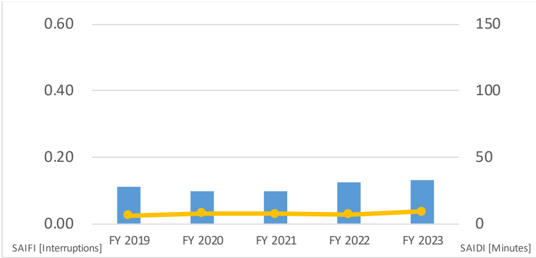

Figure 25 System average interruption indices of LV customers (Kansai, FY 2019–2023)

Table 40 Indices of system average interruption (Chugoku, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.13	0.15	0.15	0.14	0.09	0.13
	Planned	0.09	0.10	0.08	0.08	0.08	0.09
	Total	0.21	0.25	0.23	0.22	0.17	0.22
SAIDI [Minutes]	Forced	10	20	10	12	7	12
	Planned	9	11	9	9	9	9
	Total	19	31	19	21	15	21

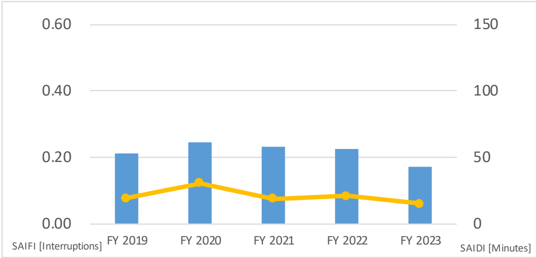

Figure 26 System average interruption indices of LV customers (Chugoku, FY 2019–2023)

Table 41 Indices of system average interruption (Shikoku, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.13	0.14	0.12	0.23	0.14	0.15
	Planned	0.14	0.14	0.14	0.15	0.14	0.14
	Total	0.27	0.28	0.26	0.38	0.28	0.29
SAIDI [Minutes]	Forced	8	10	7	35	8	14
	Planned	15	15	15	16	16	15
	Total	23	24	23	51	24	29

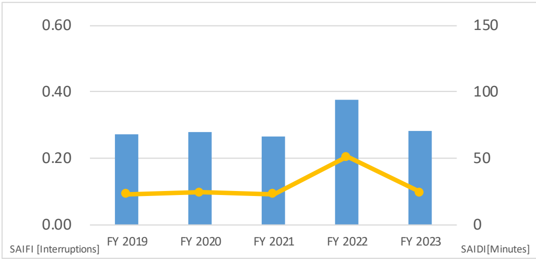

Figure 27 System average interruption indices of LV customers (Shikoku, FY 2019–2023)

Table 42 Indices of system average interruption (Kyushu, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	0.08	0.21	0.07	0.15	0.08	0.12
	Planned	0	0	0	0	0	0
	Total	0.08	0.21	0.07	0.15	0.08	0.12
SAIDI [Minutes]	Forced	15	139	3	115	11	57
	Planned	0	0	0	0	0	0
	Total	15	139	3	115	11	57

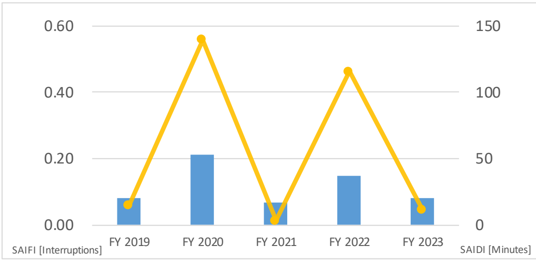

Figure 28 System average interruption indices of LV customers (Kyushu, FY 2019–2023)

Table 43 Indices of system average interruption (Okinawa, FY 2019–2023)

		FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	5-years Average
SAIFI [Interruptions]	Forced	1.11	1.12	0.57	0.98	2.30	1.22
	Planned	0.05	0.06	0.05	0.05	0.04	0.05
	Total	3.69	1.18	0.61	1.03	2.34	1.77
SAIDI [Minutes]	Forced	215	90	40	56	1,274	335
	Planned	6	11	5	5	4	6
	Total	221	101	45	61	1,278	341

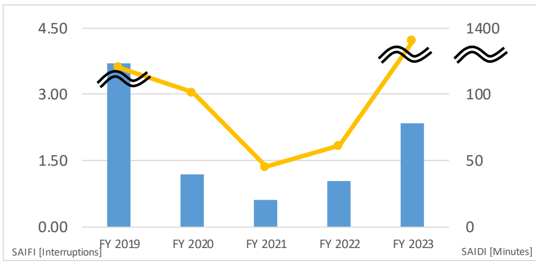

Figure 29 System average interruption indices of LV customers (Okinawa, FY 2019–2023)

Table 44 System average disturbances where interruptions were caused by outages (Nationwide, FY 2023)[20,]

			Hokkaido	Tohoku	Tokyo	Chubu	Hokuriku	Kansai	Chugoku	Shikoku	Kyushu	Okinawa	Nationwide
SAIFI [Interruptions]	Forced outage												
		Generators	0.02	0.02	0.02	0.01	0.04	0.03	0.01	0.01	0.02	0.40	
		HV lines	0.07	0.10	0.05	0.08	0.43	0.08	0.08	0.12	0.05	1.88	
		LV lines	α	α	α	α	α	α	α	0.00	α	0.02	
		Subtotal	0.09	0.12	0.07	0.10	0.48	0.12	0.09	0.14	0.08	2.30	0.13
	Planned outage												
		Generators	α	α	α	0.00	α	α	0.00	0.00	0.00	0.00	
		HV lines	α	0.01	α	0.04	0.06	0.01	0.06	0.09	0.00	0.01	
		LV lines	α	α	α	0.01	0.01	0.01	0.02	0.06	0.00	0.03	
		Subtotal	0.01	0.01	α	0.05	0.08	0.02	0.08	0.14	0.00	0.04	0.02
	Total outage												
		Generators	0.02	0.02	0.02	0.01	0.04	0.03	0.01	0.01	0.02	0.40	
		HV lines	0.07	0.11	0.05	0.12	0.50	0.09	0.14	0.20	0.05	1.89	
		LV lines	α	α	α	0.01	0.01	0.01	0.02	0.06	α	0.05	
		Total	0.09	0.13	0.08	0.15	0.55	0.13	0.17	0.28	0.08	2.34	0.15
SAIDI [Minutes]	Forced outage												
		Generators	1	1	α	1	2	1	1	0	2	10	
		HV lines	4	10	4	11	491	7	5	7	9	1,219	
		LV lines	α	1	α	2	1	1	1	1	α	45	
		Subtotal	5	12	5	14	495	8	7	8	11	1,274	34
	Planned outage												
		Generators	α	α	α	0	α	α	0	0	0	0	
		HV lines	α	1	α	5	14	1	8	12	0	1	
		LV lines	α	1	α	1	1	α	1	3	0	3	
		Subtotal	1	2	α	7	15	1	9	16	0	4	3
	Total outage												
		Generators	1	1	α	1	2	1	1	0	2	10	
		HV lines	5	11	5	16	505	8	13	19	9	1,220	
		LV lines	α	2	α	3	2	1	2	4	α	48	
		Total	6	14	5	19	510	9	15	24	11	1,278	36

* Nationwide values are calculated by weighing the values of whole regional service areas.

[20] Electric facilities such as generating plants, substations, transmission lines, and extra high voltage lines.
Alpha (α) is shown if the data are a fraction less than a unit.

IV. Conclusion

Frequency

The frequency time-kept ratio set by the GT&D companies was recorded as 100% throughout the year except for the Central and Western regions for FY 2023. At the 101st meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (September 30, 2024), the GT&D companies in the area reported the following concerns regarding the Central and Western regions[21]: monthly frequency time-kept ratio sometimes deviated from the control target of ±0.2 Hz, and the ratio decreased close to the control target of ±0.1 Hz, which is uniquely determined to be 95.00% for the lower limit by the area. These conditions were due to the increase of variable renewable energy and the decrease in synchronized generators in the transmission network, and were apparent during the light load period. The Organization carefully monitors these conditions, continuously cooperating with GT&D companies to secure a stable and quality electricity supply.

Voltage

The criteria for maintaining the voltage include the number of measured points where the metered voltage deviates from the above-stated standard and the deviation ratio, which is the ratio of the deviated points against the total number of measured points. No deviation from the voltage standard was observed nationwide in FY 2023.

Supply Disturbances and Interruption in LV Customers

The criteria for supply interruption include the number of supply disturbances and the system average interruption indices, SAIFI and SAIDI.

FY 2023 data indicate 15,132 supply disturbances, which was higher than the record of the previous fiscal year by 2.3%. Natural disasters, such as the Noto Peninsular Earthquake in January 2024, increased the supply disturbances in the Hokuriku region by 70.1%, while Typhoon No. 6 of 2023 increased the number of supply disturbances in the Okinawa region by 80.2%.

The number and causes of supply disturbances above a certain scale for FY 2023 data were analyzed. Nationwide, there were 17 cases of supply disturbances, five cases higher than the previous year. With respect to the causes of disturbances, five disturbances were triggered by natural disasters, i.e., this number decreased by one case from the previous year. However, there were nine disturbances caused by the fault of the facility or maintenance, such as physical contact, an increase of four cases from the previous year. Additionally, the number of supply disturbances above a certain scale for FY 2023 was lower than the 5-year average.

[21] See Footnote 2.

Regarding the nationwide FY 2023 SAIFI and SAIDI data, there were 0.15 interruptions for 36 minutes, per customer, respectively. The SAIFI value was lower than the previous year by 0.1 point; whereas the SAIDI value was 11 minutes higher than the previous year. The values of supply interruptions in the Hokuriku region increased; in the case of SAIFI, the increase was from 0.16 to 0.55, while SAIDI increased from 26 to 510 over the previous year. This was due to the major disaster caused by the Noto Peninsular Earthquake. The number of supply interruptions in the Okinawa region in 2023 also increased due to the major disaster caused by Typhoon No.6; SAIFI increased from 1.03 to 2.34, while SAIDI increased from 61 to 1,278.

Although topical variance was recognized for certain results triggered by natural disasters, consecutive deterioration due to facility faults or maintenance problems has not been recognized. Based on these analysis results, the OCCTO concludes that the electricity supply quality was generally maintained nationwide during FY 2023.

<Reference > Comparison of average system interruptions in Japan with those in European countries and major U.S. states for 2019–2023

Table 45 and Figure 30 show the SAIDI values for Japan and major U.S. states for 2019–2023. Table 46 and Figure 31 show the SAIFI values for the same regions and periods. The data for EU countries are cited from the report of the Council of European Energy Regulators; however, the data for 2023 for EU countries was excluded from the recently publicized report.[22] The data for major U.S. states are from each state's Public Utilities Commission report.[23] These data were aggregated and analyzed by the OCCTO.[24]

Monitoring conditions, including observed voltage, annual monitoring period (whether starting from January or April),[25] and data including/excluding natural disasters, vary across the U.S. states. Therefore, the interruption data may not be directly comparable with that of Japan. However, both the SAIDI and SAIFI values for Japan are lower than those of major U.S. states. Additionally, only LV customer data are monitored for Japan. However, such customer interruptions are estimated to have only a marginal effect on the interruption data because very few customers are not supplied by the LV network.

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[22] Source: "7TH CEER-ECRB BENCHMARKING REPORT ON THE QUALITY OF ELECTRICITY AND GAS SUPPLY 2022"

This report is published roughly every 3 years using the updated data for the previous 3 years. The latest version is linked below.

https://www.ceer.eu/wp-content/uploads/2024/04/7th-Benchmarking-Report-2022.pdf

This report will be updated to the 7.1 version in the first half of 2025.

https://www.ceer.eu/event/ceer-ecrb-second-webinar-on-the-7th-benchmarking-report-on-the-quality-of-electricity-and-gas-supply/

<Reference>

SAIDI of EU countries (totaling planned and forced outages; minutes/year, customer) in 2018; Germany 24, Italy 164, France 64, Spain 68, UK 47, Sweden 143, Finland 60, and Norway 167.

SAIFI of EU countries (totaling planned and forced outages; interruptions/year, customer) in 2018; Germany 0.35, Italy 2.45, France 0.80, Spain NA, UK 0.53, Sweden 1.63, Finland 1.65, and Norway 2.26

[23] Sources:

State of California: California Public Utilities Commission, "Electric System Reliability Annual Reports"
https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/electric-reliability/electric-system-reliability-annual-reports/2022-annual-electric-reliability-reports

State of Texas: Public Utility Commission of Texas,
"Annual Service Quality Report pursuant to PUC Substantive Rule in S.25.81,"
https://interchange.puc.texas.gov/search/filings/?UtilityType=A&ControlNumber=56005&ItemMatch=Equal&DocumentType=ALL&SortOrder=Ascendin

State of New York: Department of Public Service, "Electric Reliability Performance Reports."
https://dps.ny.gov/electric-service-reliability-reports

[24] Values for California and Texas were calculated by weighting the numbers of customers of major electric power companies according to their reliability reports. (For California, SDG&E, PG&E, and SCE are used; for Texas, all electric power companies are used in the calculation.)

[25] The fiscal year (April 1 to March 31) is used for Japan, whereas the calendar year (January 1 to December 31) is used for other countries/states.

Table 45 SAIDI of Japan, European countries, and major U.S. states for 2019–2023 by Forced and Planned Outages
(Minutes/year· customer)

Country/State			2019	2020	2021	2022	2023	Events	Voltage	Natural disaster
JAPAN			86	76	10	25	36	All*	Low Voltage	Include
		Forced	82	72	7	22	34			
		Planned	3	3	3	3	3			
U.S.A.	California		737	327	355	337	435	> 5 min.	All	Include
		Forced	690	310	330	200	352			
		Planned	48	18	25	138	84			
	Texas		335	356	1136	230	451			
		Forced	319	343	1121	207	438			
		Planned	15	13	15	23	13			
	New York		228	538	167	234	166			
		Forced	-	-	-	-	-			
		Planned	-	-	-	-	-			

* Excludes the case of which is restored by the auto-reclosing of transmission line.

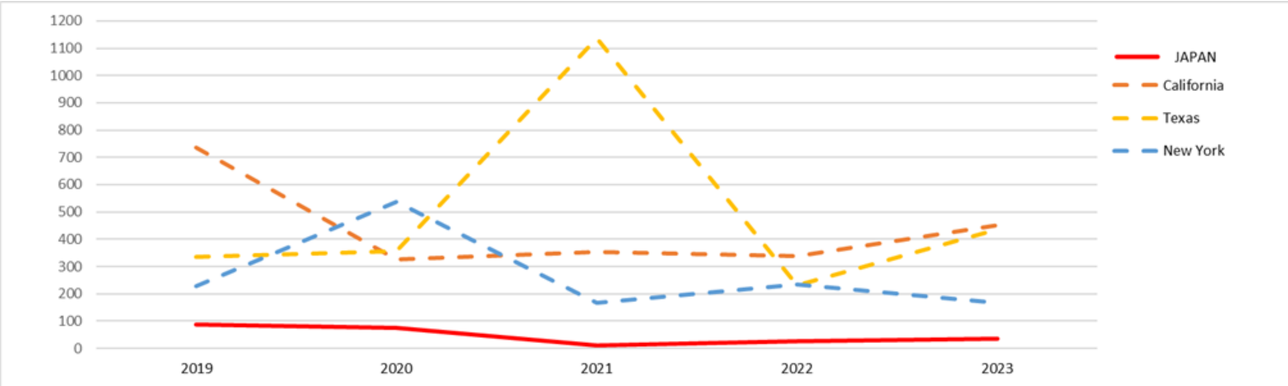

Figure 30 SAIDI of Japan, European countries, and major U.S. states for 2019–2023 (Minutes/Year· Customer)

Table 46 SAIFI of Japan, European countries, and major U.S. states for 2019–2023 by Forced and Planned Outages

(Interruptions/year· customer)

Country/State			2019	2020	2021	2022	2023	Events	Voltage	Natural disaster
JAPAN			0.23	0.21	0.13	0.16	0.15	All*	Low Voltage	Include
		Forced	0.19	0.17	0.10	0.14	0.13			
		Planned	0.04	0.03	0.03	0.03	0.02			
U.S.A.	California		1.53	1.26	1.35	1.63	1.68	> 5 min.	All	Include
		Forced	1.37	1.19	1.20	1.31	1.43			
		Planned	0.16	0.07	0.14	0.31	0.25			
	Texas		1.82	1.69	3.01	1.80	1.88			
		Forced	1.68	1.57	2.88	1.58	1.73			
		Planned	0.14	0.12	0.13	0.22	0.15			
	New York		0.88	1.06	0.85	0.87	0.72			
		Forced	-	-	-	-	-			
		Planned	-	-	-	-	-			

* Excludes the case of which is restored by the auto-reclosing of transmission line.

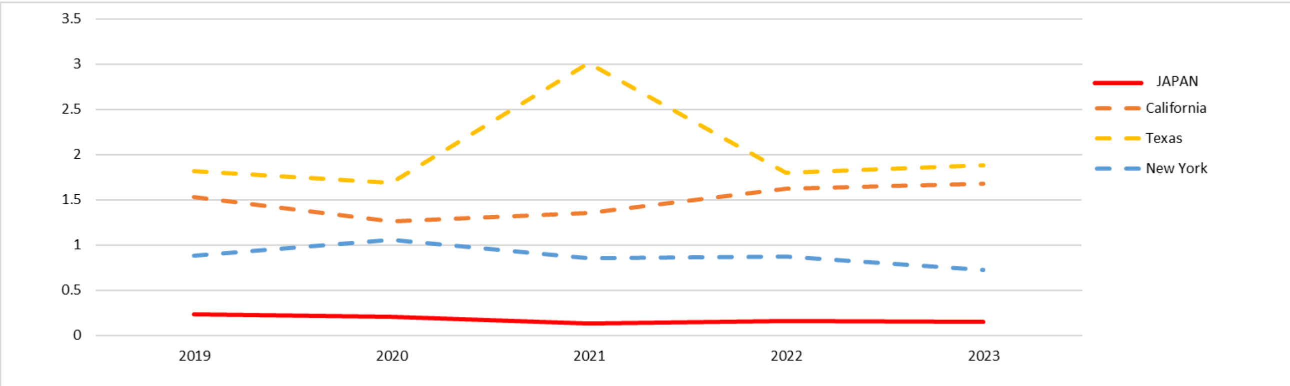

Figure 31 SAIFI of Japan, European countries, and major U.S. states for 2019–2023 (Interruptions/year· customer)

Organization for Cross-regional Coordination of
Transmission Operators, Japan
http://www.occto.or.jp/en/index.html

II. State of Electric Network

Outlook for Cross-regional Interconnection Lines

- Actual Data for FY 2023 -

November 2024

Organization for Cross-regional Coordination
of Transmission Operators, Japan

FOREWORD

The Organization for Cross-regional Coordination of Transmission Operators, Japan (hereinafter, the Organization), prepares and publishes its annual report according to the provisions of Article 181 of the Operational Rules regarding the matters specified below.

i. Actual electric supply and demand (including evaluation and analysis of quality of electricity in light of frequency, voltage, and blackouts of each regional service area)

ii. State of electric network

iii. Actual Network Access Business until the previous year.

iv. Forecast on electric demand and electric network (including forecast of improvement of restriction on network interconnection of generation facilities) for the next fiscal year and a mid- and long-term period based on a result of compiling of electricity supply plans and their issues.

v. Evaluation and verification of proper standards of reserve margin and balancing capacities of each regional service area based on the next article, as well as contents of review as needed

The Organization published the actual data for electricity supply–demand and network system utilization ahead of the annual report because of the compilation of actual data collection up to the 2023 fiscal year.

SUMMARY

This report reviews the outlook for electricity supply–demand and cross-regional interconnection lines in the 2023 fiscal year according to the provisions of Article 181 of the Operational Rules the Organization for Cross-regional Coordination of Transmission Operators, Japan (hereinafter, the Organization).

This report comprises two parts the electricity supply and demand situation and, the interconnection lines situation.

The total volume of utilization of the interconnection lines was 116,723 GWh, which was a slight decrease from the 124,975 GWh in FY 2023.

In FY 2023, 339 interconnection line maintenance events occurred, requiring 776 days-worth of work in FY 2023.

We hope that this report will be useful.

CONTENTS

CHAPTER II: ACTUAL UTILIZATION OF CROSS-REGIONAL INTERCONNECTION LINES

1. Cross-Regional Interconnection Lines and their Management

(1) Cross-Regional Interconnection Lines

Cross-regional interconnection lines represent transmission lines with 250 kV or more and AC/DC converters that regularly connect the regional service areas of members that are GT&D companies. The electric power supply outside each service area is made available through the interconnection lines. The Organization directs members to supply electricity through the cross-regional interconnection lines and secures the supply–demand balance in case of insufficient supply capacity for each regional service area. Figure 2-1 and Table 2-1 present the cross-regional interconnection lines in Japan.

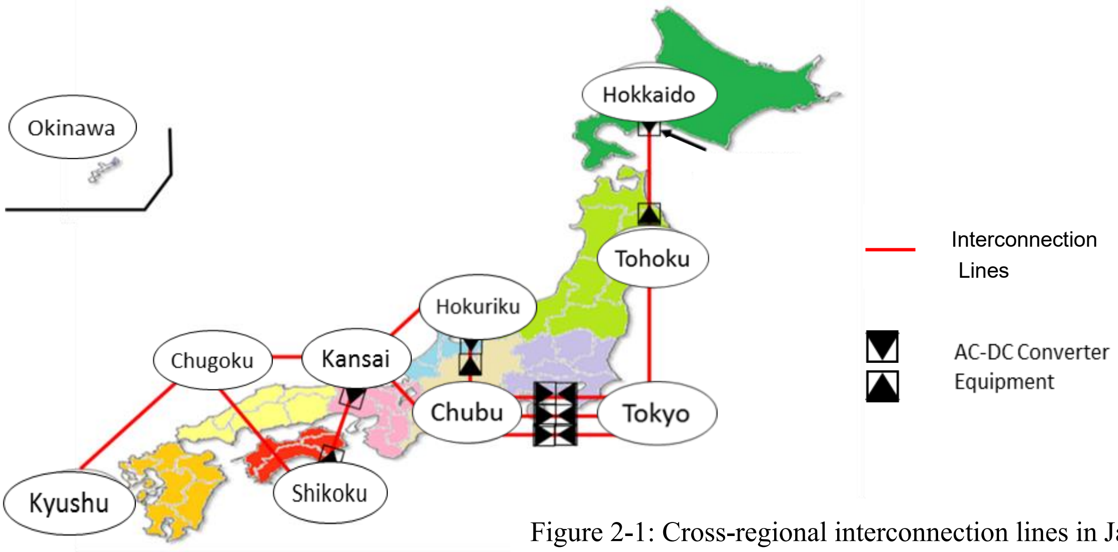

Figure 2-1: Cross-regional interconnection lines in Japan

Table 2-1: Summary of cross-regional interconnection lines (at the end of FY 2023)

Interconnection Lines	Areas·Directions				Corresponding Facilities	AC/DC
Interconnection facilities between Hokkaido and Honshu	Forward	Hokkaido	→	Tohoku	Hokkaido-Honshu HVDC Link, New Hokkaido-Honshu HVDC Link	DC
	Counter	Tohoku	→	Hokkaido		
Interconnection line between Tohoku and Tokyo	Forward	Tohoku	→	Tokyo	Soma–Futaba bulk line, Iwaki bulk line	AC
	Counter	Tokyo	→	Tohoku		
Interconnection facilities between Tokyo and Chubu	Forward	Tokyo	→	Chubu	Sakuma FC Shin Shinano FC Higashi Shimizu FC Hida–Shinano FC	DC
	Counter	Chubu	→	Tokyo		
Interconnection line between Chubu and Kansai	Forward	Chubu	→	Kansai	Mie–Higashi Omi line	AC
	Counter	Kansai	→	Chubu		
Interconnection facilities between Chubu and Hokuriku	Forward	Chubu	→	Hokuriku	Interconnection facilities of Minami Fukumitsu HVDC BTB Converter Station and Minami Fukumitsu Substation	DC
	Counter	Hokuriku	→	Chubu		
Interconnection line between Hokuriku and Kansai	Forward	Hokuriku	→	Kansai	Echizen–Reinan line	AC
	Counter	Kansai	→	Hokuriku		
Interconnection lines between Kansai and Chugoku	Forward	Kansai	→	Chugoku	Seiban–Higashi Okayama line, Yamazaki–Chizu line	AC
	Counter	Chugoku	→	Kansai		
Interconnection facilities between Kansai and Shikoku	Forward	Kansai	→	Shikoku	Interconnection facilities between Kihoku and Anan AC/DC Converter Station	DC
	Counter	Shikoku	→	Kansai		
Interconnection line between Chugoku and Shikoku	Forward	Chugoku	→	Shikoku	Honshi interconnection line	AC
	Counter	Shikoku	→	Chugoku		
Interconnection line between Chugoku and Kyushu	Forward	Chugoku	→	Kyushu	Kanmon interconnection line	AC
	Counter	Kyushu	→	Chugoku		

(2) Management of the Cross-regional Interconnection Lines

The Organization manages the interconnection lines according to the Operational Rules. Regarding the effective utilization of interconnection lines, the security of fairness and transparency among interconnection line users, and the environmental development of the energy trading market, the Organization has currently revised the cross-regional interconnection utilization rules from those based on a "first-come, first-served" principle to those based on the "implicit auction scheme."[1] The implicit auction scheme entirely allocates the capabilities of the interconnection lines through the energy trading market but does not directly allocate the position or right of utilization through auctions. The rule revision is described in Figure 2-2.

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<u>Termination of capability allocation plans and changes of timing at capability registration</u>

Figure 2-2 depicts the before and after of introducing the implicit auction scheme. Before its introduction, capability allocation implemented on a "first-come, first-served" basis piled up, and the resulting ATC at 10:00 on the day before was used for day-ahead spot trading of the energy market. After its introduction, principally, the whole capability is traded in the day-ahead spot market.

Thus, there are no capability allocation plans, and the capability is registered after the day-ahead spot market according to the revision of cross-regional interconnection lines from a "first-come, first-served" basis to the implicit auction scheme.

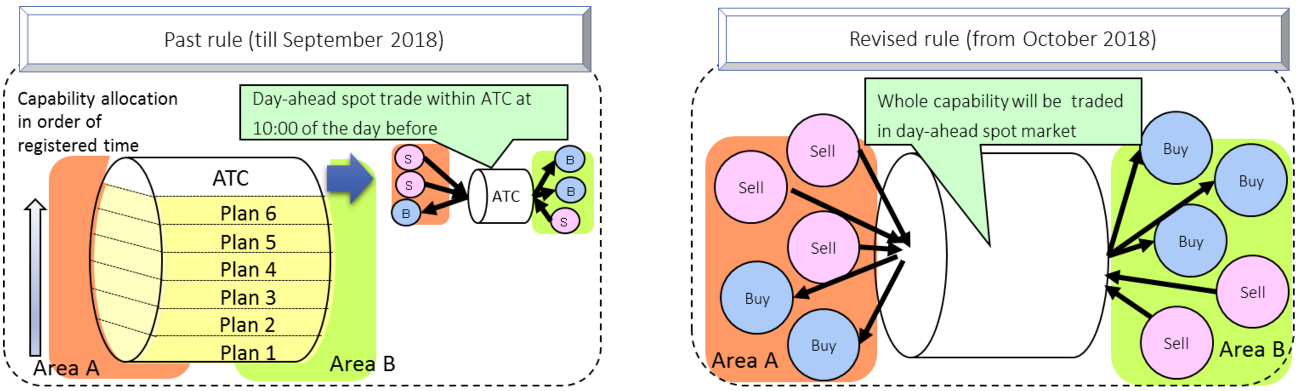


Figure 2-2: Management of the interconnection lines

[1] http://www.occto.or.jp/occtosystem/kansetsu_auction/kansetsu_auction_gaiyou.html (in Japanese only).

2. Actual Utilization of Cross-Regional Interconnection Lines

The following section reports the actual utilization of cross-regional interconnection lines that are managed according to the provisions of Article 124 of the Operational Rules.

(1) Actual Utilization of Cross-regional Interconnection Lines in FY 2023

Table 2-2 and Figure 2-3 present the monthly and annual utilization of the cross-regional interconnection lines for the regional service areas in FY 2023. The annual actual utilization in FY 2023 is described in decreasing order as follows; 1) Tohoku to Tokyo: 35,535 GWh; 2) Kansai to Chubu: 18,008 GWh; 3) Chugoku to Kansai: 16,485 GWh; 4) Kyushu to Chugoku: 15,440 GWh; 5) Shikoku to Kansai: 9,765 GWh; and 6) Chubu to Tokyo: 6,568 GWh. After January 2024, the utilization from Hokuriku to Kansai decreased, but that from Kansai to Hokuriku increased. This was due to the capacity shortage in the Hokuriku area triggered by the Noto Peninsular Earthquake.

Table 2-2: Monthly and annual utilization of cross-regional interconnection lines for the regional service areas[2]

[GWh]

		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
Hokkaido - Honshu	→Tohoku (Forward)	188	150	99	72	86	75	115	170	103	88	103	74	1,322
	→Hokkaido (Counter)	38	78	82	91	69	59	49	47	103	82	99	171	969
Tohoku-Tokyo	→Tokyo (Forward)	2,440	2,225	2,324	3,232	3,492	2,832	2,562	2,751	3,588	3,823	3,797	2,471	35,535
	→Tohoku (Counter)	17	21	19	66	75	64	31	12	35	35	28	57	459
Tokyo-Chubu	→Chubu (Forward)	230	122	107	197	245	130	66	68	266	210	193	252	2,086
	→Tokyo (Counter)	317	429	497	478	463	561	694	762	578	737	579	472	6,568
Chubu-Kansai	→Kansai (Forward)	70	36	18	15	31	25	37	31	136	108	33	59	599
	→Chubu (Counter)	1,509	1,527	1,583	1,655	1,533	1,497	1,578	1,482	1,337	1,423	1,484	1,399	18,008
Chubu-Hokuriku	→Hokuriku (Forward)	0	0	6	0	0	3	1	0	1	2	4	2	19
	→Chubu (Counter)	115	140	133	199	158	154	172	134	116	106	138	88	1,653
Hokuriku - Kanasai	→Kansai (Forward)	115	62	60	61	62	74	80	199	140	24	12	33	921
	→Hokuriku (Counter)	77	164	136	148	140	83	82	49	76	491	577	547	2,570
Kansai-Chugoku	→Chugoku (Forward)	99	51	48	37	44	23	39	49	111	77	48	41	666
	→Kansai (Counter)	827	1,041	1,415	2,014	2,003	1,656	1,269	1,018	1,299	1,570	1,230	1,143	16,485
Kansai-Shikoku	→Shikoku (Forward)	0	0	1	1	0	0	0	0	19	0	0	16	36
	→Kansai (Counter)	205	385	879	936	1,009	942	857	996	868	978	858	853	9,765
Chugoku - Shikoku	→Shikoku (Forward)	61	36	8	9	3	4	2	8	5	22	7	10	174
	→Chugoku (Counter)	43	45	146	295	611	397	293	303	202	312	185	199	3,032
Chugoku - Kyushu	→Kyushu (Forward)	19	28	55	32	14	12	30	17	108	65	13	20	414
	→Chugoku (Counter)	1,173	1,073	1,010	1,275	1,590	1,561	1,271	1,138	1,255	1,300	1,459	1,334	15,440

* Based on the scheduled power flows of cross-regional interconnection lines. Figures are shown before offsetting is performed.

* The figures in red and blue represent the annual maximum and minimum capabilities for each line and direction, respectively.

[2] Figures were rounded off to the first decimal place, and the minimum figure in blue was determined before rounding off.

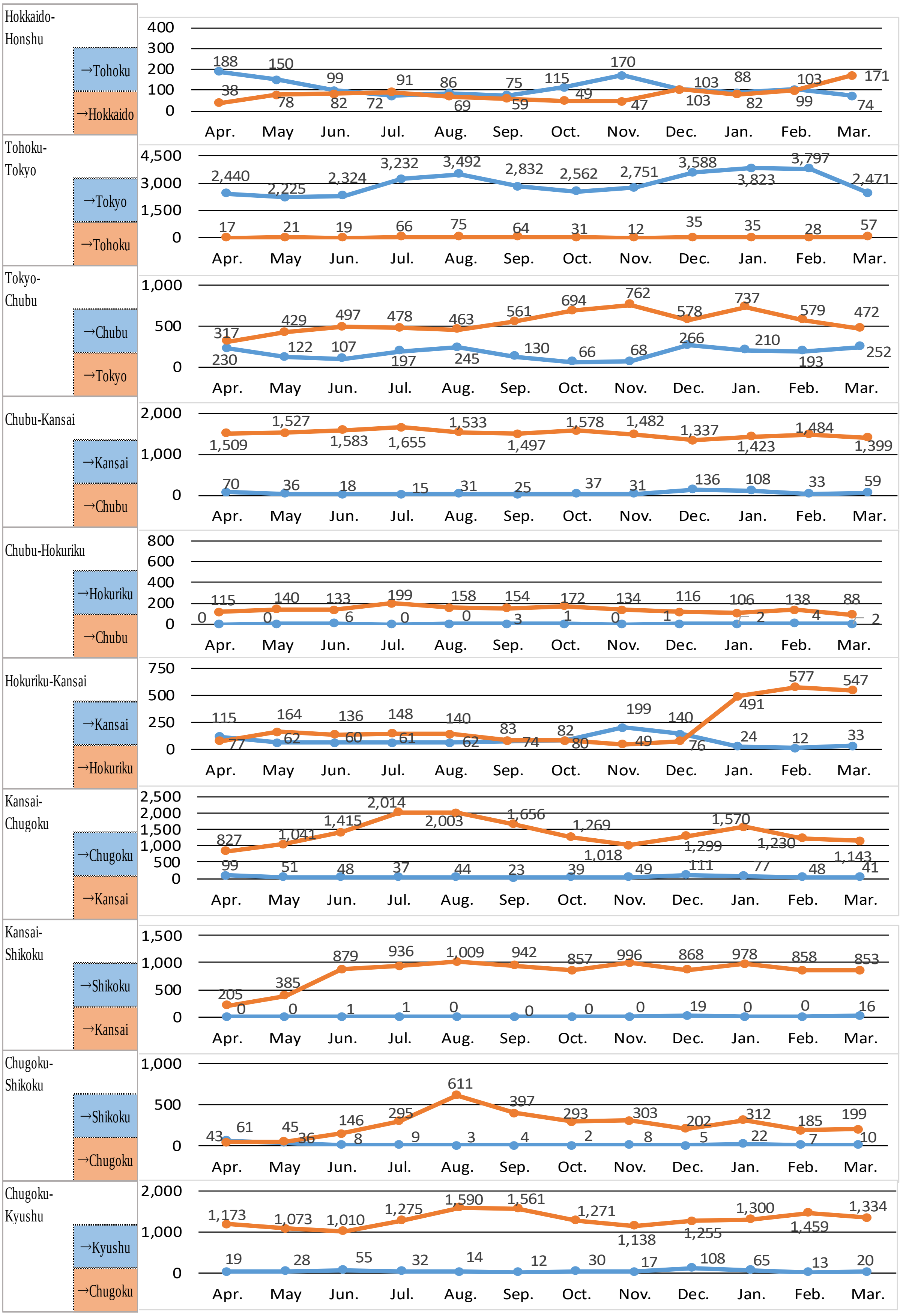


Figure 2-3: Monthly utilization of cross-regional interconnection lines for the regional service areas

(2) Actual Utilization of Cross-Regional Interconnection Lines from FY 2014 to FY 2023

Table 2-3 and Figure 2-4 depict the annual utilization of cross-regional interconnection lines for regional service areas from FY 2014 to FY 2023. In FY 2023, the actual utilization of Tohoku to Tokyo and Kansai to Hokuriku registered their maximum records; however, Chubu to Kansai and Hokuriku to Kansai registered their minimum records.

Table 2-3 Annual utilization of cross-regional interconnection lines for regional service areas (FY 2014 –2023)

[GWh]

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Hokkaido-Honshu	→Tohoku (Forward)	143	146	237	340	130	279	947	2,607	1,620	1,322
	→Hokkaido (Counter)	617	804	1,033	1,270	1,005	2,117	1,154	382	1,058	969
Tohoku-Tokyo	→Tokyo (Forward)	21,273	22,587	23,097	28,238	27,298	27,575	31,396	29,092	25,841	35,535
	→Tohoku (Counter)	4,029	3,714	4,660	7,071	3,139	252	541	897	708	459
Tokyo-Chubu	→Chubu (Forward)	2,702	693	2,729	3,954	1,711	354	1,497	6,200	2,012	2,086
	→Tokyo (Counter)	2,755	4,513	5,144	5,328	5,116	4,147	3,016	3,043	7,079	6,568
Chubu-Kansai	→Kansai (Forward)	7,131	3,412	5,538	8,106	3,675	980	4,413	2,964	1,300	599
	→Chubu (Counter)	6,342	7,577	6,544	9,889	9,980	7,175	13,285	17,251	28,458	18,008
Chubu-Hokuriku	→Hokuriku (Forward)	231	108	241	353	134	7	91	96	29	19
	→Chubu (Counter)	296	172	59	108	76	40	458	2,063	1,177	1,653
Hokuriku-Kanasai	→Kansai (Forward)	2,265	2,047	2,033	2,949	2,033	2,918	3,223	3,005	3,467	921
	→Hokuriku (Counter)	491	502	640	1,260	2,540	547	620	376	477	2,570
Kansai-Chugoku	→Chugoku (Forward)	2,252	948	716	4,493	4,734	578	584	564	435	666
	→Kansai (Counter)	5,994	9,138	13,179	16,727	13,388	9,793	12,416	15,056	20,302	16,485
Kansai-Shikoku	→Shikoku (Forward)	1	2	2	1	82	31	10	28	7	36
	→Kansai (Counter)	9,362	9,611	8,856	9,510	8,840	9,956	8,623	8,343	9,831	9,765
Chugoku-Shikoku	→Shikoku (Forward)	2,677	3,423	3,294	4,061	2,579	131	245	113	123	174
	→Chugoku (Counter)	3,912	4,631	7,638	7,540	4,023	4,143	1,445	1,756	2,398	3,032
Chugoku-Kyushu	→Kyushu (Forward)	3,596	2,174	1,935	3,014	1,998	138	177	142	117	414
	→Chugoku (Counter)	11,218	14,947	15,476	18,183	18,280	16,311	15,864	17,098	18,536	15,440

* Based on the scheduled power flows of cross-regional interconnection lines

* The figures in red and blue represent the annual maximum and the minimum capabilities in each line and direction between FY 2014 and FY 2023, respectively.

* Figures were rounded off to the first decimal place.

Figure 2-4: Annual utilization of cross-regional interconnection lines for regional service areas (FY 2014–2023)

(3) Monthly Utilization of Cross-Regional Interconnection Lines by Transaction in FY 2023

Table 2-4 presents the monthly and annual utilization of cross-regional interconnection lines by transaction in FY 2022. Bilateral contracts include transactions at the balancing market that started in April 2021.

Table 2-4: Monthly and annual utilization of cross-regional interconnection lines by transaction

[GWh]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
Bilateral	143	167	61	54	46	12	48	24	36	61	40	89	782
Day-ahead	6,626	6,738	7,885	10,023	10,838	9,477	8,616	8,686	9,311	10,389	10,080	8,235	106,904
1 Hour-ahead	774	707	681	736	746	662	564	524	998	1,001	726	919	9,037

* The figures in red and blue represent the annual maximum and minimum capabilities, respectively.
* The implicit auction scheme was introduced in October 2018.

(4) Annual Utilization of Cross-Regional Interconnection Lines by Transaction from FY 2014 to FY 2023

Table 2-5 and Figures 2-5, 2-6, and 2-7 depict the annual utilization of cross-regional interconnection lines by transaction for FY 2014–FY 2023. Day-ahead and hour-ahead transactions were included in the records for the decade (FY 2014–FY 2023), which was due to the introduction of the implicit auction scheme in October 2018, making the entire utilization of cross-regional interconnection lines available through the spot market and activating the spot market.

Table 2-5: Annual utilization of cross-regional interconnection lines by transaction (FY 2014–2023)

[GWh]

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Bilateral	71,558	75,947	84,843	109,842	56,710	255	1,103	366	468	782
Day-ahead	14,174	13,152	14,817	18,350	51,120	83,216	91,229	102,328	116,101	106,904
1 Hour-ahead	1,554	2,050	3,392	4,203	2,932	4,000	7,675	8,382	8,406	9,037

* "Hour-ahead" means transactions that are 4 h ahead of the gate closure in FY 2015. From FY 2016, it refers to the transactions that are 1 h ahead of the gate closure.

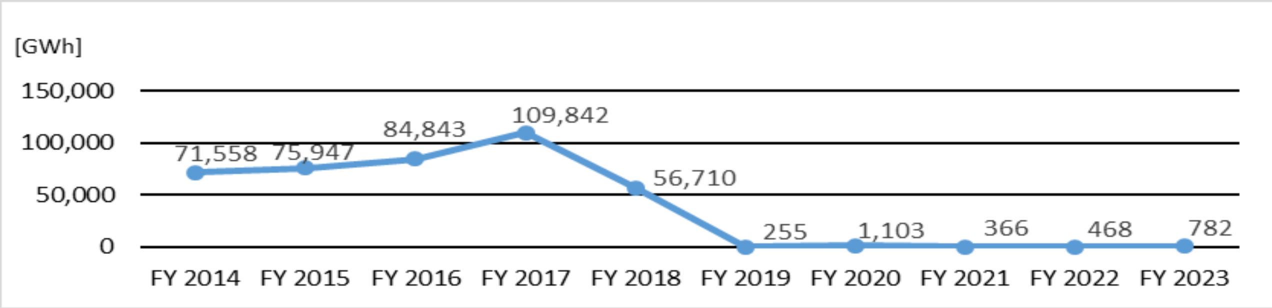


Figure 2-5: Annual utilization of cross-regional interconnection lines by bilateral transaction (FY 2014–2023)

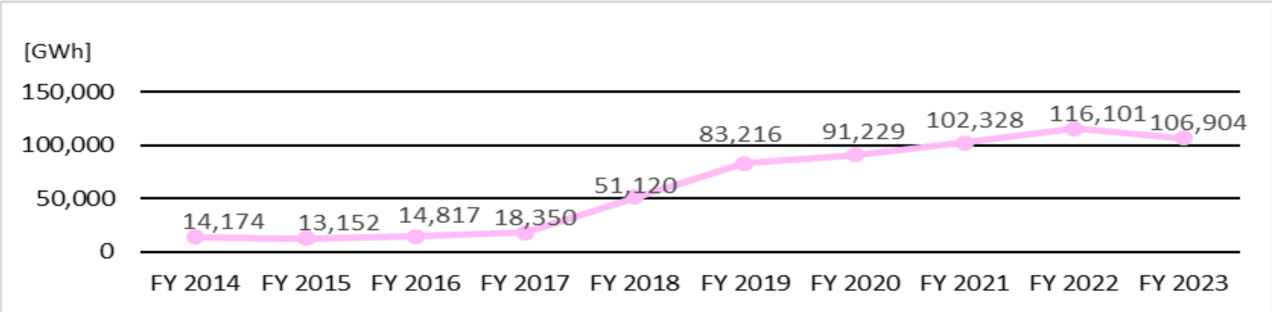


Figure 2-6: Annual utilization of cross-regional interconnection lines by day-ahead transaction (FY 2014–2023)

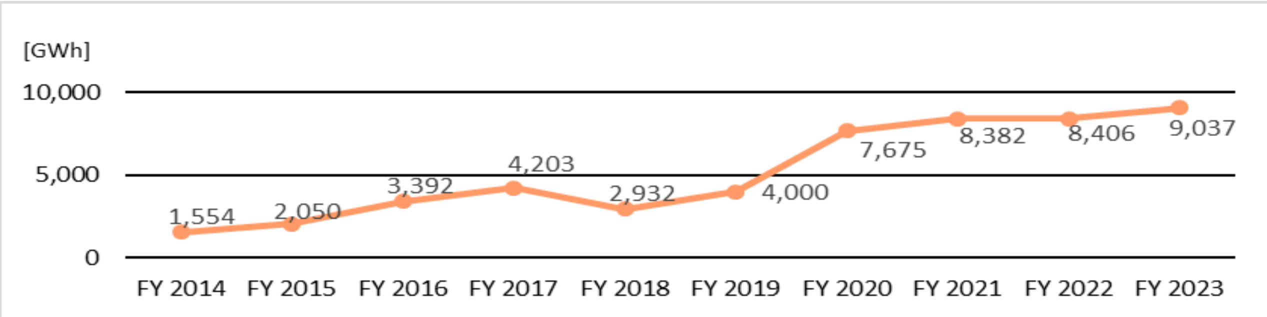


Figure 2-7: Annual utilization of cross-regional interconnection lines by hour-ahead transaction (FY 2014–2023)

3. Status of Maintenance Work on Cross-Regional Interconnection Lines

The following describes the details of the actual maintenance work on the cross-regional interconnection lines, as reported by the GT&D companies in accordance with the provisions of Article 167 of the Operational Rules.

(1) Actual Monthly Maintenance Work on Cross-Regional Interconnection Lines in FY 2023

Table 2-6 presents the monthly and annual maintenance works on cross-regional interconnection lines in FY 2023, and Figure 2-8 depicts the nationwide monthly planned outage rate for FY 2023. The annual maintenance work on cross-regional interconnection lines for FY 2023 occurred on 339 occasions, with 776 days nationwide. Compared with the previous year, work occasions decreased 84 times, but work days increased by 171 days. Shin Shinano FC C.S. and Higashi Shimizu FC C.S. had much work on both occasions and days.

Table 2-6: Monthly and annual maintenance works on cross-regional interconnection lines

Interconnection	Corresponding Facilities	Apr.		May		Jun.		Jul.		Aug.		Sep.		Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Annual	
		Nos.	Days	Nos.	Days	Nos.	Days	Nos.	Days	Nos.	Days	Nos.	Days	Nos.	Days	Nos.	Days	Nos.	Days	Nos.	Days	Nos.	Days	Nos.	Days	**Nos.**	**Days**
Hokkaido-Honshu	Hokkaido and Honshu HVDC Link, New Hokkaido and Honshu HVDC Link	0	0	0	0	13	8	0	0	8	11	12	10	6	7	0	0	0	0	0	0	4	1	2	3	45	40
Tohoku-Tokyo	Soma-Futaba bulk line, Iwaki bulk line	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	17	0	0	0	0	0	0	0	0	2	17
Tokyo-Chubu	Sakuma FC C.S.	0	0	0	0	1	1	0	0	0	0	0	0	0	0	4	3	7	12	1	1	0	0	0	0	13	17
	Shin Shinano FC C.S.	2	2	3	20	7	22	2	31	1	31	2	30	12	31	23	30	1	31	1	31	2	29	4	16	60	304
	Higashi Shimizu FC C.S.	7	30	11	31	10	30	3	27	0	0	1	1	0	0	0	0	0	0	0	0	0	0	12	28	44	147
	Hida–Shinano FC	0	0	0	0	4	6	0	0	2	2	45	21	18	15	0	0	12	9	0	0	0	0	2	10	83	63
Chubu-Kansai	Mie-Higashi Omi line	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chubu-Hokuriku	Minami Fukumitsu HVDC BTB C.S., Minami Fukumitsu Substation	3	2	0	0	10	13	0	0	0	0	1	6	4	7	0	0	2	1	1	1	0	0	0	0	21	30
Hokuriku-Kansai	Echizen-Reinan line	0	0	0	0	3	4	0	0	0	0	3	6	3	5	0	0	0	0	0	0	0	0	0	0	9	15
Kansai-Chugoku	Seiban-Higashi Okayama line, Yamazaki-Chizu line	0	0	1	1	3	3	0	0	0	0	10	13	2	4	8	6	0	0	0	0	0	0	0	0	24	27
Kansai-Shikoku	Kihoku and Anan AC/DC C.S.	3	2	3	4	1	1	0	0	0	0	0	0	3	2	0	0	1	2	0	0	1	1	1	5	13	17
Chugoku-Shikoku	Honshi interconnection line	5	22	1	22	5	27	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	2	2	15	75
Chugoku-Kyushu	Kanmon interconnection line	6	13	4	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	24
Nationwide (Cumulative works for the same facilities deducted)		26	71	23	89	57	115	5	58	11	44	74	87	49	72	38	57	23	55	3	33	7	31	23	64	339	776

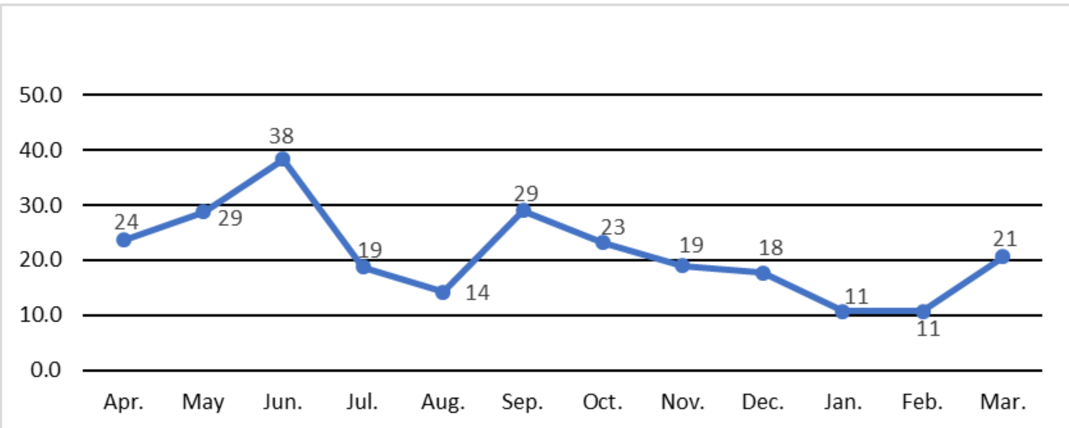


Figure 2-8: Nationwide monthly planned outage rate

$$\text{* Monthly Planned Outage Rate (\%)} = \frac{\text{Total days of planned outage in the month}}{\text{10 interconnection lines} \times \text{calendar days}}$$

(2) Annual Maintenance Works on Cross-regional Interconnection Lines from FY 2014 to FY 2023

Table 2-7 presents the annual maintenance work on cross-regional interconnection lines for FY 2014–FY 2023.

Table 2-7: Annual maintenance work on cross-regional interconnection lines (FY 2014–FY 2023)

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	Total	10-years Average
Nationwide	63	91	218	267	205	353	385	379	423	339	2,723	272

* The significant increase from FY 2015 to FY 2016 is attributable to the introduction of the Cross-Regional Operation System, which made detailed data management available.

4. Forced Outage of the Cross-Regional Interconnection Lines

(1) Forced Outage of Cross-Regional Interconnection Lines in FY 2023

Table 2-8 presents the forced outage of the cross-regional interconnection lines in FY 2023. Five of nine outages were occurred at Sakuma FC Converter Station.

Table 2-8: Forced outage of the cross-regional interconnection lines

Date	Facility	Background
June 3	Hida–Shinano FC	Frequency converter unit failure
July 23	Seiban-Higashi Okayama Trunk Line + Yamazaki-Chizu Line	Shutdown of 500 kV Chugoku Higashi trunk line No.1
July 26	Shin Shinano FC	Frequency converter unit (No.1) failure
August 3	Sakuma FC	Frequency converter unit failure
August 17	Sakuma FC	Frequency converter unit failure
August 19	Sakuma FC	Frequency converter unit failure
August 26	Sakuma FC	Frequency converter unit failure
December 13	Hida–Shinano FC	Frequency converter unit failure
December 30	Anan-Kihoku AC/DC Converter	Bulb group No.1 failure at Anan CS

* The forced outage affecting the TTC is described.

(2) Annual Forced Outage of Cross-regional Interconnection Lines for FY 2014–FY 2023

Table 2-9 presents the annual forced outage of cross-regional interconnection lines from FY 2014 to FY 2023. The number of annual forced outages of cross-regional interconnection lines in FY 2023 was 9, which was lower than the previous year's by 2 outages.

Table 2-9: Annual forced outage of cross-regional interconnection lines (FY 2014–FY 2023)

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	Total	10-years Average
Nationwide	1	3	3	3	6	9	8	11	11	9	64	6

5. Actual Employment of the Transmission Margin

“Employment of the transmission margin” refers to the supply of electricity by GT&D companies through their transmission margin to interconnection lines in which the supply–demand balance is restricted or insufficient to reduce power supply. Table 2-10 presents the actual employment of the transmission margin for FY 2023 according to the provisions of Article 152 of the Operational Rules. The actual employment of the transmission margin for FY 2023 was 1 day, which was performed in the interconnection facilities between Tokyo and Chubu, where the flow was from Chubu to Tokyo. This was attributable to the instruction that responded to the insufficient ability to reduce the power supply to Kansai T&D on June 3, 2023.

Table 2-10: Actual employment of the transmission margin

Date	Facility	Background
June 3, 2023	Interconnection facilities between Tokyo and Chubu (Flow from Chubu to Tokyo)	Insufficient ability of reducing power supply which is necessary for keeping the supply-demand balance in Kansai T&D area due to unexpected demand decrease and solar power output increase

Table 2-11: Actual employment of the transmission margin (FY 2015–FY 2023)

[days]

FY	2015	2016	2017	2018	2019	2020	2021	2022	2023
Nationwide	1	0	3	15	1	16	7	6	1

6. Actual Available Transfer Capabilities of Each Cross-Regional Interconnection Line

The actual ATC values calculated and published are depicted in Figures 2-10 to 2-19. (Figures 2-9 and Table 2-12 details how to interpret the ATC graphs.)

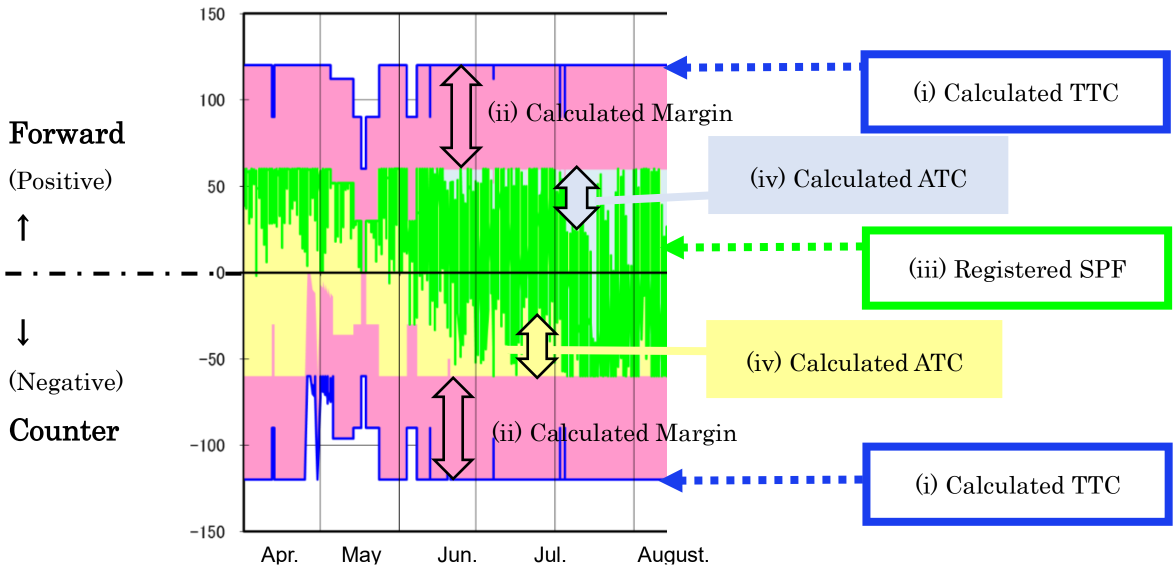


Figure 2-9: How to interpret an ATC graph

Table 2-12: Explanation of the ATC graph components

	By the end of September, 2018	After October, 2018 (introduction of implicit auction scheme)
(i) Calculated TTC	The maximum electricity that can be sent to the distribution facilities while securing supply reliability without damaging the transmission and distribution facilities	The same as the left
(ii) Calculated Transmission Margin	The amount of electricity managed by the Organization as a part of total TTC by the directions of scheduled power flows of the interconnection lines to receive electricity from other regional service areas through interconnection lines under abnormal situations of electric network, supply shortage or other emergent situations, to keep stabilizing the electric network, or to develop an environment of market trading of electricity, or to procure balancing capacity from other regional service areas. Power flows of allocation plans utilizing transmission margin and those employing transmission margin shall be deducted.	The amount of electricity managed by the Organization as a part of total transfer capability of the interconnection lines to receive electricity from other regional service areas through interconnection lines under abnormal situations of electric network, supply shortage or other emergent situations, to keep stabilizing the electric network, or to procure balancing capacity from other regional service areas. Scheduled power flows employing transmission margin shall be deducted.
(iii) Registered SPF	Sum of the registered power flows stated below: 1) allocation plans in "first come, first seerved" principle 2) trade in day-ahead spot market 3) trade in 1 hour-ahead market	Sum of the registered power flows stated below: 1) trade in day-ahead spot market 2) trade in 1 hour-ahead market
(iv) Calculated ATC	(iv) = (i) - (ii) - (iii) The necessary capability for long-cycle cross-regional frequency control shall be immediately deducted from ATC at the decision of its implementation.	The same as the left

The actual flows on the transmission lines are offset in each direction. Therefore, the scheduled power flow is the offset figure between the forward and counter flows but not the simple addition of each direction. In addition, the offset figures on the graphs are observed as SPF rather than the capacity of each forward and counter flow.

(Reference) Publishing actual ATC

Detailed network system information including actual ATC is available at the URL below.

URL http://occtonet.occto.or.jp/public/dfw/RP11/OCCTO/SD/LOGIN_login#

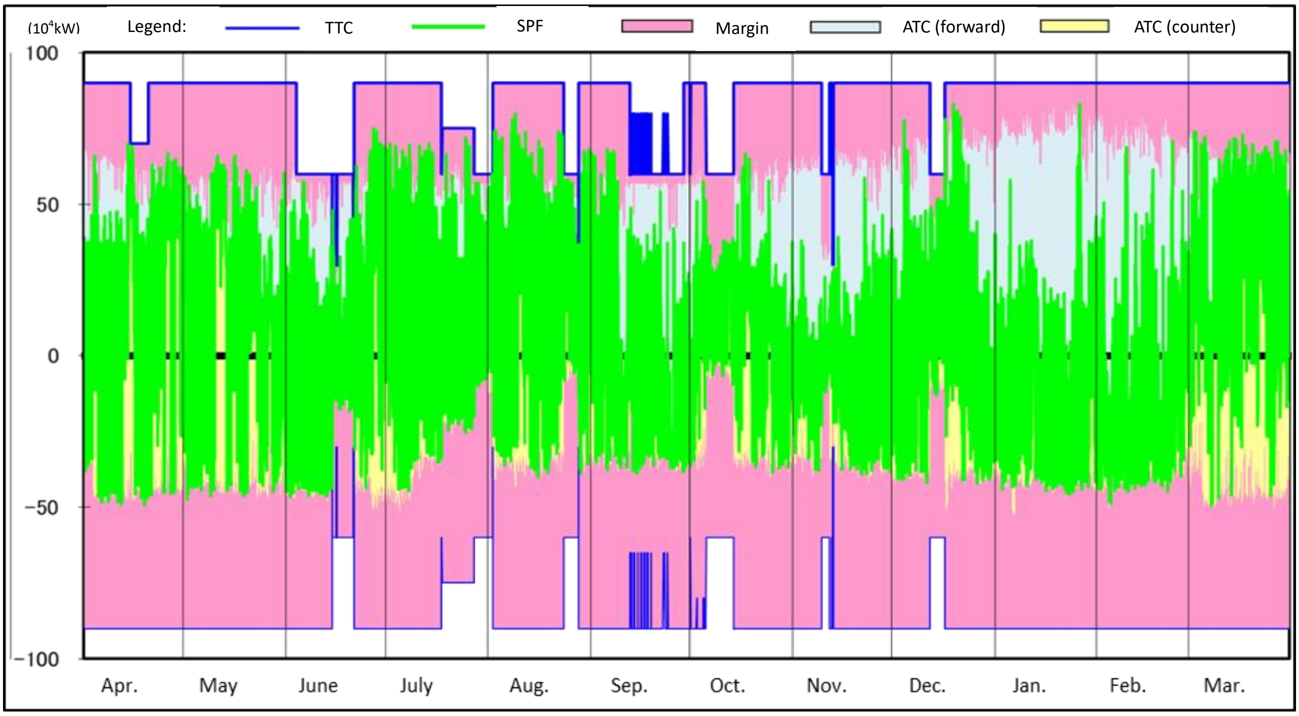


Figure 2-10: Actual ATC for the interconnection facilities between Hokkaido and Honshu (Hokkaido–Honshu HVDC Link, and New Hokkaido–Honshu HVDC Link)

Note: Hokkaido to Tohoku is considered a forward (positive) flow, with Tohoku to Hokkaido being a counter (negative) flow.

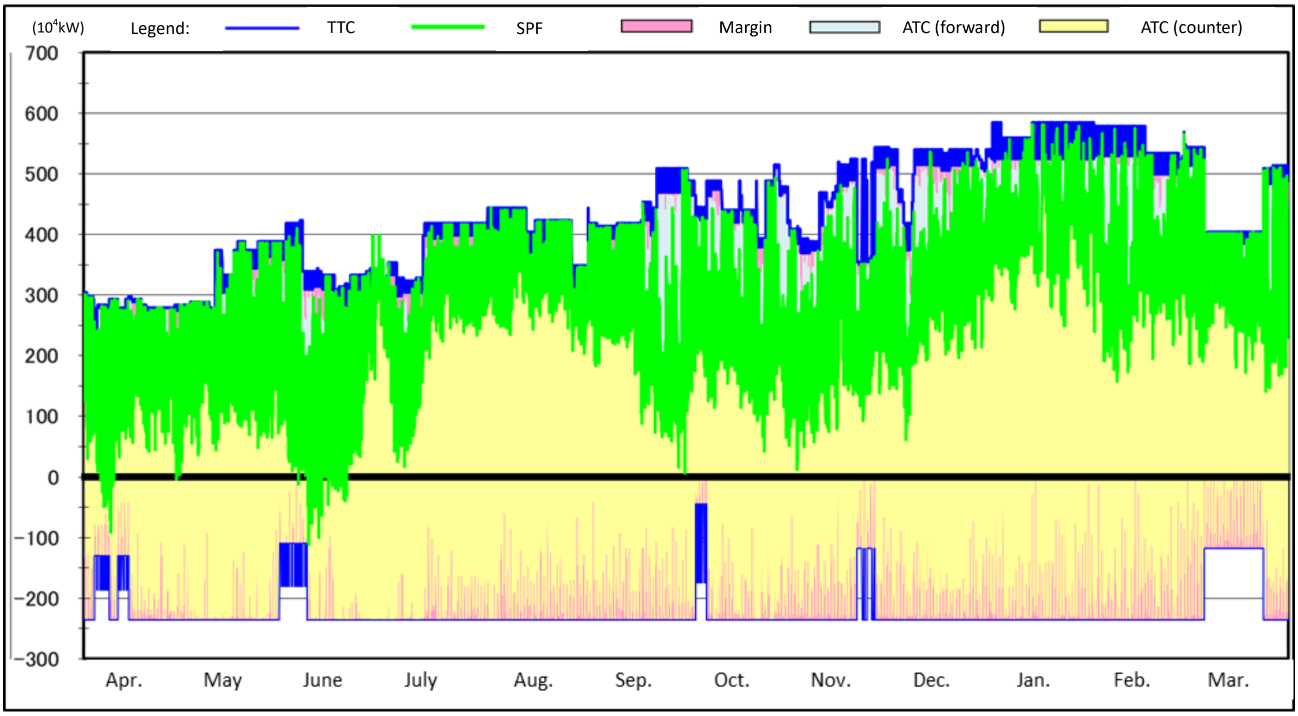


Figure 2-11: Actual ATC for the interconnection lines between Tohoku and Tokyo (Soma–Futaba Bulk Line and Iwaki Bulk Line)

Note: Tohoku to Tokyo is considered a forward (positive) flow, with Tokyo to Tohoku being a counter (negative) flow.

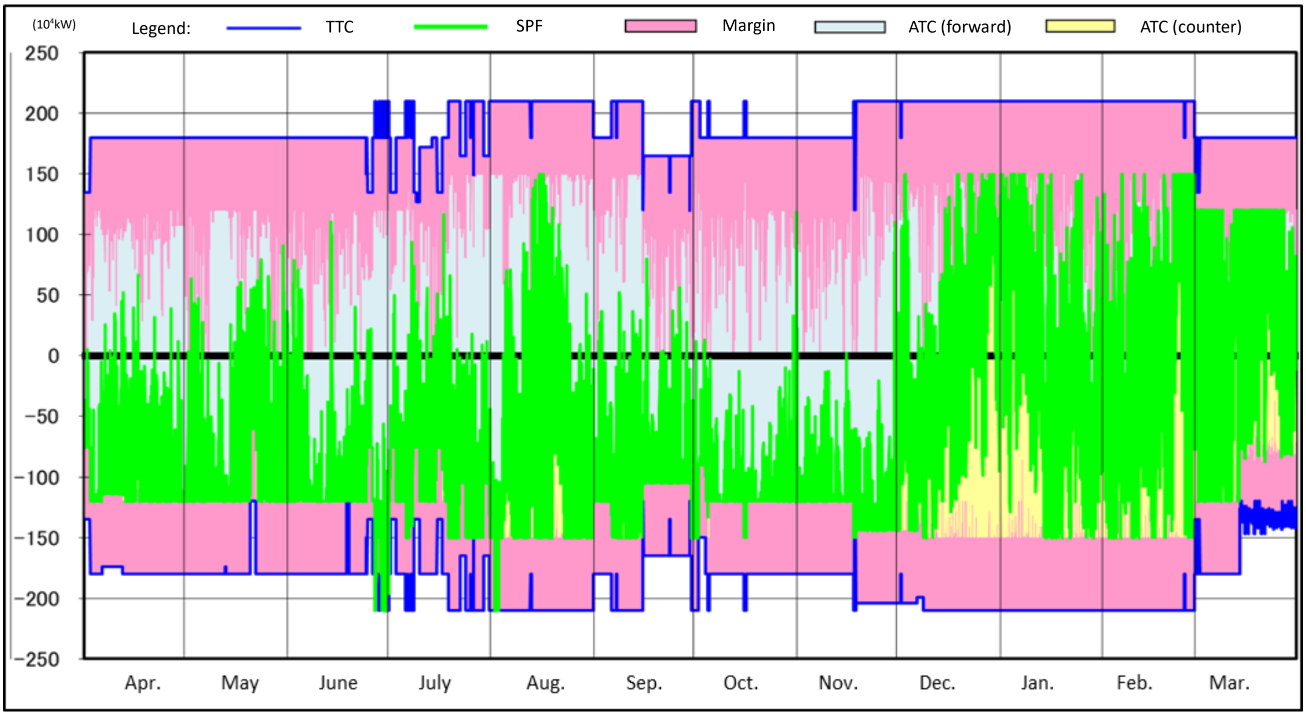


Figure 2-12: Actual ATC for the interconnection facilities between Tokyo and Chubu (Sakuma, Shin Shinano and Higashi Shimizu and Hida–Shinano F.C.)

Note: Tokyo to Chubu is considered a forward (positive) flow, with Chubu to Tokyo being a counter (negative) flow.

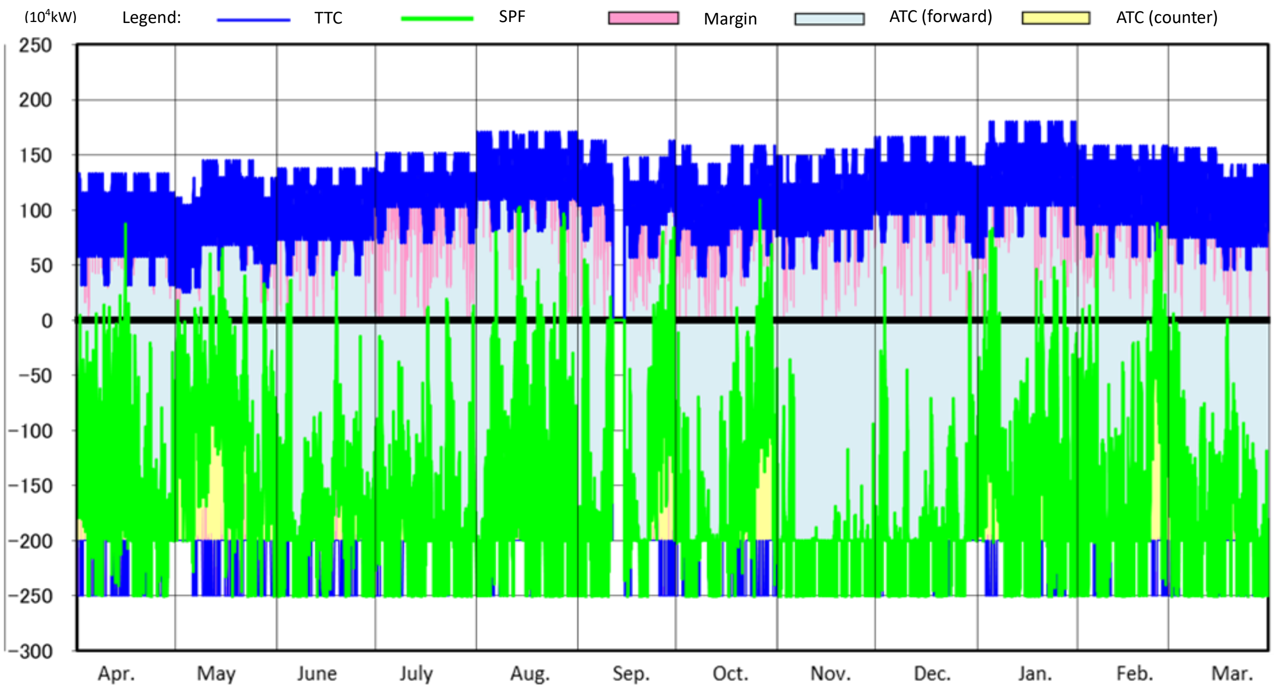


Figure 2-13: Actual ATC for the interconnection line between Chubu and Kansai (Mie–Higashi Omi Line)

Note: Chubu to Kansai is considered a forward (positive) flow, with Kansai to Chubu being a counter (negative) flow.

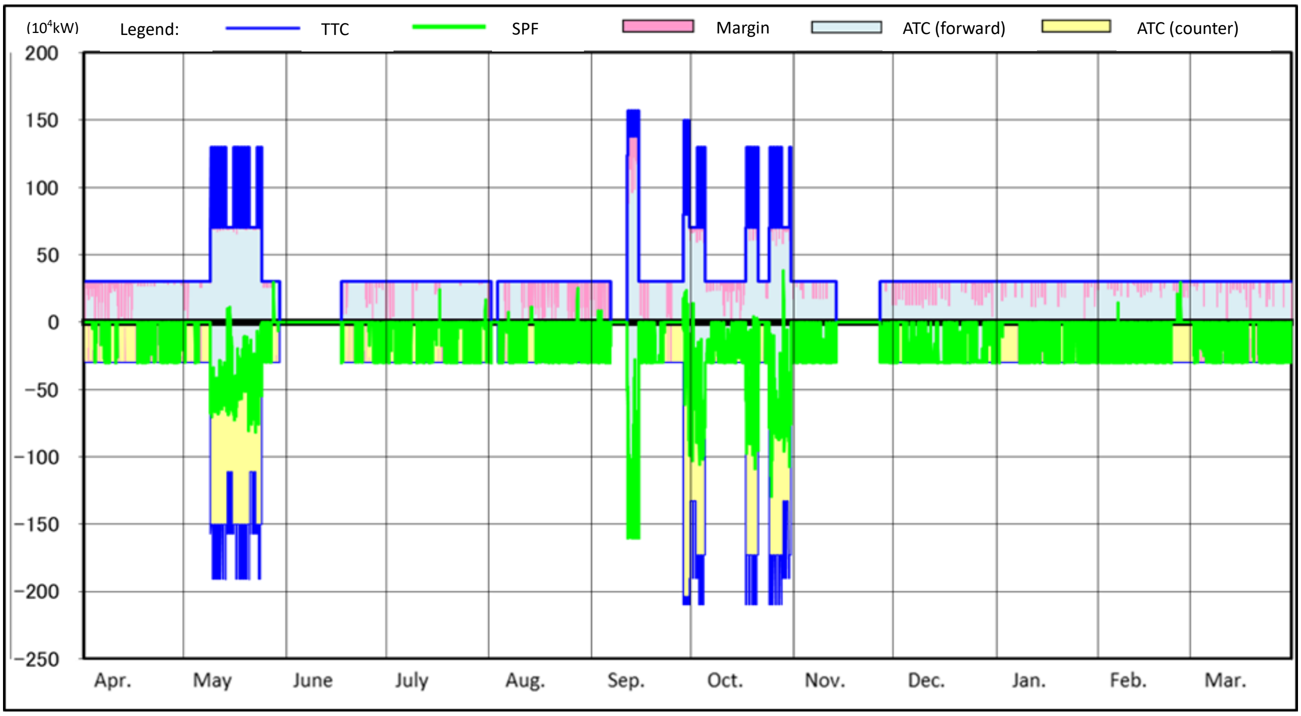


Figure 2-14: Actual ATC for the interconnection facilities between Chubu and Hokuriku (Minami Fukumitsu HVDC BTB Converter Station and Minami Fukumitsu Substation)

Note: Chubu to Hokuriku is considered a forward (positive) flow, with Hokuriku to Chubu being a counter (negative) flow.

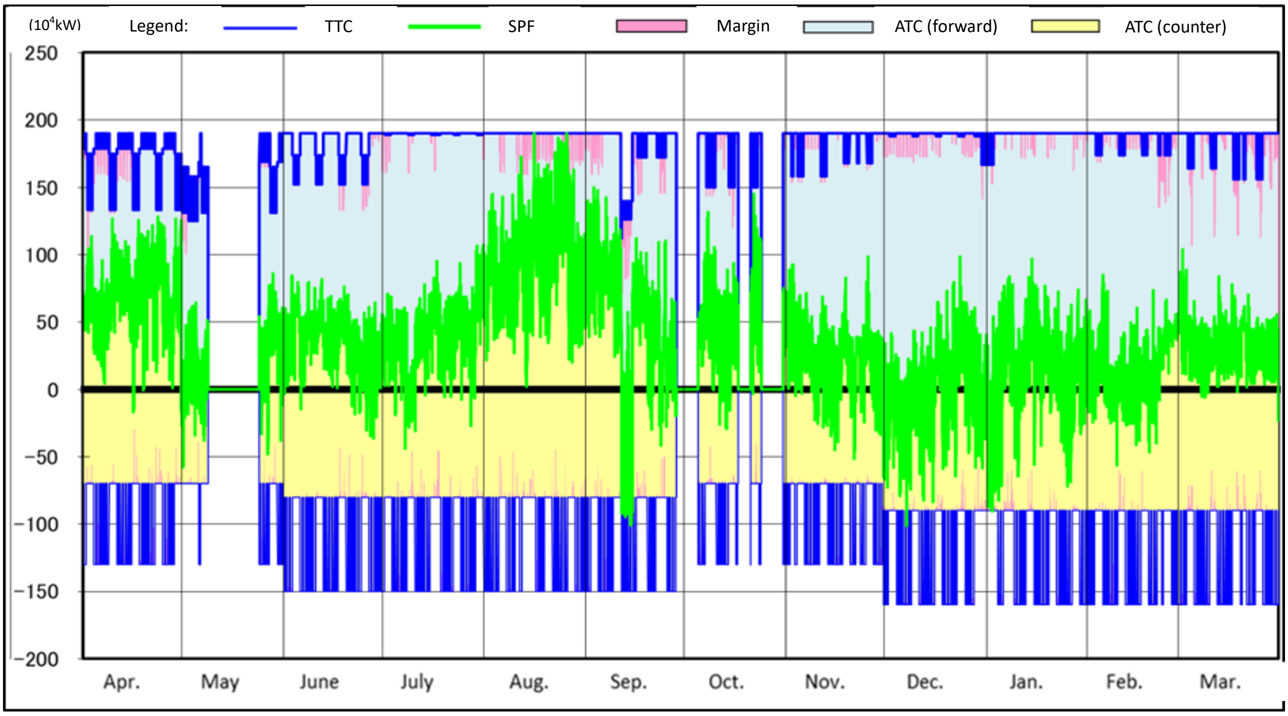


Figure 2-15: Actual ATC for the interconnection line between Hokuriku and Kansai (Echizen–Reinan Line)

Note: Hokuriku to Kansai is considered a forward (positive) flow, with Kansai to Hokuriku being a counter (negative) flow.

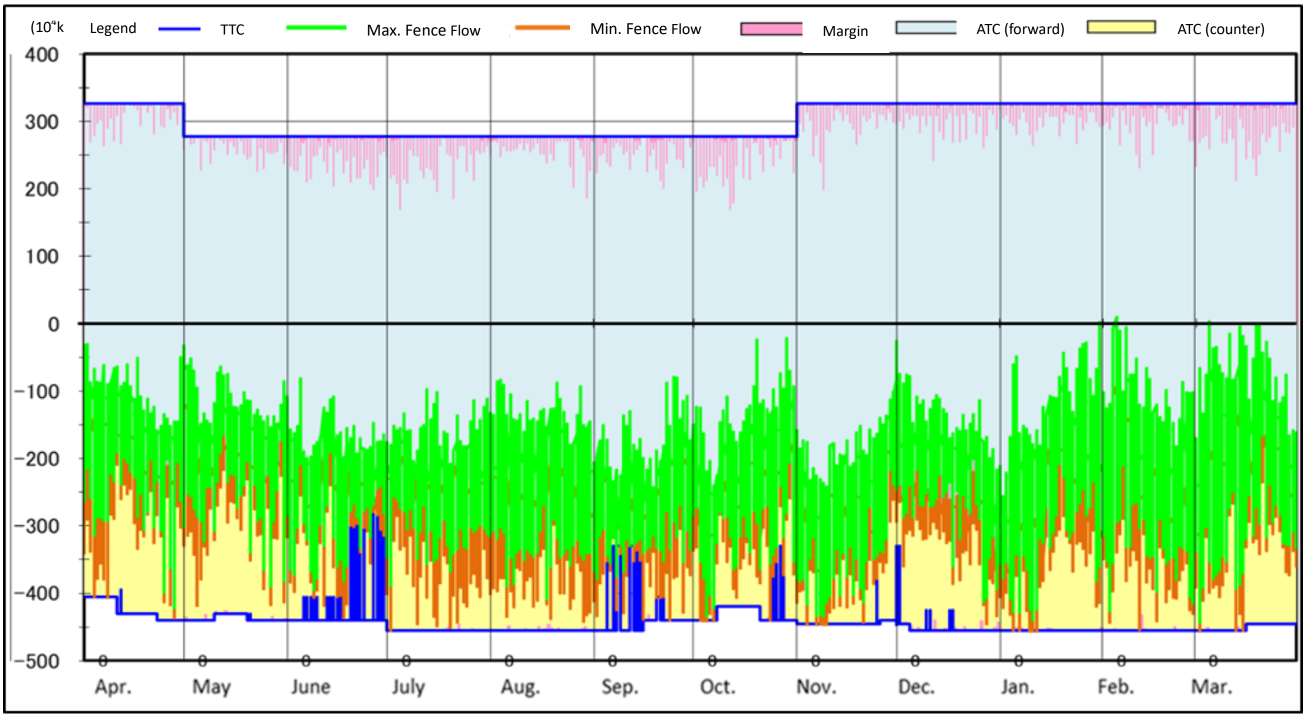


Figure 2-16: Actual ATC for the interconnection lines between Kansai and Chugoku
(Seiban–Higashi Okayama Line and Yamazaki–Chizu Line)

Note: Kansai to Chugoku is considered a forward (positive) flow, with Chugoku to Kansai being a counter (negative) flow.

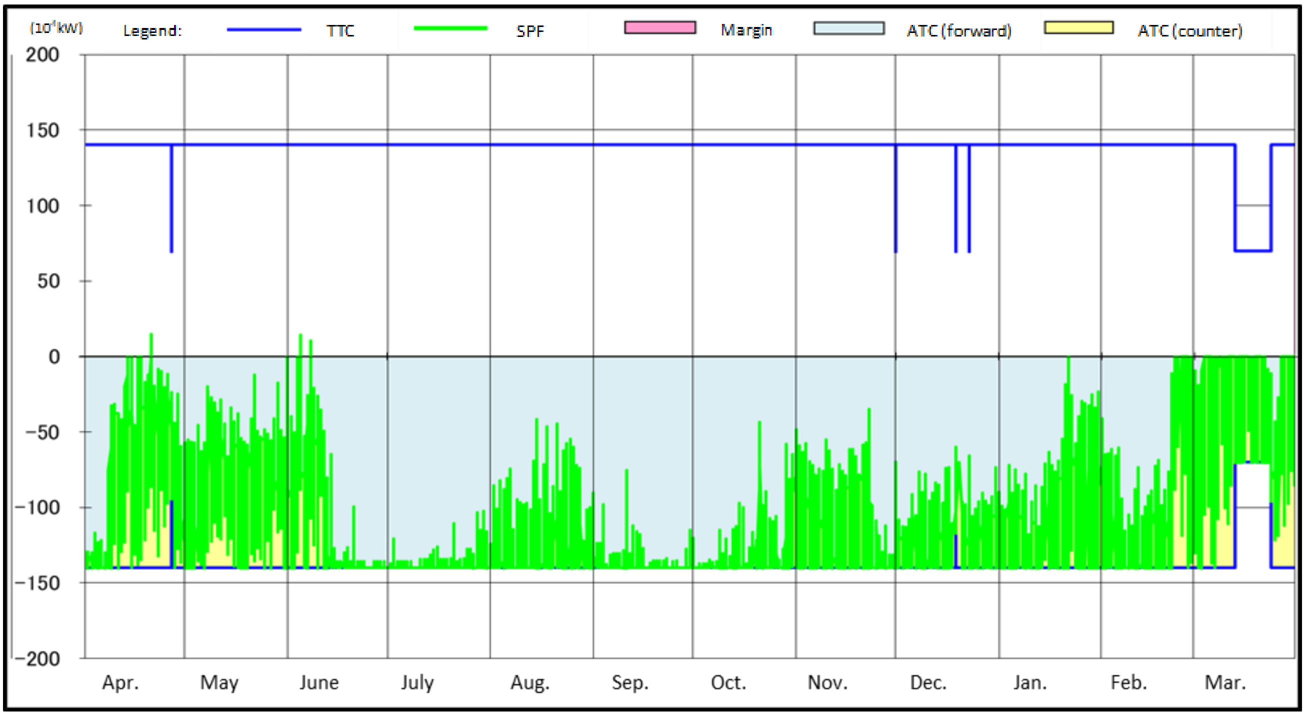


Figure 2-17: Actual ATC for the interconnection facilities between Kansai and Shikoku
(Interconnection facilities between Kihoku and Anan AC/DC Converter Station)

Note: Kansai to Shikoku is considered a forward (positive) flow, with Shikoku to Kansai being a counter (negative) flow.
*The ATC for the forward flow is calculated and chosen as the smaller from the following.
・TTC–transfer margin–SPF.
・TTC of Minami Awa Bulk Line– (Supply Capacity of Tachibanawan Thermal Power Station–SPF of Anan–Kihoku DC Bulk Line).

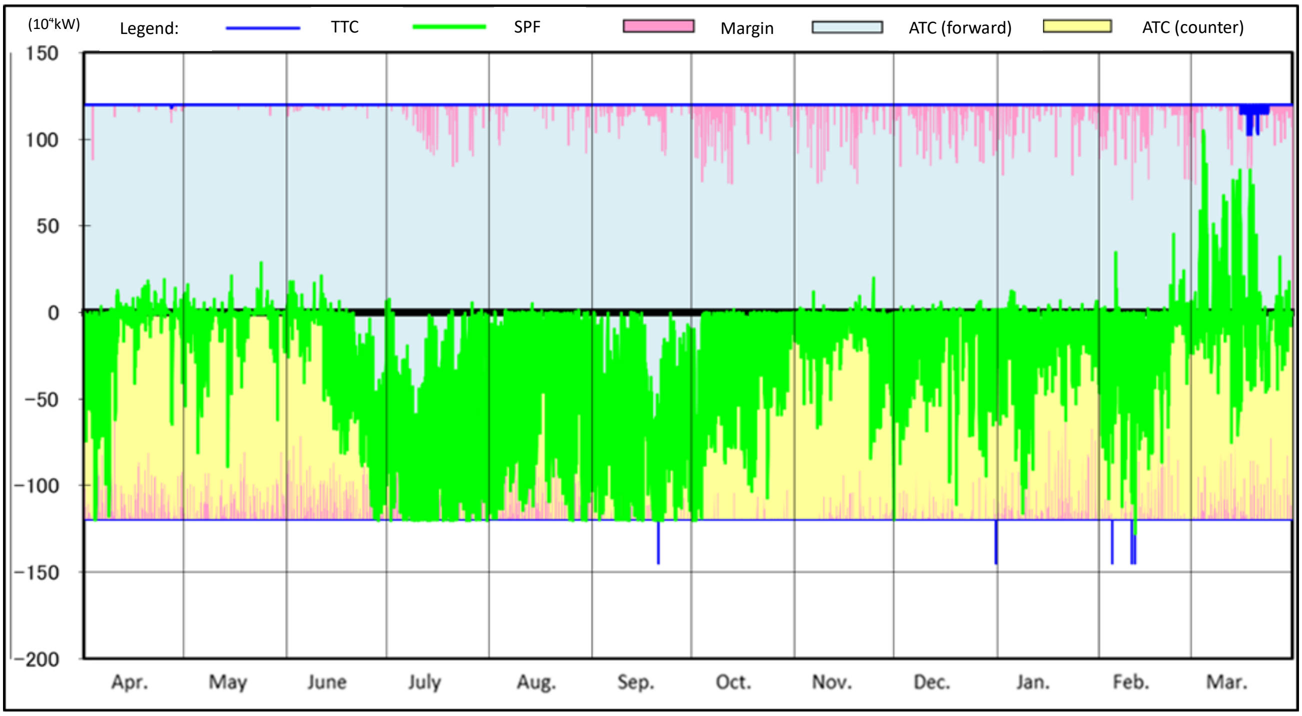


Figure 2-18: Actual ATC for the interconnection line between Chugoku and Shikoku (Honshi Interconnection Line)

Note: Chugoku to Shikoku is considered a forward (positive) flow, with Shikoku to Chugoku being a counter (negative) flow.

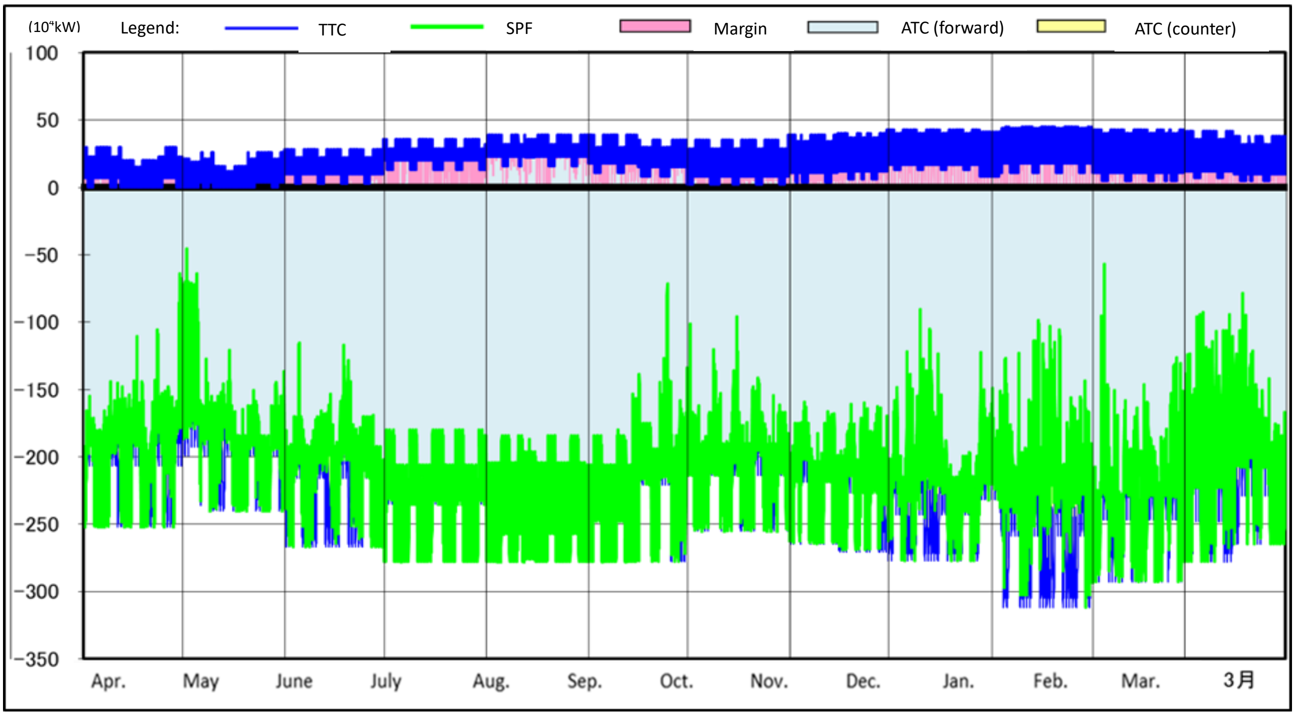


Figure 2-19: Actual ATC for the interconnection line between Chugoku and Kyushu (Kanmon Interconnection Line)

Note: Chugoku to Kyushu is considered a forward (positive) flow, with Kyushu to Chugoku being a counter (negative) flow.

7. Actual Constraints on Cross-Regional Interconnection Lines Nationwide

For the constraints on each regional service area of the 10 GT&D companies, please see the links below.

* Constraints maps are published on the websites below (in Japanese only).

Hokkaido Electric Power Network, Inc.:
http://www.hepco.co.jp/network/con_service/public_document/bid_info.html
Tohoku Electric Power Network Co., Inc.:
https://nw.tohoku-epco.co.jp/consignment/system/announcement/
TEPCO Power Grid, Incorporated:
http://www.tepco.co.jp/pg/consignment/system/index-j.html
Chubu Electric Power Grid Co., Inc.:
https://powergrid.chuden.co.jp/takuso_service/hatsuden_kouri/takuso_kyokyu/rule/map/
Hokuriku Electric Power Transmission & Distribution Company:
https://www.rikuden.co.jp/nw_notification/U_154seiyaku.html#akiyouryu
Kansai Transmission and Distribution, Inc.:
https://www.kansai-td.co.jp/consignment/disclosure/distribution-equipment/index.html
Chugoku Electric Power Transmission & Distribution Company, Incorporated:
https://www.energia.co.jp/nw/service/retailer/keitou/access/
Shikoku Electric Power Transmission & Distribution Company, Incorporated:
https://www.yonden.co.jp/nw/line_access/index.html
Kyushu Electric Power Transmission & Distribution Co., Inc.:
https://www.kyuden.co.jp/td_service_wheeling_rule-document_disclosure
The Okinawa Electric Power Company Incorporated:
http://www.okiden.co.jp/business-support/service/rule/plan/index.html

CONCLUSION

Actual Utilization of Cross-Regional Interconnection Lines

For the actual utilization of cross-regional interconnection lines, data on the utilization, congestion management, maintenance work, unplanned outage, employment of transmission margin, and available transfer capability were collected.

Organization for Cross-regional Coordination of
Transmission Operators, Japan
http://www.occto.or.jp/en/index.html

III. Actual Network Access Business

Actual Data of Preliminary Consultation, System Impact Study, and Contract Applications in FY 2023

[written only in Japanese]

https://www.occto.or.jp/access/toukei/2024/240626_access_toukei.html

June 2024

Organization for Cross-regional Coordination of Transmission Operators, Japan

IV. Projection and Challenges regarding Electricity Supply–Demand and Network based on the Aggregation of Electricity Supply Plan

Aggregation of Electricity Supply Plans

Fiscal Year 2024

September 2024

Organization for Cross-regional Coordination of

Transmission Operators, Japan

INTRODUCTION

The Organization for Cross-regional Coordination of Transmission Operators, Japan (hereinafter “the Organization”) has aggregated electricity supply plans for the 2024 fiscal year (FY). This aggregation was conducted according to the provisions of Article 28 of the Operational Rules of the Organization and Article 29 of the Electricity Business Act (hereinafter “the Act”). These articles require electric power companies (EPCOs) to submit plans and publish their results.

EPCOs are required to submit their electricity supply plans according to the Network Code of the Organization. The Organization then aggregates the plans and sends them to the Ministry of Economy, Trade and Industry (METI) by the end of March each year. A total of 1,902 electricity supply plans were aggregated for FY 2024, including 1,893 submissions from companies that had become EPCOs by the end of November 2023 and nine from companies that had become EPCOs by March 1, 2024.

Number of Electric Power Companies Subject to the Aggregation in FY 2024

Business License	Number
Generation Companies	1,108
Retail Companies	680
Specified Wholesale Suppliers	60
Specified Transmission, Distribution and Retail Companies	33
Specified Transmission and Distribution Companies	8
Transmission Companies	3
General Transmission and Distribution Companies	10
Distribution Companies	0
Total	1,902

[Reference] Electricity supply plan

EPCOs shall develop a comprehensive plan regarding electricity supply and the development of a generation or transmission facility for 10 years according to the provisions of Article 29 of the Act.

METI will then recommend alterations to the EPCOs' supply plans if it recognizes them as inadequate for comprehensively and rationally ensuring the security of a stable supply through cross-regional operation or other development aspects of the electricity business.

Due Date of Submission of Supply Plans	
(1)Electric Power Company (EPCO) except General Transmission and Distribution Company, and Distribution Company: submission to the Organization	March 1, 2024 (draft submission: Feb. 9, 2024)
(2)General Transmission and Distribution Company, and Distribution Company: submission to the Organization	March 25, 2024 (draft submission: Mar. 8, 2024)
(3)The Organization: submission to the METI	End of March, 2024

[Reference] Items to be aggregated in the electricity supply plan

Items aggregated in the electricity supply plan are described in the relevant cover letter according to the provisions of METI's ordinance. The Organization aggregated the plans according to this description.

Items to be reported in the Aggregation (determined by the Ordinance of the METI)	Contents
I. Electricity Demand Forecast	
1. Actual and Preliminary Data for FY 2023, and Forecast for FY 2024 and 2025 (Short-Term)	**Actual peak demand for the previous year, and forecast peak demand for the 1st and 2nd years of the projected period in both each regional area and nationwide**
2. 10-Year Demand Forecast (Long-Term)	**Forecast peak demand from the 3rd to 10th years of the projected period in both each regional area and nationwide**
II. Electricity Supply and Demand	
1. Actual Data for FY 2023, and Projection for FY 2024 and 2025 (Short-Term)	**Actual supply-demand for the previous year, and projected supply-demand for the 1st and 2nd years of the projected period in both each regional area and nationwide**
2. Projection of Supply–Demand Balance for 10 years (Long-Term)	**Projected supply-demand from the 3rd to 10th years of the projected period in both each regional area and nationwide**
III. Analysis of the Transition of Power Generation Sources	**Development and retirement plans of power generation sources which express the transition of power generation in nationwide**
IV. Development Plans for Transmission and Distribution Facilities	**Aggregated reinforcement plans of inter- and intra-regional transmission and distribution facilities**
V. Cross-Regional Operation	**Aggregated transaction plans between each area**
VI. Analysis of Characteristics of Electric Power Companies	**Aggregated situation for electric power companies by each business licenses**
VII. Findings and Current Challenges	**Opinion to the Minister of Economics, Trade & Industry**

CONTENTS

I. Electricity Demand Forecast

1. Actual and Preliminary Data for FY 2023 and Forecast Values for FY 2024 and 2025 (Short Term)

a. Peak Demand (Average Value of the Three Highest Daily Loads) in August[1]

Table 1-1 presents actual data for the aggregated peak demand for each regional service area[2] submitted by 10 general transmission and distribution (GT&D) companies for FY 2023 and the forecast[3] values for FY 2024 and 2025.

The peak demand (i.e., the average value of the three highest daily loads) for FY 2024 was forecast to be 158,570 MW. This represents a 0.8% increase over 157,230 MW, the temperature-adjusted[4] value for FY 2023.

Furthermore, the peak demand for FY 2025 was forecast to be 159,410 MW, which represents a 1.4% increase over the temperature-adjusted [4] value for FY 2023.

Table 1-1 Peak Demand (Average Value of the Three Highest Daily Loads) in August
(Nationwide, 10^4 kW at the Sending End)

FY 2023 Actual (temperature adjusted)	FY 2024 Forecast	FY 2025 Forecast
15,723	15,857 (+0.8%*)	15,941 (+1.4%*)

*% change compared with actual data for FY 2023 (temperature adjusted)

b. Forecast Values for FY 2024 and 2025

Tables 1-2 and 1-3 present the monthly peak demand in FY 2024 and 2025, respectively, from the aggregated peak demand for each regional service area submitted by 10 GT&D companies. The monthly peak demand in summer (August) is approximately 10 gigawatts (GW) more than that in winter (January); therefore, the nationwide peak demand occurs in summer.

1 The peak demand corresponds to the average value of the three highest daily loads (hourly average) each month.

2 The peak demand in the regional service areas refers to the average value of the three highest daily loads in public demand supplied by retail companies and GT&D companies through the latter companies' transmission and distribution network. The Organization publishes these average values according to the provisions of paragraph 5, Article 23 of the Operational Rules.

3 The demand forecast beyond FY 2024 is based on normal weather. Thus, the weather conditions for the forecast assumptions may vary compared with the actual data or estimated value in FY 2023.

4 Temperature adjustment is implemented to capture the current demand based on normal weather, which excludes demand fluctuations triggered by air-conditioner operation.

Table 1-2 Monthly Peak Demand (Average Value of the Three Highest Daily Loads) in FY 2024
(Nationwide, 10^4 kW at the Sending End)

	Apr.	May	Jun.	Jul.	Aug.	Sep.
Peak Demand	11,119	11,055	12,624	15,823	15,857	13,704
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Peak Demand	11,639	11,967	13,868	14,806	14,790	12,801

Table 1-3 Monthly Peak Demand (Average Value of the Three Highest Daily Loads) in FY 2025
(Nationwide, 10^4 kW at the Sending End)

	Apr.	May	Jun.	Jul.	Aug.	Sep.
Peak Demand	11,203	11,136	12,708	15,908	15,941	13,793
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Peak Demand	11,722	12,050	13,951	14,891	14,874	12,885

c. Annual Electrical Energy Requirements

Table 1-4 presents the preliminary data[5] for FY 2023 and the forecast values for FY 2024 from the aggregated electrical energy requirements of each regional service area submitted by the 10 GT&D companies.

The electrical energy requirements for FY 2024 are forecast to be 846.1 TWh, which is an increase of 0.6% compared with the 841.3 TWh in the preliminary data for FY 2023.

Table 1-4 Annual Electrical Energy Requirements
(Nationwide, TWh at the Sending End)

FY 2023 Preliminary (temperature- and leap-year-adjusted)	FY 2024 Forecast
841.3	846.1 (+0.6%*)

* % changes over the preliminary value for the previous year

[5] The preliminary data for annual electrical energy requirements are an aggregation of actual data from April to November 2023 with the preliminary data from December 2023 to March 2024.

2. 10-Year Demand Forecast (Long Term)

Table 1-5 presents significant economic indicators developed and published by the Organization on November 29, 2023. These indicators are assumptions to be used by GT&D companies to forecast the peak demand in their regional service areas.

The real gross domestic product (GDP)[6] was estimated to be 556.9 trillion Japanese yen (JPY) in FY 2023 and 598.6 trillion JPY in FY 2033, with an annual average growth rate (AAGR) of 0.7%. The index of industrial production (IIP)[7] was projected to be 104.3 in FY 2023 and 111.3 in FY 2033, with an AAGR of 0.7%. By contrast, the population was estimated to be 124.41 million in FY 2023, with a projected 118.07 million in FY 2033, representing an AAGR of −0.5%.

Table 1-5 Major Economic Indicators Assumed for the Demand Forecast

	FY 2023	FY 2033
Gross Domestic Product(GDP)	556.9 trillion JPY	598.6 trillion JPY [+0.7%]*
Index of Industrial Product(IIP)	104.3	111.3 [+0.7%]*
Population	124.41 million	118.07 million [−0.5%]*

* Average annual growth rate for the forecast values of FY 2023

a. Peak Demand in August

Table 1-6 presents the peak demand forecast for FY 2024, 2028, and 2033 as the aggregation of peak demand values for each regional service area submitted by the 10 GT&D companies. Furthermore, Figure 1-1 presents the actual data and forecast values of the peak demand from FY 2012 to 2033.

The peak demand nationwide is forecast to be 161,170 MW in FY 2028 and 161,630 MW in FY 2033, with an AAGR of 0.3% from FY 2023 to 2033.

The peak demand in FY 2023 exhibits a downward trend due to the decreasing residential demand through a reduction in the remote work–energy conservation ratio. However, beyond FY 2024, it is forecast to exhibit an upward trend due to larger positive factors, such as economic recovery and demand growth triggered by the new installation of data centers and semiconductor factories, compared with negative factors, such as efforts to reduce electricity use, wider use of energy-saving electrical appliances, and a decreasing population.

Table 1-6 Peak Demand Forecast (Average Value of the Three Highest Daily Loads) for August (Nationwide, 10^4 kW at the Sending End)

FY 2024 [aforementioned]	FY 2028	FY 2033
15,857	16,117 [+0.5%]*	16,163 [+0.3%]*

* Average annual growth rate for the forecast values of FY 2023

6 Expressed as the chained price for calendar year (CY) 2015.
7 Index value in CY 2020 = 100.

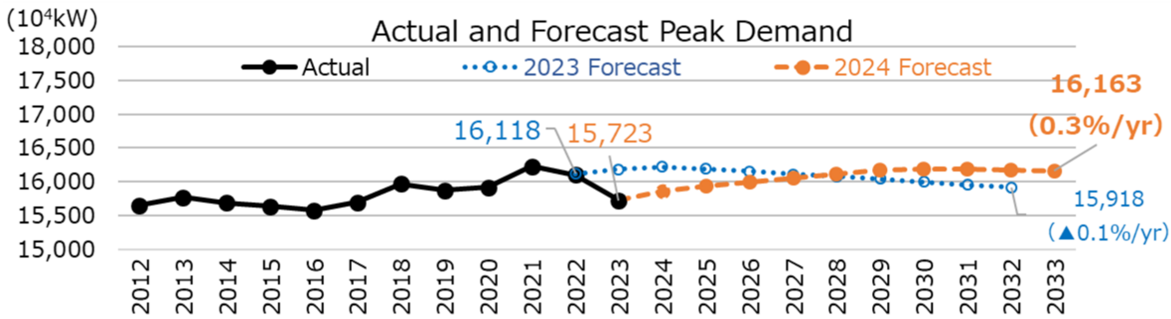


Figure 1-1 Actual and Forecast Peak Demand (August for Nationwide, 10^4 kW at the Sending End)

b. Annual Electric Energy Requirement

Table 1-7 presents the forecast annual electrical energy requirements in FY 2024, 2028, and 2033 as the aggregation of the electrical energy requirements for each regional service area submitted by the 10 GT&D companies.

The nationwide annual electrical energy requirement is forecast to be 869.1 TWh in FY 2028 and 875.4 TWh in FY 2033, with an increase in the AAGR of 0.4% from FY 2023 to 2033.

The peak demand in FY 2023 presents a downward trend due to a decreasing residential demand through a reduction of the remote work–energy conservation ratio. However, beyond FY 2024, it is forecast to exhibit an upward trend due to larger positive factors, such as economic recovery and demand growth triggered by the new installation of data centers and semiconductor factories, compared with negative factors, such as efforts to reduce electricity use, the wider use of energy-saving electrical appliances, and a decreasing population.

Table 1-7 Annual Electrical Energy Requirement Forecast
(Nationwide, TWh at the Sending End)

FY 2024 [aforementioned]	FY 2028	FY 2033
846.1	869.1 [+0.7%]*	875.4 [+0.4%]*

* Average annual growth rate for the forecast values of FY 2023

II. Electricity Supply and Demand

1. Supply Reliability Criteria

In FY 2021, the Organization applied expected unserved energy (EUE) as a reliability criterion to the electricity supply plans based on discussions held by the Study Committee on Regulating the Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation.[8] In the discussion at the Committee's 81st meeting, the basic principle of considering severe weather among the criteria for supply reliability was reviewed,[9] while accidental supply–demand variance and severe weather were decided to be calculated based on recent data for each target year at the 94th and 95th meetings.[10] Therefore, the Organization applies the target outage rate to the capacity market scheme, which is shown in Table 2-1 for the 2024 Supply Plan. For the Okinawa area, the evaluation is implemented based on the policy developed at the Committee's 85th meeting..[11]

Now, among the supply reliability criteria applied for electricity supply plans, annual EUE criteria are included to confirm supply reliability; however, supply capacity must be balanced for each month according to each area's characteristics, such as winter in Hokkaido or severe weather. Therefore, the Organization evaluates whether the supply capacity in the short term (the first and second year of the projected period) is satisfied by the annual EUE criteria and simultaneously confirms the reserve margin of each area and month.

Table 2-1 Target Outage Volume at Capacity Market Scheme in the FY 2024 Electricity Supply Plan [kWh/kW・year]

Forecast	Nationwide Peak Demand (excl. isolated islands)* [10^4kW]	RM for Accidental Supply-demand Variance [%]	RM for Severe Weather Condition [%]		RM for Rare Occurrences Risk [%]	Target Outage Volume at Capacity Market Scheme in Electricity Supply Plan [kWh/kW・year]	RM for Continuous Supply-demand Variance [%]
			Summer/ Winter	Spring/ Autumn			
FY 2024	15,799	6.7	3.4	3.0	1	0.033	2
FY 2025	15,882	6.7	3.4	3.0		0.033	
FY 2026	15,937	6.6	3.6	3.1		0.028	
FY 2027	16,007	6.5	3.6	3.2		0.027	
FY 2028	16,058	5.9	4.2	3.6		0.016	
FY 2029	16,110	5.8	4.2	3.7		0.016	
FY 2030	16,120	5.8	4.3	3.7		0.015	
FY 2031	16,121	5.8	4.3	3.7		0.015	
FY 2032	16,114	5.8	4.3	3.7		0.015	
FY 2033	16,098	5.8	4.3	3.7		0.015	

* RM: Reserve Margin
Sum of peak demand in each area in August, except for Hokkaido, Tohoku, and Hokuriku in January.

[8] Source: Material 2, 58th meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (March 3, 2021) [written only in Japanese].
https://www.occto.or.jp/iinkai/chouseiryoku/2020/files/chousei_58_02.pdf

[9] Source: Material 1, 81st meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (January 24, 2023) [written only in Japanese].
https://www.occto.or.jp/iinkai/chouseiryoku/2022/files/chousei_81_01r.pdf

[10] Source: Material 1, 94th meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (January 24, 2024) [written only in Japanese].
https://www.occto.or.jp/iinkai/chouseiryoku/2023/files/chousei_94_01.pdf
Source: Material 1, 95th meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (February 20, 2024) [written only in Japanese].
https://www.occto.or.jp/iinkai/chouseiryoku/2023/files/chousei_95_01.pdf

[11] Source: Material 1, 85th meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (April 19, 2023) [written only in Japanese].
https://www.occto.or.jp/iinkai/chouseiryoku/2023/chousei_jukyu_85_haifu.html

(Reference) Characteristics of the Annual EUE

Figure 2-1 presents the characteristics of annual EUE. For evaluations using annual EUE criteria, a stable supply is secured throughout the year at the usual level if the annual EUE value is less than the target outage volume in the capacity market scheme and electricity supply plan.

Still, it is difficult to understand the lowering of the reserve margin in a specific area and month solely by the annual EUE evaluation. This is because of an imbalance in the supply capacity caused by the scheduled maintenance of the generation facilities and other factors. Therefore, the Organization implements a conventional approach for evaluating the reserve capacity each month.

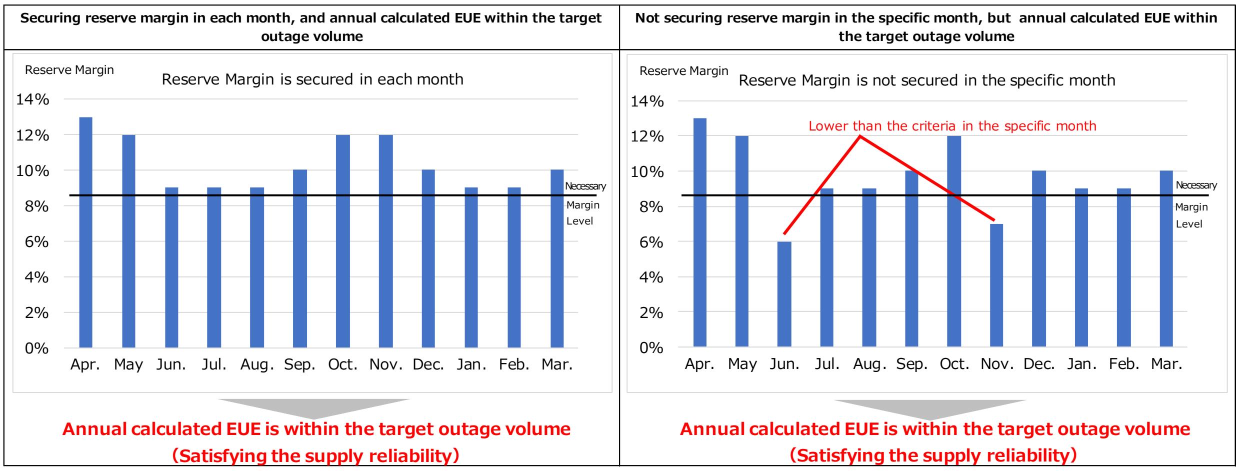


Figure 2-1 Characteristics of the Annual EUE

2. Evaluation of Supply Capacity Using the EUE Approach in the Projected Period (FY 2024–2033)

Table 2-2 presents the calculated supply capacity results using the annual EUE approach. In the short term (the first and second years of the projected period), supply capacity shortages are forecast in the Hokkaido, Tokyo, and Kyushu areas in FY 2025 due to suspension and decommissioned or scheduled maintenance of generating units.

In the long term, due to the suspension and decommissioning of generating units, the calculated results do not fall within the criteria for FY 2026–2029 in the Hokkaido and Tokyo areas; the Tohoku area for FY 2026, 2028, and 2029; the Kyushu area for FY 2026–2033; and the Okinawa area for FY 2026 and 2028.

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

(kWh/kW-year)

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Hokkaido	0.024	0.085	0.035	0.214	0.024	0.021	0.014	0.011	0.012	0.010
Tohoku	0.001	0.004	0.104	0.002	0.029	0.027	0.010	0.008	0.009	0.008
Tokyo	0.009	0.043	0.612	0.047	0.029	0.027	0.011	0.009	0.009	0.008
Chubu	0.001	0.017	0.022	0.010	0.006	0.006	0.003	0.005	0.006	0.006
Hokuriku	0.009	0.000	0.004	0.004	0.004	0.004	0.002	0.003	0.003	0.004
Kanasai	0.000	0.000	0.004	0.004	0.004	0.004	0.002	0.003	0.004	0.005
Chugoku	0.000	0.000	0.004	0.004	0.004	0.004	0.002	0.003	0.004	0.005
Shikoku	0.000	0.000	0.003	0.003	0.003	0.003	0.001	0.002	0.002	0.003
Kyushu	0.002	0.039	0.803	0.701	0.726	0.567	0.240	0.234	0.213	0.193
Interconnected areas	0.005	0.024	0.303	0.093	0.085	0.068	0.029	0.028	0.027	0.025
Okinawa	0.069	0.094	3.385	1.163	3.745	1.276	1.364	1.462	1.521	1.354
<Target outage volume aimed by capacity market and electricity supply plan>										
Interconnected areas	0.033	0.033	0.028	0.027	0.016	0.016	0.015	0.015	0.015	0.015
Okinawa	1.996	1.996	1.996	1.996	1.996	1.996	1.996	1.996	1.996	1.996

3. Short-Term Evaluation of Supply Capacity Using the Conventional Approach

The Organization evaluates the supply–demand balance nationwide and for each regional service area using the supply capacity[12] and peak demand data for the regional service areas. Then, it confirms that the reserve margin[13] against the peak demand exceeds the sum of the accidental supply–demand variance and the continuous supply–demand variance.

In the Okinawa EPCO regional service area, the criterion is to secure the supply capacity (which is deducted from the necessary reserve capacity based on actual operation[14]) or the activating standard of Generator I'[15], (whichever is larger), which must cover the average of the three highest loads in its regional service area. The evaluation is implemented at the time of the smallest reserve margin.

Figure 2-2 summarizes the supply–demand balance evaluation. The supply capacity is the sum of the generation capacity owned by EPCOs (main generation company) and the traded supply capacity of non-EPCOs (sales deducted from procurement); then, the traded supply capacity of the registered specified transmission, distribution, and retail company is subtracted.

When the operation of a nuclear power plant becomes uncertain, the corresponding unit or plant's supply capacity is recorded as zero. Furthermore, the corresponding supply capacity is reported as "uncertain" according to the Procedures for Electricity Supply Plans of FY 2024, published in December 2023 by the Agency for Natural Resources and Energy.[16]

12 Supply capacity is the maximum power generated steadily during the peak demand period (average value of the three highest daily loads)..

13 Reserve margin (%) describes the difference between the supply capacity and the peak demand (average value of the three highest daily loads) divided by the peak demand.

14 Reference: Material 2, 85th meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (April 19, 2023) [written only in Japanese]. https://www.occto.or.jp/iinkai/chouseiryoku/2023/files/chousei_85_02.pdf

15 Reference: Guideline for soliciting balancing capacity of Generator I' activating at severe weather for FY 2024 [written only in Japanese]. https://www.okiden.co.jp/shared/pdf/business/free/2023/ps1/dengen_tyousei_10.pdf

16 Procedures for Electricity Supply Plans of FY 2024 https://www.enecho.meti.go.jp/category/electricity_and_gas/electricity_measures/001/pdf/2023-12_kyoukei_kisaiyouryou.pdf

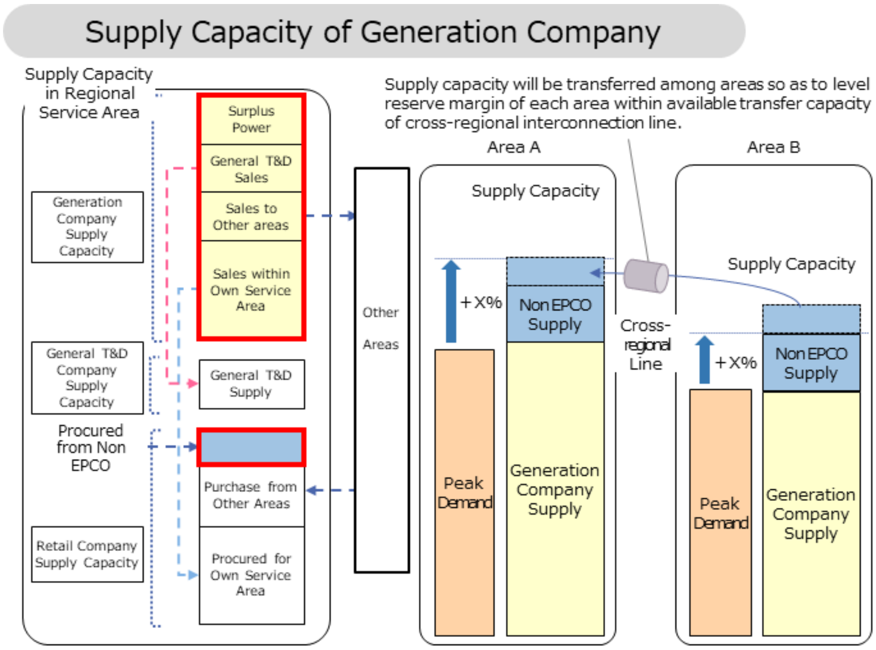


Figure 2-2 Summary of Supply–Demand Balance Evaluation

[Reference] Method for Calculating the Supply Capacity

The calculation method for supply capacity or surplus power is based on the description in the "Guidelines for the Calculation of Demand and Supply Capacity"[17](Agency for Natural Resources and Energy: December 2023) and "Procedures for Electricity Supply Plans of FY 2024"[16] (Agency for Natural Resources and Energy: December 2023). Essentially, the evaluation segment of supply capacity is performed according to the segment of supply capacity submission.

[Reference] Calculation Method of Available Transfer Capability(ATC)

When calculating the cross-regional reserve margin, the supply capacity is transferred within the available transfer capacity to level around the neighboring areas. The supply capacity in each regional area is calculated based on the generation facilities of EPCOs before the levelization and does not consider the scheduled trade of utilizing cross-regional interconnection lines. Therefore, the Organization calculates the scheduled power flow as zero to the margin levelization.

ATC = transfer capability (1) – transfer margin (2)

<u>Short term</u>

(1) Based on the "Transfer Capability of Cross-regional Interconnection Lines FY 2024–2033"

[17] Guideline for the Calculation of Demand and Supply Capacity [written only in Japanese].
https://www.enecho.meti.go.jp/category/electricity_and_gas/electricity_measures/001/pdf/2023-12_jukyujuyou_keijogaidorain.pdf

(annual and long-term plans; March 1, 2024: The Organization)[18]
(2) Based on the "Transmission Margin of Cross-regional Interconnection Lines FY 2024 and 2025" (annual plan; March 1, 2024: The Organization)[19], a and the calculated figures considering expected contributions from external areas (equivalent to 3% of the transfer capability of interconnection lines) lines)
(3) Based on monthly scheduled power flows reported in the "Plan for Transaction of Electricity (Table 36)" of the electricity supply plan for FY 2023 and 2024

Mid-to-long term
(1) For FY 2024 and 2025, the August value was calculated from (1) in the short term above; the value for FY 2026–2033 was based on the "Transfer Capability of Cross-regional Interconnection Lines FY 2024–2033" (annual and long-term plans; March 1, 2024: The Organization)[18]
(2) For FY 2024 and 2025, the August value was calculated from (2) in the short term above; the value for FY 2026–2033 was based on the "Transmission Margin of Cross-regional Interconnection Lines FY 2024–2033" (long-term plans; March 1, 2024: The Organization). [19]

[18] Reference: "Cross-regional Transfer Capability from FY 2024 to FY 2033" (annual and long-term) [written only in Japanese].
https://www.occto.or.jp/renkeisenriyou/oshirase/2023/files/oshirase_1_2024-2033_unyouyouryou.pdf
[19] Reference: "Cross-regional Transmission Margin from FY 2024 to FY 2033 (annual and long-term), consideration and securing reasons for margin setting at the actual supply–demand timing" [written only in Japanese].
https://www.occto.or.jp/renkeisenriyou/oshirase/2023/files/20240301_margin_3_kakuhoriyuu.pdf

a. Projection of the Supply–Demand Balance in FY 2024 and 2025

To present the cross-regional reserve margin, the Organization recalculates the monthly projection of the smallest reserve margin for each regional service area to the level of neighboring areas. Furthermore, additional supply capacity is applied to the interconnected areas (except Okinawa) in July and August based on the correlation between solar power generation and electric demand.[20]

In addition, information on the environmental assessment of thermal power plants[21] probably includes some generation facilities in which EPCOs confirm their business judgment and proceed to their construction. Therefore, the Organization has investigated generation facilities that are not included in electricity supply plans; however, they have already applied for generator connections to GT&D companies and submitted construction plans according to the provisions of Article 48 of the Act in cooperation with the government.

(i) Projection for FY 2024

Table 2-3 presents the projected reserve margin in each regional service area for FY 2024. The reserve margin in every area and month exceeds 13%.

Table 2-2 Monthly Projection of Cross-Regional Reserve Margins Nationwide and for Each Regional Service Area (at the Sending End)

Note: Power exchanges through cross-regional interconnection lines and generation facilities not included in the electricity supply plans have been added.

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	25.1%	33.8%	26.2%	20.9%	28.0%	27.0%	24.2%	13.6%	25.7%	20.3%	19.7%	24.5%
Tohoku	25.1%	33.8%	25.8%	20.9%	18.9%	27.0%	16.9%	13.6%	25.7%	20.3%	19.7%	31.5%
Tokyo	25.1%	24.6%	17.6%	18.4%	18.9%	27.0%	16.9%	13.6%	25.7%	20.3%	19.7%	31.5%
Chubu	27.6%	31.0%	26.8%	18.4%	18.9%	27.0%	30.3%	23.5%	19.9%	17.9%	19.0%	30.2%
Hokuriku	29.9%	31.0%	26.8%	18.4%	18.9%	27.0%	31.1%	24.2%	19.9%	17.9%	18.5%	30.2%
Kansai	29.9%	31.0%	26.8%	18.4%	18.9%	27.0%	31.1%	24.2%	19.9%	17.9%	19.0%	30.2%
Chugoku	29.9%	31.0%	26.8%	18.4%	18.9%	27.0%	31.1%	24.2%	19.9%	17.9%	19.0%	30.2%
Shikoku	29.9%	36.4%	32.2%	18.4%	18.9%	27.0%	31.1%	24.2%	19.9%	17.9%	19.0%	30.2%
Kyushu	32.3%	31.0%	26.8%	18.4%	18.9%	27.0%	31.1%	24.2%	19.9%	17.9%	19.0%	30.2%
Okinawa	67.8%	42.7%	31.7%	36.6%	39.3%	32.9%	49.6%	65.8%	96.9%	65.6%	71.3%	78.4%

* Cross-regional reserve margins becoming the same value are shown in the same background colors after utilization of cross-regional interconnection line. The least reserve margins in the Okinawa area are included.

The Okinawa EPCO regional service area[22] is a small, isolated island system that is unable to receive power through interconnection lines; thus, the same criteria used in other areas cannot be applied. In Okinawa, the stable supply criterion means to secure a supply capacity over the peak demand by deducting the necessary reserve capacity based on the actual operation of 342 MW.

[20] Reference: 69th meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation [written only in Japanese]. https://www.occto.or.jp/iinkai/chouseiryoku/2021/files/chousei_69_01.pdf

[21] Reference: Information on the environmental assessment of thermal power plants (METI website) [written only in Japanese]. https://www.meti.go.jp/policy/safety_security/industrial_safety/sangyo/electric/detail/index_assessment.html

[22] In the Okinawa EPCO regional service area, the evaluation is implemented at the time of the lowest reserve margin instead of when the peak demand occurs.

Table 2-4 presents the monthly reserve margin, indicating that the stable supply was secured in each month:

Table 2-4 Monthly Reserve Margin Forecast Using the Conventional Approach in Okinawa (at the Sending End)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Okinawa	34.4%	16.1%	8.5%	14.6%	17.2%	10.4%	24.1%	35.2%	61.3%	32.9%	35.6%	41.9%

(ii) Projection for FY 2025

Table 2-5 presents similar calculation results for FY 2025, indicating that the reserve margins are over 10% in every month and area:

Table 2-5 Monthly Projection of Cross-Regional Reserve Margins Nationwide and for Each Regional Service Area (at the Sending End)

Note: Power exchanges through cross-regional interconnection lines and generation facilities not included in the electricity supply plans have been added.

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	19.3%	29.6%	33.9%	23.2%	18.0%	22.0%	17.7%	12.7%	20.5%	15.5%	17.0%	23.0%
Tohoku	19.3%	17.3%	16.8%	17.1%	18.0%	27.1%	17.7%	12.7%	20.5%	15.5%	17.0%	23.0%
Tokyo	19.3%	17.3%	16.8%	17.1%	18.0%	27.1%	10.9%	12.7%	20.5%	15.5%	17.0%	23.0%
Chubu	29.1%	30.7%	28.1%	17.1%	18.0%	27.1%	30.7%	23.7%	20.5%	15.5%	17.1%	33.6%
Hokuriku	29.1%	30.7%	28.2%	17.2%	18.0%	27.1%	30.7%	23.7%	20.5%	19.1%	18.3%	33.6%
Kansai	29.1%	30.7%	28.2%	17.2%	18.0%	27.1%	30.7%	23.7%	20.5%	19.1%	18.3%	33.6%
Chugoku	29.1%	30.7%	28.2%	17.2%	18.0%	27.1%	30.7%	23.7%	20.5%	19.1%	18.3%	33.6%
Shikoku	29.1%	34.6%	35.8%	42.5%	40.7%	45.0%	54.1%	49.6%	20.5%	19.8%	18.3%	35.2%
Kyushu	29.1%	21.3%	28.2%	17.2%	18.0%	27.1%	30.7%	23.7%	20.5%	19.1%	15.2%	32.1%
Okinawa	60.1%	40.7%	38.8%	29.8%	39.7%	34.7%	42.3%	57.3%	66.2%	60.5%	74.2%	83.8%

* Reserve margins becoming the same value are shown in the same background colors after utilization of cross-regional interconnection line. The least reserve margins in the Okinawa area are included.

Like the FY 2024 evaluation, Table 2-6 presents the monthly reserve margin for Okinawa, indicating that a stable supply was secured each month:

Table 2-6 Monthly Reserve Margin Forecast Using the Conventional Approach in Okinawa (at the Sending End)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Okinawa	26.8%	14.3%	15.7%	8.0%	17.7%	12.4%	17.0%	26.9%	30.8%	27.9%	38.7%	47.5%

b. Difference Between Scheduled Maintenance of Generation Facilities for FY 2024 Evaluated Using the Conventional Approach

Figure 2-3 presents the monthly scheduled maintenance planned for FY 2024 in the 2024 Supply Plan, which is subject to a generation capacity of 100 MW and above. Figure 2-4 presents the difference in scheduled maintenance for FY 2024 between the supply plans for FY 2024 (1st year) and FY 2023 (2nd year), which was subject to the same generation capacity.

The Organization has requested that all EPCOs avoid tight supply–demand balance periods for the scheduled maintenance of their generation facilities.[23] However, major generation facilities have been shut down and their restoration was unknown at the time of submitting supply plans; moreover, scheduled maintenance has increased compared with the 2023 Supply Plan.

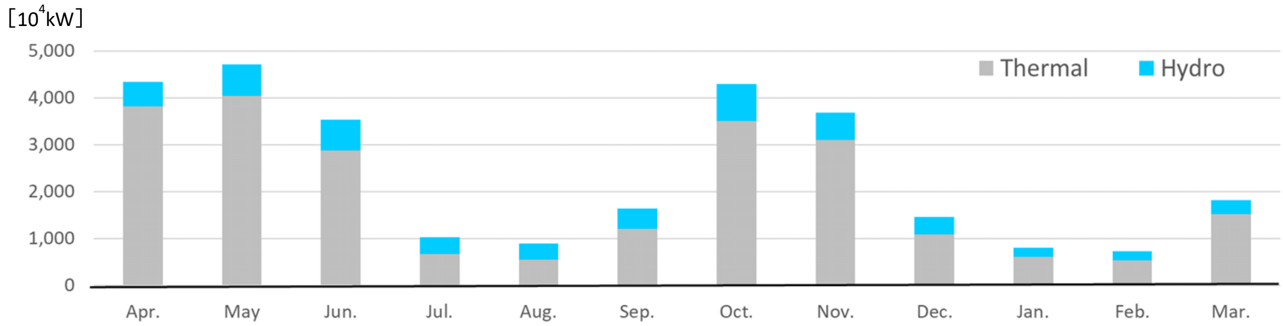


Figure 2-3 Monthly Scheduled Maintenance Planned for FY 2024 in the 2024 Supply Plan

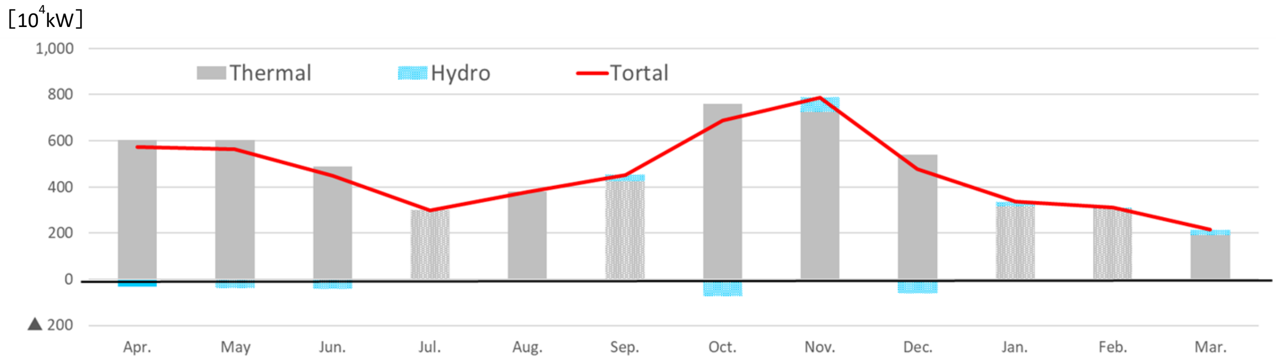


Figure 2-4 Difference in Scheduled Maintenance for FY 2024 between the FY 2023 (2nd year) and FY 2024 (1st year) Supply Plans

c. Suspension and Decommissioning of Generation Facilities in the 2024 Supply Plan

Table 2-7 presents the suspension and decommissioning of thermal generation facilities (subject to the generation capacity of 1 MW and over, excluding isolated island facilities) in the 2024 Supply Plan.

The plan adds a capacity of 220 MW to the suspension and decommissioning plan. Furthermore, 1,930 MW of generation facilities has been included in the suspension and decommissioning plan until FY 2023. In total, a capacity of 2,150 MW is planned for suspension and decommissioning in FY 2024.

Table 2-7 Suspension and Decommissioning of Generation Facilities in the 2024 Supply Plan (10^4 kW)

(10^4kW)

Fuel	Newly Added	Already Included	Total Capacity to be Decommissioned
LNG	0	62	62
Oil	0	95	95
Coal	22	36	58
Total	22	193	215

[23] Reference: “Further Security of Supply Capacity in FY 2024” [written only in Japanese]. https://www.occto.or.jp/kyoukei/oshirase/231201_2024kyoukyuryokukakuho.html

4. Evaluation of Energy Supply

To evaluate the energy supply (kWh), the Organization has implemented a semiannual evaluation since FY 2021, which it calls "Supply Energy Monitoring," for the summer and winter periods. It is implemented when various types of information required for the demand forecast (e.g., weather forecast and generation fuel inventory) are available, enabling additional fuel procurement for generation. The Organization plans to continue these evaluations and publish the results.

Notably, the Organization did not evaluate the energy supply balance in the aggregated FY 2024 Supply Plan; however, it did confirm the annual energy supply balance at this point and published information to elicit a response from EPCOs.

a. Projection of Energy Supply

Figure 2-5 presents the monthly energy supply balance for nine interconnected areas in FY 2024 (the 1st year of the projected period of the FY 2024 plans). Table 2-8 presents the forecast energy requirement of the FY 2024 plan along with volumes and shortage rates from the forecast. In some months, the energy supply[24] will be 1.3 TWh/month less than the forecast energy requirement (equivalent to 1.8% against the forecast energy requirement).

The Organization expects retail companies to procure supply capacity in a premeditated manner, while it expects generation companies to procure fuel to increase their energy generation to meet the actual demand and supply timing based on projections. Additionally, the Organization shall confirm projections for securing the energy supply by implementing kWh monitoring for the high-demand period.

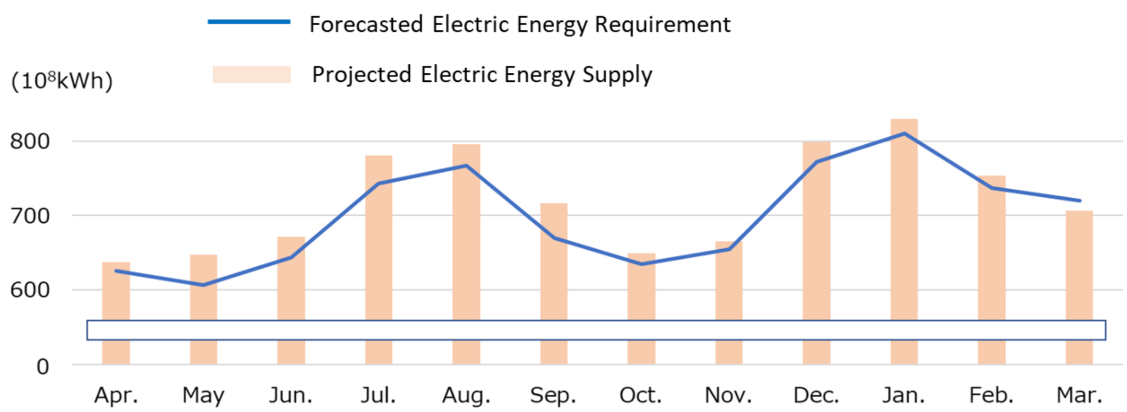


Figure 2-5 Monthly Energy Supply Balance for a Total of Nine Interconnected Areas in FY 2024

Table 2-8 Forecast Energy Requirement in the FY 2024 Plan, Volumes, and Shortage Rates from the Forecast

(10^8kWh)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual total
Forecasted Energy Requirement	626	606	643	743	767	669	634	654	772	810	737	719	8,381
Projected Energy Supply Shortage	11	41	28	37	29	47	15	11	27	20	16	-13	268
Projected Shortage Rate	1.8%	6.8%	4.4%	5.0%	3.8%	7.0%	2.4%	1.7%	3.5%	2.5%	2.2%	-1.8%	3.2%

24 The projected energy supply is the addition of energy supply with bilateral contract to retail companies, which includes the generation of nonelectric power companies, and surplus power expected for market trade.

5. Evaluation of Supply–Demand for Supply Capacity and Energy Supply

・ Evaluation of Supply Capacity Using the EUE Approach

In the FY 2024 evaluation, the EUE indices are within the target outage volume in all areas. For FY 2025, the EUE indices exceed the targets for the Hokkaido, Tokyo, and Kyushu service areas. In the mid-to-long term (FY 2026–2033), the EUE indices exceed targets for Hokkaido and Tokyo from FY 2026 to 2029; Tohoku for FY 2026, 2028, and 2029; Kyushu from FY 2026 to 2033; and Okinawa in FY 2026 and 2028 due to the suspension or decommissioning of generation facilities.

・ Evaluation of Supply Capacity Using the Conventional Approach

The reserve margin is secured for 10% in FY 2024 and 2025 in every area and for all months.

・ Evaluation of Energy Supply

The energy supply in some months of FY 2024 is expected to be 1.3 TWh/month in volume less than the forecast energy requirement (equivalent to 1.8% against the forecast energy requirement).

・ Despite the coordination of scheduled maintenance among generation facilities in the capacity market scheme and the supply plan, the annual EUE of the Hokkaido, Tokyo, and Kyushu service areas for FY 2025 exceeds the target outage volume. The reasons are attributable to the following conditions:

- The revised annual EUE is more severe than the EUE used for coordinating scheduled maintenance among generation facilities due to the greater accuracy of reliability evaluations and reviews of the calculation of necessary capacities under severe weather.[25]
- Scheduled maintenance among generation facilities is coordinated based on the premise that part of the supply capacity—equivalent to 2% of the forecast peak demand—is planned to be procured at the incremental auction of the capacity market.

For FY 2025, the Organization shall coordinate with the government and corresponding EPCOs regarding supply–demand measures (e.g., the coordination of maintenance schedules), considering the necessity of the incremental auction discussed in the governmental council and its results.

In supply plans beyond FY 2026, the Organization shall carefully re-examine the supply capacity based on continuous observations of generation facility development in the mid-to-long term. It will also determine the necessity of incremental auctions as required with coordinated maintenance schedule results implemented two years in advance for the actual supply.

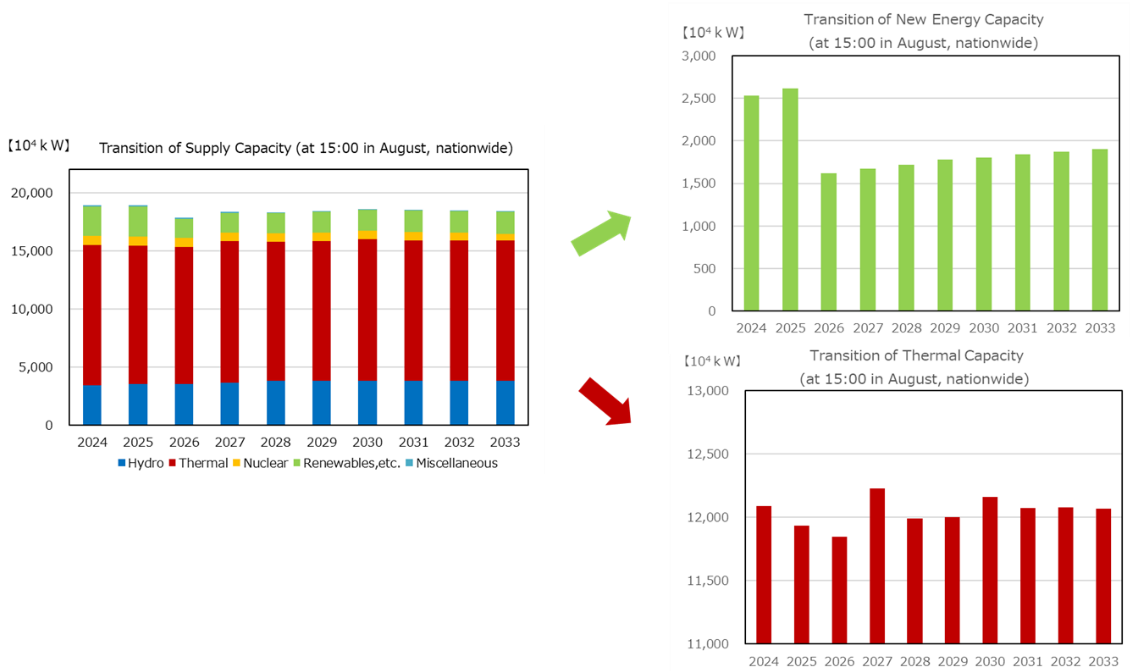
[25] As one requirement of stable generators contracted in the main auction of the capacity market, the maintenance schedule of generation facilities shall be coordinated, among other reasons, to secure reliability in each area and month two years before the actual supply.

[Reference] Detailed Analysis of the Aggregation:

a. Transition of Supply Capacity by Generation Sources

Figure 2-6 presents the power generation sources' supply capacity (nationwide in August) in the projected period.

The supply capacity of new energy, among others, is projected to decrease temporarily in FY 2026 due to the calculation using an annual adjustment factor after that year; however, it is projected to increase thereafter. Furthermore, thermal power is projected to decrease until FY 2026 due to the suspension and decommissioning of generation facilities. Lastly, supply capacity is projected to increase until FY 2025 and then to remain almost the same.



Aggregated value submitted by each electric power company

New Energy, etc: Wind, Solar, Geothermal, Biomass and Waste, classified by "Guideline for the Calculation of Demand and Supply Capacity" (Agency for Natural Resources and Energy: Dec. 2011)

Renewable Energy : New Energy and Hydro

Figure 2-6 Transition of Supply Capacity by Generation Sources

b. Transition of Suspended Thermal Power Plants

Figure 2-7 presents mid-to-long-term projections of suspended thermal power plants (6–12 GW), which are not counted as part of the supply capacity due to long-term planned outages. While they tend to increase until FY 2026, the suspended capacity is projected to decrease for FY 2027 due to the resumption of operations following suspension for 1 year.

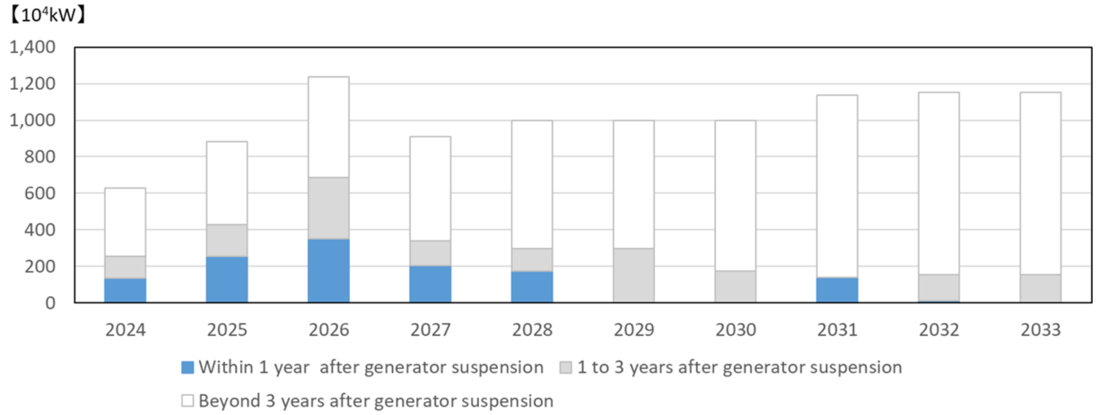


Figure 2-7 Projections of Suspended Thermal Power Plants

III. Analysis of the Transition of Power Generation Sources

This chapter's analysis is based on the automatic aggregation of values submitted by EPCOs. These values will not necessarily be realized in the future due to the operating conditions of power plants or actions due to political measures.

1. Transition of Power Generation Sources (Capacity)

The installed power generation capacity is the automatic aggregation of the capacity of an electric power plant's capacity owned by EPCOs and feed-in-tariff generators owned by companies (other than EPCOs) registered as procurers of the supply capacity for retail, specified wholesale suppliers, and GT&D companies in the projected period. For EPCOs' development plans, only generation facilities with a given probability of development are included in the calculation; however, not all development plans will necessarily be realized. In the future, inefficient facilities will proceed toward being decommissioned due to political measures.

The installed generation capacity by a power generation source submitted by EPCOs is calculated according to the following concepts:

*1 Hydro and Thermal[26]

For existing facilities, the generation company aggregates the generation facility that it owns. For a newly installed facility, a generation facility such as one that proceeds with its environmental assessment or publishing of its commercial operation, is included in the aggregation.

*2 Nuclear

The generation company aggregates its generation facilities with actual operation experience, along with 33 units for which the date for resuming operations is uncertain. Any facilities that have terminated their operations are excluded.

*3 Solar and Wind

The GT&D company aggregates the projected value of the generation facility's integration according to a preliminary consultation and the available connecting capacity of its transmission lines or the actual growth trend of integration.

Table 3-1 and Figure 3-1 present the transition of the installed power generation capacity by a power generation source. The EPCO submission values are automatically aggregated based on the abovementioned concepts.

[26] The same concept is applied to geothermal, biomass, and waste power generation sources as well as storage facilities.

Table 3-1 Composition of the Transition of Installed Power Generation Capacities by Power Generation Source (Nationwide, 10^4 kW)

Power Generation Sources		2023	2024	2028	2033
Thermal*1		14,880	15,018	14,755	14,946
	Coal	5,221	5,196	5,005	4,995
	LNG	7,942	8,178	8,156	8,354
	Oil and others[27]	1,717	1,645	1,594	1,598
Nuclear*2		3,308	3,308	3,308	3,308
Hydro and Renewables		13,752	14,116	16,065	17,803
	Conventional Hydro	2,192	2,196	2,210	2,219
	Pumped Storage	2,734	2,734	2,734	2,734
	Wind*3	562	621	1,257	1,798
	Solar*3	7,465	7,737	8,877	10,055
	Geothermal*1	50	50	54	55
	Biomass*1	591	645	738	740
	Waste*1	132	106	98	93
	Storage(battery)*1	24	28	97	109
Miscellaneous		204	252	58	58
Total		32,144	32,695	34,186	36,116

Note: The totals are not necessarily equal due to independent rounding.

*1 The Organization automatically aggregates the value of the generation facility owned by the generation company; however, not all development plans will necessarily be realized. In the future, inefficient facilities will be retired due to actions related to political measures. For newly installed facilities, generation facilities (e.g., proceeding with environmental assessments or publishing commercial operations) are included in the aggregation.

*2 Included are facilities with actual operation experience along with 33 units for which the date for resuming operations is uncertain; operation-terminated facilities are excluded.

*3 The GT&D company aggregates the projected value of integrating the generation facility according to a preliminary consultation and the available connecting capacity of its transmission lines or the actual growth trend of integration.

[27] The category of "oil and others" includes the total installed capacities from oil, LPG, and other gas and bituminous mixture fired capacities.

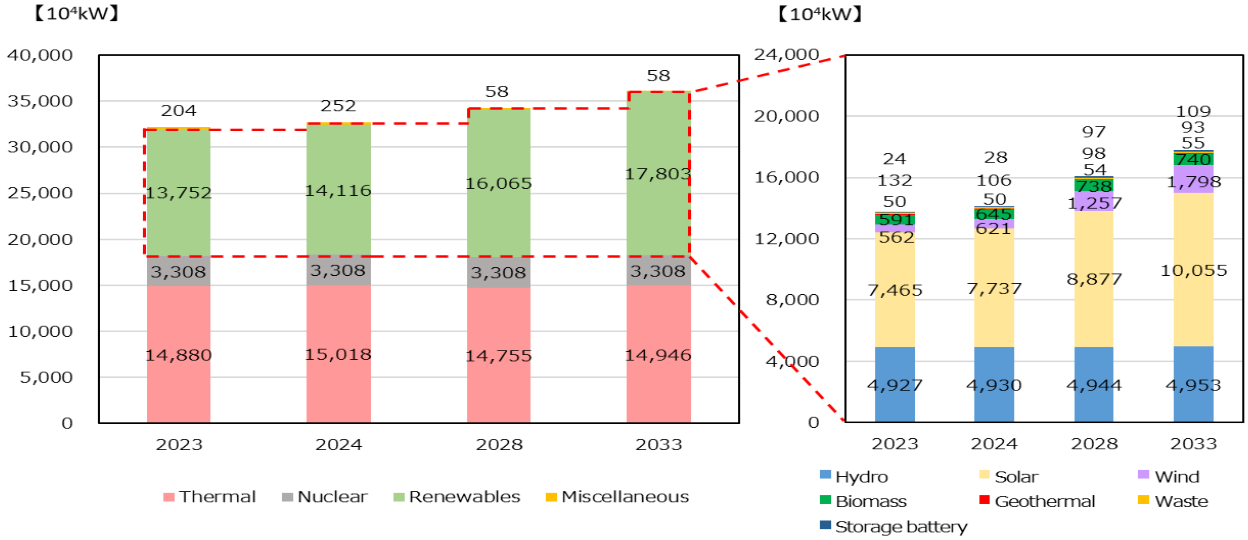


Figure 3-1 Transition of Installed Power Generation Capacities by Power Generation Sources (Nationwide)

* The sum of each power generation source's installed generation capacity is an aggregation of the values submitted by EPCOs.

2. Installed Power Generation Capacity for Each Regional Service Area

Figure 3-2 presents each regional service area's installed power generation capacity at the end of FY 2023.

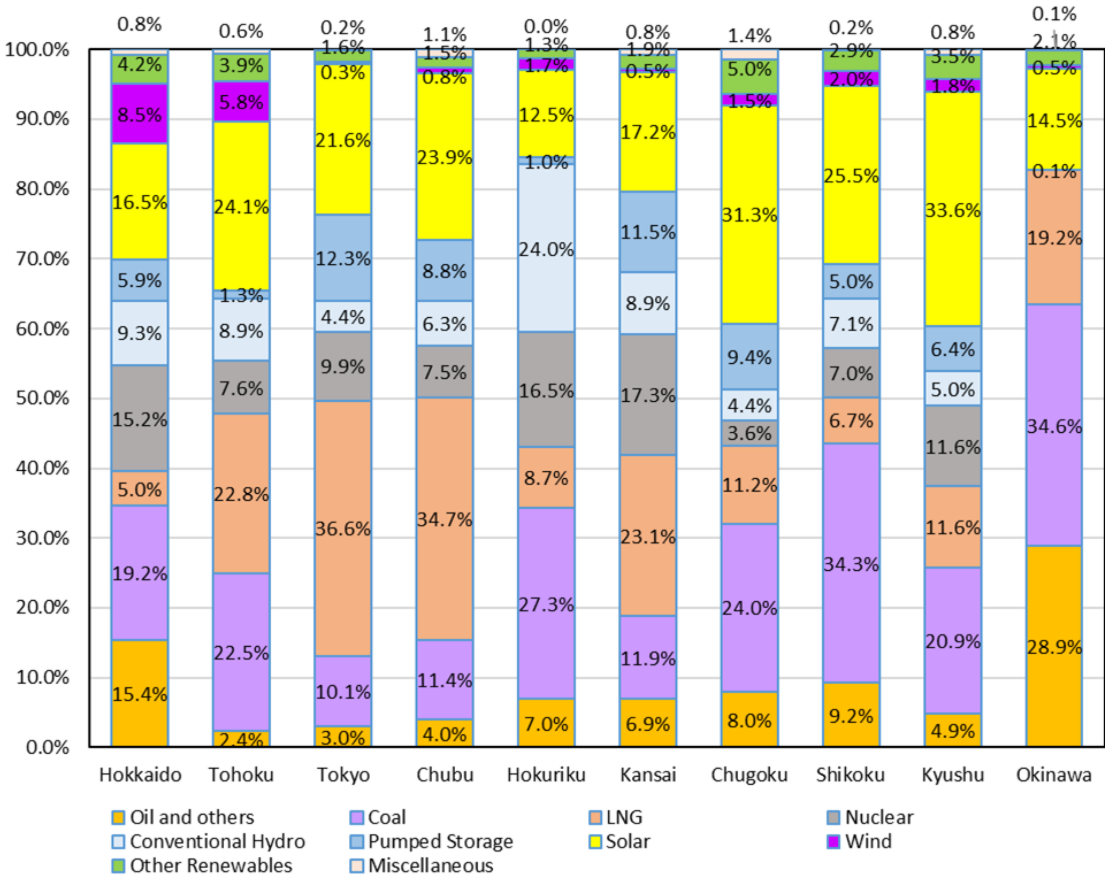


Figure 3-2 Composition of Installed Power Generation Capacity (kW) for Each Regional Service Area

* Each source's installed power generation capacity ratio is calculated by automatically aggregating the values.

3. Transition of Solar and Wind-Generation Capacities

Figure 3-3 presents the projection of integrated solar and wind-generation capacities for each regional service area (at the end of the indicated FY[28]):

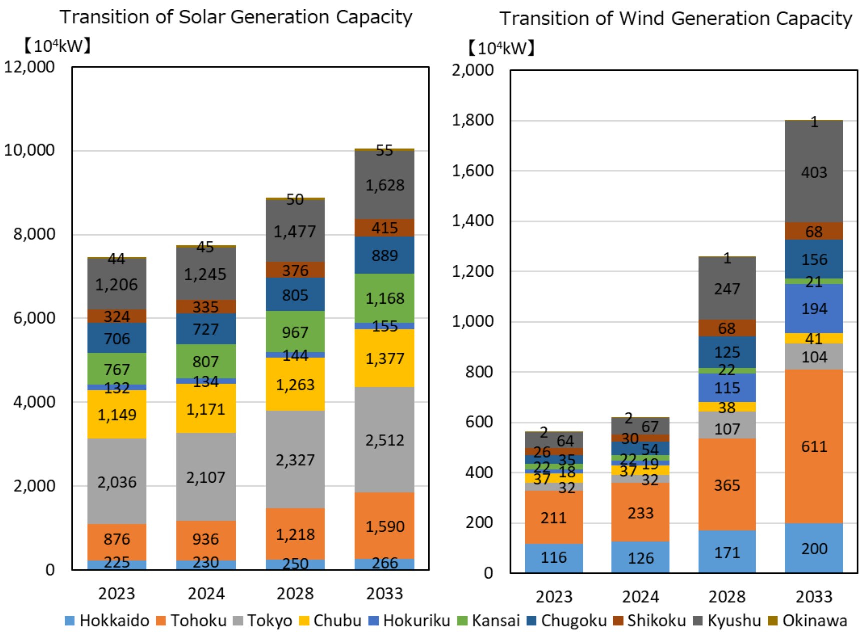


Figure 3-3 Transition of Solar and Wind Generation Capacities for Each Regional Service Area

[28] The GT&D company of each regional area aggregates the projected value of generation facility integration according to preliminary consultations for generator interconnection and the available connecting capacity of its transmission lines or the actual growth trend of integration.

4. Development Plans According to the Power Generation Source

Table 3-2 presents the development plans[29] of generation companies up to FY 2033, according to each one's new developments, uprated or derated installed facilities, and planned decommissioning of facilities in the projected period.

Table 3-2 Generation Development Plans up to FY 2033 by Stages (Nationwide, 10^4 kW)

Power Generation Sources		New Installation		Uprating/Derating		Decommission	
		Capacity	Sites	Capacity	Sites	Capacity	Sites
Hydro		**27.2**	**45**	**7.8**	**58**	**△3.5**	**11**
	Conventional	27.2	45	7.8	58	△3.5	11
	Pumped Storage	—	—	—	—	—	—
Thermal		**656.5**	**32**	—	—	**△483.0**	**42**
	Coal	—	—	—	—	△162.9	8
	LNG	641.4	13	—	—	△229.5	8
	Oil	15.1	19	—	—	△90.7	26
	LPG	—	—	—	—	—	—
	Bituminous	—	—	—	—	—	—
	Other Gas	—	—	—	—	—	—
Nuclear		**1,018.0**	**7**	**15.2**	**1**	—	—
Renewables		**1,023.4**	**331**	**0.2**	**1**	**△48.9**	**81**
	Wind	562.2	80	—	—	△33.2	43
	Solar	257.4	175	—	—	△6.0	28
	Geothermal	6.0	4	—	—	—	—
	Biomass	119.3	35	—	—	△3.4	3
	Waste	8.0	6	0.2	1	△6.4	7
	Storage(battery)	70.5	31	—	—	—	—
Total		**2,725.1**	**415**	**23.3**	**60**	**△535.5**	**134**

Note: The totals are not necessarily equal due to independent rounding to two decimal places.

[29] These are aggregated, including facilities for which the commercial operation date is "uncertain."

[Reference] Transition of New and Added Installation, Suspension, and Decommissioning of Thermal Power Plants:

Figure 3-4 presents the aggregated capacity of thermal power plants for the coming 10 years, which offsets the new and added installation as well as suspension with decommissioning. A comparison is made between the 2023 and 2024 Supply Plans.

The offset capacity increases in FY 2024 due to the increase in new and added installations. After FY 2025, the offset capacity will decrease due to an increase in suspension and decommissioning. For FY 2027, the resumption of operation capacity will offset the suspension and decommissioning capacity; however, the offset capacity will remain flat in the state of greater suspension and decommissioning compared with new and added installations.

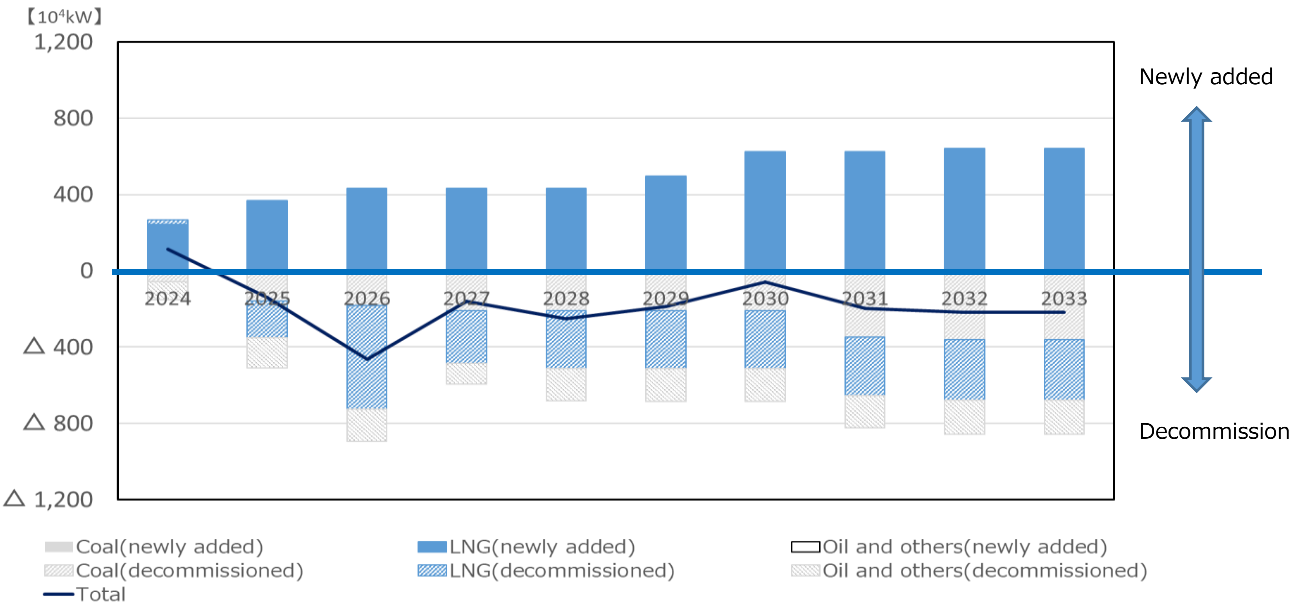


Figure 3-4 New and Added Installation, Suspension, and Decommissioning of Thermal Power Plants (Capacity, Aggregation from FY 2024)

5. Transition of Balancing Capacity

From the FY 2024 Supply Plan, the Organization requests the submission of a balancing capacity plan (e.g., output variance) to the generation company that owns such power plants. Figure 3-5 presents the transition of balancing capacity for the actual and projected figures:

Regarding the balancing capacity, increases and decreases are observed every year; however, almost the same level will be maintained as the actual figure from FY 2023. The balancing capacity is mainly composed of thermal power plants (coal and LNG-fired) and pumped-storage hydropower plants, and the same composition will remain at a similar level for the next decade. In addition, storage (battery) facilities will gradually increase.

Figure 3-5 aggregates the output variance submitted in the plan regarding balancing capacity. The method for calculating the output variance is based on the description in the "Guidelines for the Calculation of Demand and Supply Capacity" (Agency for Natural Resources and Energy: December 2023) and the "Procedures for Electricity Supply Plans of FY 2024" (Agency for Natural Resources and Energy: December 2023)

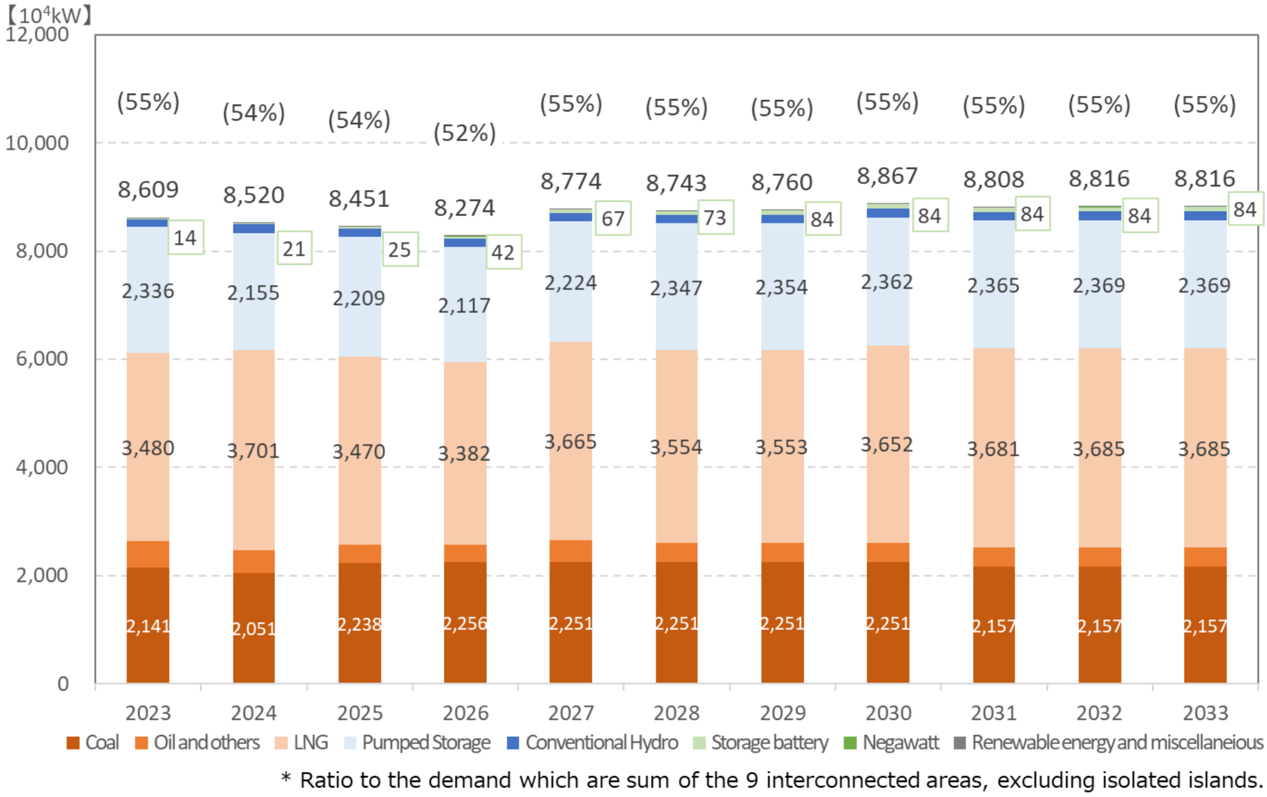


Figure 3-5 Transition of the Balancing Capacity

[Reference] Net Electrical Energy Generation (at the Sending End):
The net electrical energy generation (at the sending end) for the projected period is an estimation[30] of values calculated by the power generation source in each premise for each generation company. This estimation is not necessarily the same as net electrical energy generation.

Each generation company submits its electrical energy generation value, which is the sum of the energy generated by available generation facilities in the projected period. This amount is automatically summed in the merit order of operational cost. Furthermore, the value is based on future energy sales led by actual sales and future sales contracts without considering the effect of regulatory measures.

This estimation of net electrical energy generation may change according to the operating conditions of nuclear power plants, changes in generation sources (specified as "miscellaneous" in future trends), and the energy output's shedding of inefficient coal-fired thermal power generation according to the regulatory measures for generation efficiency promulgated under the Energy Conservation Act. Thus, the estimation is not necessarily the same as the electrical energy generation in the future and is likely to approximate the target value of the country's energy mix.
The calculation method and results of net electrical energy generation by power generation source are stated as follows:

(1) Renewables (Table 3-3)
For solar and wind power, each GT&D company calculates its energy generation based on the aggregation of projected values of generation facility integration according to the preliminary consultation and available connecting capacity of its transmission lines or the actual growth trend of the integration. For geothermal, biomass, and waste power generation sources, the company calculates its energy generation based on its development plan.

Table 3-3 Composition of the Transition of Electrical Energy Generated by Renewable Generation Sources
(Nationwide, at the Sending End; 10^8 kWh)

Generation Source		2023	2024	2028	2033
Renewables		1,415	1,508	1,827	2,059
	Wind	108	119	217	324
	Solar	918	951	1,072	1,184
	Geothermal	26	26	30	31
	Biomass	317	373	462	474
	Waste	44	33	31	30
	Storage(battery)	1	5	15	16

[30] This estimation includes the electrical energy generated from generation facilities owned by generation companies and generation facilities, such as FIT generators, which retail companies, specified wholesale suppliers, and GT&D companies procure from sources other than non-EPCO companies.

(2) Hydro and Thermal (Table 3-4)

Each generation company calculates its energy generation based on its development plan. For thermal power generation, the energy generated from coal-fired thermal power, which has relatively low operation costs, has a large share due to its merit order ranking (by operation cost) without considering the effect of regulatory measures.

Table 3-4 Composition of the Transition of Electrical Energy Generated by Hydro and Thermal Generation Sources (Nationwide, at the Sending End; 10^8 kWh)

Generation Source		2023	2024	2028	2033
Hydro		793	795	840	857
	Conventional	696	744	793	801
	Pumped Storage	98	50	47	56
Thermal		5,886	5,784	5,493	5,260
	Coal	2,631	2,793	2,813	2,545
	LNG	2,995	2,781	2,475	2,490
	Oil and others [27]	260	211	206	226

(3) Nuclear (Table 3-5)

The generation company calculates its energy generation based on the plan developed for units that resumed operations at the end of February 2024.

Table 3-5 Composition of the Electrical Energy Transition Generated by Nuclear Generation Sources (Nationwide, at the Sending End; 10^8 kWh)

Generation Source	2023	2024	2028	2033
Nuclear	799	756	690	527

Table 3-6 sums items (1), (2), and (3) from above with “miscellaneous” energy generation.

Table 3-6 Composition of the Electrical Energy Transition Generated by All Generation Sources (Nationwide, at the Sending End; 10^8 kWh)

	2023	2024	2028	2033
Total	8,900	8,853	8,858	8,711

[Reference] Net Electrical Energy Generation for Each Regional Service Area:

Figure 3-6 presents each regional service area's net electrical energy generation in FY 2023:

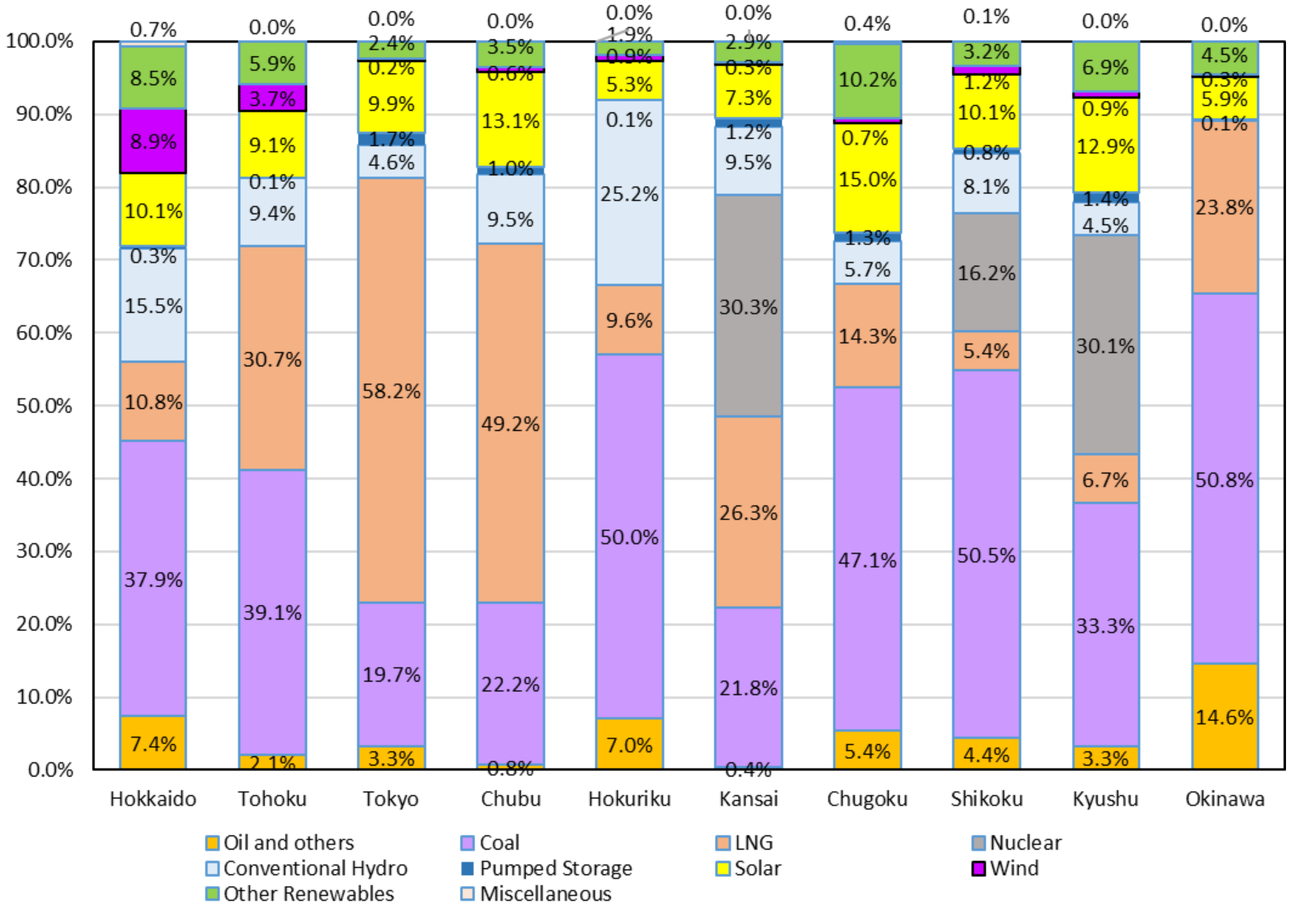


Figure 3-6 Composition of the Net Electrical Energy Generation (kWh) for Each Regional Service Area

[Reference] Transition of Capacity Factors by Power Generation Sources:

Table 3-7 and Figure 3-7 present the capacity factors by sources of power generation. The projection of the capacity factors is automatically calculated using the power generation sources and net electrical energy generation data provided to the Organization.

As noted, these values are calculated from a given projection; the capacity factors in this chapter differ from those in actual operations.

Table 3-7 Capacity Factors by Power Generation Source (Nationwide)

Power Generation Sources		2023	2024	2028	2033
Hydro		18.3%	18.4%	19.4%	19.8%
	Conventional	36.1%	38.7%	41.0%	41.2%
	Pumped Storage	4.1%	2.1%	1.9%	2.4%
Thermal		45.0%	44.0%	42.5%	40.2%
	Coal	57.4%	61.4%	64.2%	58.2%
	LNG	42.9%	38.8%	34.6%	34.0%
	Oil and others [27]	17.2%	14.6%	14.7%	16.1%
Nuclear		27.5%	26.1%	23.8%	18.2%
Renewables		18.3%	18.7%	18.8%	18.3%
	Wind	21.9%	22.0%	19.7%	20.6%
	Solar	14.0%	14.0%	13.8%	13.4%
	Geothermal	59.2%	60.1%	64.5%	64.1%
	Biomass	61.0%	66.1%	71.4%	73.2%
	Waste	38.3%	35.7%	35.5%	36.1%
	Storage(battery)	6.7%	18.7%	17.2%	16.8%

* These values are calculated from a given projection; note that the capacity factors in this chapter differ from those in actual operations.

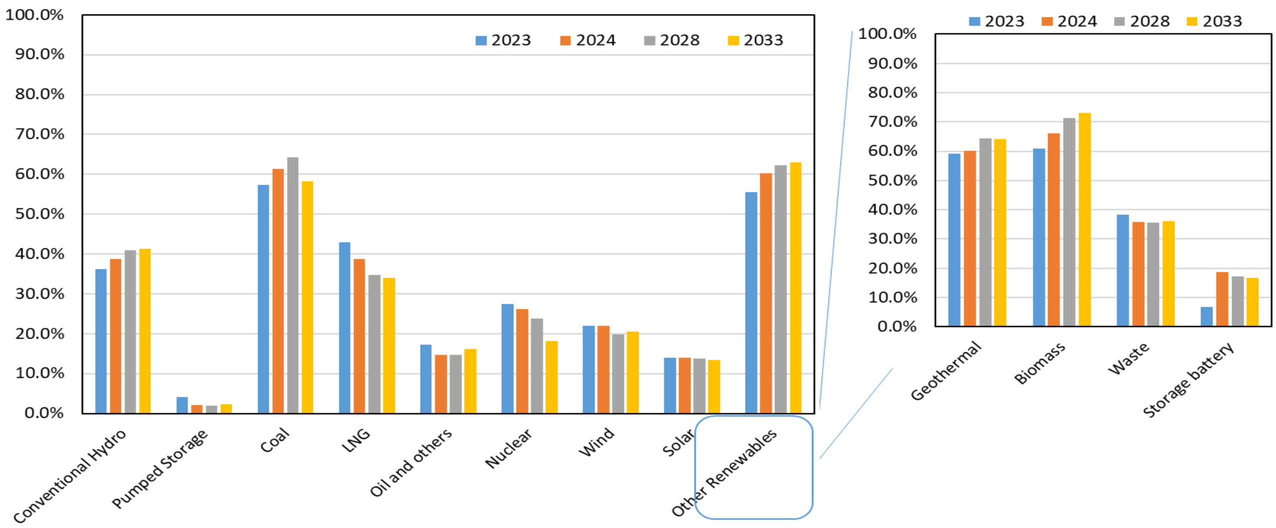


Figure 3-7 Capacity Factors by Power Generation Source (Nationwide)

IV. Development Plans for Transmission and Distribution Facilities

The Organization aggregates development plans[31] for cross-regional transmission lines and substations (transformers and AC/DC converters) up to FY 2033, as submitted by GT&D and transmission companies. Table 4-1 presents the development plans for cross-regional transmission lines and substations, while Figure 4-1 presents the outlook for nationwide electric systems. Items (1), (2), and (3) below list the development plans according to cross-regional transmission lines, major substations, and summaries, respectively.

Table 4-1 Development Plans for Cross-Regional Transmission Lines and Substations[32]

Increased Length of Transmission Lines [33]*[34]		443km (439 km)
	Overhead Lines*	356 km (381 km)
	Underground Lines	87 km (58 km)
Uprated Capacities of Transformers		30,648 MVA (30,163 MVA)
Uprated Capacities of AC/DC Converters [35]		1,200 MW (1,200 MW)
Decreased Length of Transmission Lines (Decommission)		△94 km (△104 km)
Derated Capacities of Transformers (Decommission)		△6,300 MVA (△5,600 MVA)

Enhancement plans for cross-regional transmission lines are summarized below.

Interconnection Facility Enhancement Plan Between Hokkaido and Honshu
(900 MW → 1,200 MW; in service: March 2028)

AC/DC Converter Stations	・Hokuto Converter Station: 300 MW→600 MW ・Imabetsu Converter Station: 300 MW→600 MW
275 kV DC Lines	・Hokuto Imabetsu DC Interconnection Line: 122 km ・Imabetsu Bulk Line extension: 50 km

[31] Development plans for transmission lines and substations must be submitted for voltages higher than 250 kV or within two classes of the highest voltage available in the regional service areas. (For the Okinawa EPCO, the requirement applies only for 132 kV or higher.) The totals are not necessarily equal due to independent rounding.
[32] The figures in parentheses are those from the previous year.
[33] Development plans corresponding to changes in the line category or circuit numbers that were not included when measuring the increased length of transmission lines were treated as "no change in the length of transmission lines."
[34] Increased length does not include the item with * because of an undetermined in-service date.
[35] The DC transmission system includes the installed capacity for the converter station on one side.

Interconnection Facility Enhancement Plan Between Tohoku and Tokyo
(in service: November 2027)

500kV Transmission Lines	・Miyagi-Marumori Bulk Line: 79 km ・Marumori-Iwaki Bulk Line: 64 km ・Soma-Futaba Bulk Line/ Connecting Point Change: 16 km ・Shinchi Access Line/ Miyagi-Marumori Switching Station lead-in: 1km ・Joban Bulk Line/ Miyagi-Marumori Switching Station Dπ lead-in: 1 km ・Fukushima Bulk Line/Mountain Line connecting point change: 1 km
Switching Stations	Miyagi-Marumori Switching Station: 10 circuits

Interconnection Facility Enhancement Plan Between Tokyo and Chubu
(2,100 MW→3,000 MW; in service: FY 2027)

Frequency Converter Stations	・Shin Sakuma FC station: 300 MW ・Higashi Shimizu Substation: 300 MW→900 MW
275 kV Transmission Lines	・Higashi Shimizu Line: 19 km ・Sakuma Higashi Bulk Line/ FC Branch Line: 3 km ・Sakuma-Toei Line/ FC Branch Line: 1 km ・Shin Toyone-Toei Line: 1 km ・Sakuma-Toei Line: 11km, 2km ・Sakuma Higashi Bulk Line: 123 km
500 kV Transformers	・Shin Fuji Substation: 750 MVA×1 ・Shizuoka Substation: 1,000 MVA×1 ・Toei Substation: 800MVA×1 →1,500 MVA×2
275 kV Transformers	・Shin Fuji Substation: 200MVA×1→0 MVA

Interconnection Facility Enhancement Plan Between Chubu and Kansai
(in service: not determined)
* Under review in the Cross-Regional Transmission Line Development Process[36]

500 kV Transmission Lines	・Sekigahara-Kita Oomi Line: 2 km ・Sangi Bulk Line/ Sekigahara Switching Station π lead-in: 0.2 km ・Kita Oomi Line/ Kita Oomi Switching Station π lead-in: 0.5 km
Switching Stations	・Sekigahara Switching Station: 6 circuits ・Kita Oomi Switching Station: 6 circuits

Interconnection Facility Enhancement Plan Between Chubu and Hokuriku
(To be decommissioned: Apil 2026)

BTB Converter Station Decommission	Minami Fukumitsu Converter Station: 300 MW→0 MW

[36] The planning process for cross-regional transmission lines is applied to the specific development plan of the master plan and implemented based on the long-term cross-regional development policy, power flows of cross-regional interconnection lines, and replacement plans of cross-regional transmission lines.

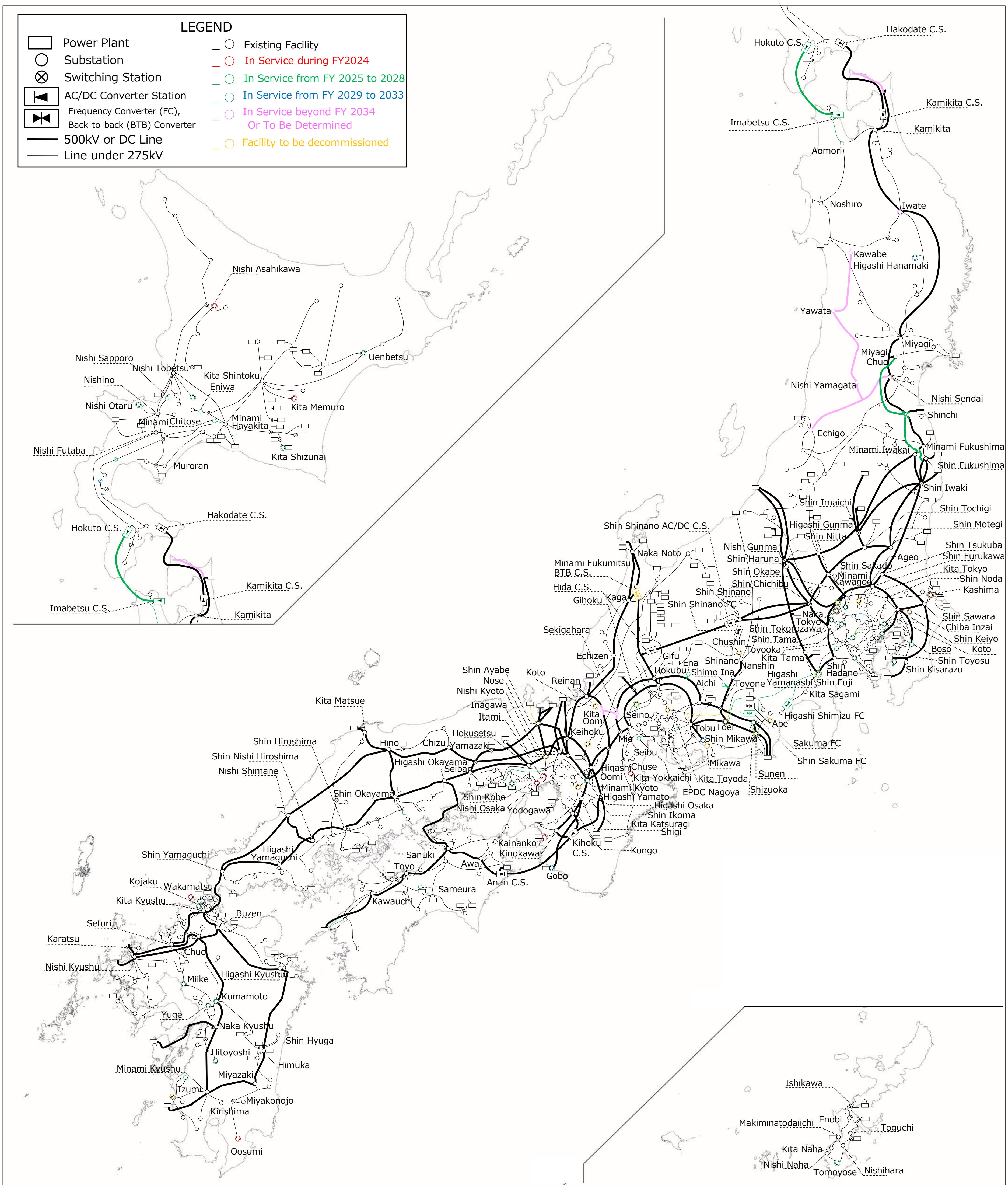


Figure 4-1 Power Grid Configuration in Japan

1. Development Plans for Major Transmission Lines

Table 4-2 Development Plans Under Construction

Company	Line[37]	Voltage	Length[38,39]	Circuit	Under construction	In service	Purpose[40]
Hokkaido Electric Power Network, Co., Inc.	Hokuto-Imabetsu DC Interconnection Line	DC-250 kV	98 km*3 24 km*2,3	1→2	Oct. 2023	Mar. 2028	Reliability upgrade*4
Tohoku Electric Power Network Co., Inc.	Soma-Futaba Bulk Line/connecting point change	500 kV	16 km	2	Sep. 2022	Apr. 2026(No.1) Jun. 2026(No.2)	Generator connection, Reliability upgrade*4
	Dewa Bulk Line	500 kV	96 km	2	Jun. 2022	Beyond FY 2031	Generator connection
	Miyagi-Marumori Bulk Line	500 kV	79 km	2	Sep. 2022	Nov. 2027	Generator connection, Reliability upgrade*4
	Miyagi-Marumori Switching Station	500 kV	-	10	Oct. 2022	Nov. 2027 (May 2026)	Generator connection, Reliability Upgrade*4
	Imabetsu Bulk Line extension	275 kV	50 km*3	2	Apr. 2023	Nov. 2027	Generator connection, Reliability upgrade, Aging Management*4
	Plant A Branch Line*1	275 kV	0.2 km	1	Jun. 2023	May 2024	Generator connection
	Akita-Kawabe Branch Line	275 kV	5 km	2	Aug. 2023	Beyond FY 2029	Generator connection
TEPCO Power Grid, Inc.	Shinjuku Line replacement	275 kV	22 km→ 21 km(No.1) 20 km→ 21 km(No.2) 20 km→ 21 km(No.3) *2*3	3	Sep. 2019	Aug. 2030(No.1) Nov. 2032(No.2) Dec. 2027(No.3)	Aging management
	Chiba Inzai Line	275 kV	11 km	2	Jun. 2020	May 2024	Demand coverage
	Johoku Line	275 kV	21 km*2	3	Sep. 2022	Feb. 2030	Economic upgrade
	Higashi Shimizu Line	275 kV	12 km 6 km (diversion)	2	Apr. 2023	Jan. 2027	Reliability upgrade*4
Chubu Electric Power Grid Co., Inc.	Shimo Ina Branch Line	500 kV	0.3 km	2	Jan. 2022	Oct. 2027	Demand coverage
	Ena Branch Line	500 kV	1 km	2	Sep. 2020	Oct. 2025	Demand coverage
	Higashi Nagoya -Tobu Line	275 kV	8 km*3	2	Apr. 2019	Nov. 2025	Aging management, Economic upgrade
Kansai Transmission & Distribution, Inc.	Himeji Access Line*1	275 kV	0.8 km*2	2	Mar. 2021	Jan. 2025	Generator connection
	Shin Kakogawa Line extnsion	275 kV	25 km*3	2	Jul. 2021	Jun. 2025	Generator connection, Aging management
	Himeji Access East Line improvement*1	275 kV	18 km→ 18 km*3	2	Feb. 2022	Dec. 203	Aging management

37 *1 denotes the line renamed not to be identified as the fuel of the connecting power plant.
38 *2 denotes “underground,” otherwise “overhead.”
39 *3 denotes that changes in line category and circuit number are not included in Table 4-1.
40 *4 indicates enforcement related to cross-regional interconnection lines.
*5 indicates that the case is under review in the cross-regional development master plan.

Demand coverage	Related to increase/decrease demand
Generator connection	Related to generator connection or decommission
Aging management	Related to aging management of facilities (including the proper update of facilities and with evaluation of obsolescence
Reliability upgrade	Related to improvement in the reliability or security of stable supply
Economic upgrade	Related to improvement in economies, such as reducing transmission loss, facility downsizing, or upgrading the stability of the system

Company	Line[37]	Voltage	Length[38,39]	Circuit	Under construction	In service	Purpose[40]
Shikoku Electrc Power Transmission & Distribution, Inc.	Ikata North Bulk Line	187 kV	19 km*3	2	Jan. 2024	Sep. 2028	Aging management
Kyushu Electric Power Transmission & Distribution Co., Inc.	Hibiki-Wakamatsu Line	220 kV	4 km	2	May 2023	Apr. 2025	Generator connection
	Shin Kokura Line	220 kV	15 km→ 15 km*2*3	3→2	May 2021	Oct. 2029	Aging management
J-POWER Transmission Network Co.,Ltd.	Ooma Bulk Line	500 kV	61 km	2	Jun. 2006	TBD	Generator connection
	Sakuma Higashi Bulk Line	275 kV	124 km→ 123 km*3	2	Jul. 2022	Mar. 2027(No.1) Apr. 2027(No.2)	Reliability upgrade*4
	Sakuma Higashi Bulk Line/ FC Branch Line	275 kV	3 km	2	Oct. 2023	Sep. 2027	Reliability upgrade*4
	Sakuma-Toei Line/ FC Branch Line	275 kV	1 km	2	Oct. 2023	Sep. 2027	Reliability upgrade*4
	Shin Toyone-Toei Line	275 kV	1 km	1	Oct. 2023	Aug. 2027	Reliability upgrade*4
	Sakuma-Toei Line	275 kV	11 km→ 11 km*3	2	Oct. 2023	Aug. 2027	Reliability upgrade*4
	Sakuma-Toei Line	275 kV	2 km	2	Oct. 2023	Aug. 2027	Reliability upgrade*4
Fukushima Souden	Abukumananbu Line	154 kV	24 km*2	1	Jul. 2020	Jun. 2024	Generator connection

Table 4-3 Development Plans in Planning Stages

Company	Line[37]	Voltage	Length[38,39]	Circuit	Under construction	In service	Purpose[40]
Hokkaido Electric Power Network, Inc.	Branch Line E *1	187 kV	2.4 km	2	May 2024	Aug. 2028	Demand coverage
	Branch Line F *1	275 kV	7.9 km	2	May 2024	Aug. 2028	Demand coverage
	Branch Line G *1	187 kV	5.8 km	2	May 2024	Aug. 2028	Demand coverage
	(prov.) Plant H Access Line*1	275 kV	0.1 km	1	Apr. 2026	Jul. 2027	Genrator connection
	(prov.) Minami Chitose UG Line	187 kV	13 km*2	2	Sep. 2024	Oct. 2027	Generator connection
	Kita Oshamanbe Switching Station	187 kV	-	5	Oct. 2024	Aug. 2028	Generator connection
	Hakodate Bulk Line/ Kita Oshamanbe S.S. π lead-in*1	187 kV	0.7 km	2	Jun. 2026	Aug. 2028	Generator connection
	(prov.) 187kV Nishi Yakumo Switching Station	187 kV	-	5	Oct. 2025	Aug. 2028	Generator connection
	(prov.) Hakodate Bulk Line/ 187kV Nishi Yakumo Switching Station	187 kV	0.1 km	2	Oct. 2027	May 2029	Generator connection
Tohoku Electric Power Network Co., Inc.	Marumori-Iwaki Bulk Line	500 kV	64 km	2	Apr. 2024	Nov. 2027	Generator connection, Reliability upgrade*4
	Joban Bulk Line/ Miyagi-Marumori Switching Station Dπ lead-in	500 kV	1 km	2	Jun. 2024	May 2026 (No.1) Jul. 2026 (No.2)	Generator connection, Reliability upgrade*4
	Shinchi Access Line/ Miyagi-Marumori Switching Station lead-in*1	500 kV	1 km	2	Sep. 2024	May 2026 (No.1) Jul. 2026 (No.2)	Generator connection, Reliability upgrade*4

Company	Line[37]	Voltage	Length[38,39]	Circuit	Under construction	In service	Purpose[40]
Tohoku Electric Power Network Co., Inc.	Yamagata Bulk Line uprating/ extension	275kV→500kV	53 km→103 km	2	Beyond FY 2026	Beyond FY 2031	Generator connection
	Northern Akita Prefecture HS Line	275 kV	0.2 km*2	2	Jul. 2024	Mar. 2028	Generator connection
	Akimori-Kawabe Branch Line	275 kV	0.3 km	2	Beyond FY 2027	Beyond FY 2029	Generator connection
	Asahi Bulk Line uprating	275kV→500kV	139km→138km	2	Beyond FY 2028	Beyond FY 2030	Generator connection
	Minami Yamagata Bulk Line uprating	275kV→500kV	23 km→23 km	2	Beyond FY 2029	Beyond FY 2030	Generator connection
TEPCO Power Grid, Inc.	Higashi Shinjuku Line replacement	275 kV	23km→5km (No.2) 23km→5km (No.3)*2*3	2	FY 2026	Nov. 2032 (No.2) Dec. 2027 (No.3)	Aging management
	MS18GHZ051500 Access Line (prov.)	275 kV	0.1 km	2	Mar. 2025	Jun. 2026	Generator connection
	G5100026 Access Line(prov.)	500 kV	0.5 km*2	2	Apr. 2024	Dec. 2028	Generator connection
	Shin Sodegaura Line	500 kV	0.1 km(No.1) 0.1 km(No.2)	2	Jan. 2028	Nov. 2028 (No.1) May 2029 (No.2)	Generator connection, Reliability upgrade
	Fukushima Bulk Line / Mountain Line connecting point change	500 kV	1 km(No.1) 1 km(No.2)	2	Jun. 2024	May 2025 (No.1) Aug. 2025 (No.2)	Generator connection, Reliability upgrade*4
	Kashima Kaihin Line /connecting point change	275 kV	0.2km(No.1) 0.2km(No.2) *2	2	Oct. 2024 (No.1) Sep. 2024 (No.2)	Apr. 2025 (No.1) Nov. 2024 (No.2)	Economic upgrade
	Chiba Inzai Line	275 kV	11 km(No.3) 11 km(No.4)*2	2	Apr. 2024	Feb. 2027 (No.3) Nov. 2025 (No.4)	Demand coverage
	Kita Musashino Line	275 kV	14 km*2, 3	2→3	Sep. 2024	May 2027	Reliability upgrade
Chubu Electric Power Grid Co., Inc.	Kita Yokkaichi Branch Line	275 kV	0.2 km 6 km*2	2	Dec. 2024	Jan. 2029 (No.1) Aug. 2029 (No.2)	Demand coverage, Economic upgrade
	Sekigahara-Kita Oomi Line	500 kV	2 km	2	TBD	TBD	Reliability upgrade *4, *5
	Sekigahara Switching Station	500 kV	—	6	TBD	TBD	Reliability upgrade *4, *5
	Sangi Bulk Line/ Sekigahara Switching Station π lead-in	500 kV	0.2 km	2	TBD	TBD	Reliability upgrade *4, *5
Kansai Transmission & Distribution, Inc.	Kita Oomi Line/ Kita Oomi Switching Station πlead-in	500 kV	0.5 km	2	TBD	TBD	Reliability upgrade *4, *5
	Kita Oomi Switching Station	500 kV	—	6	TBD	TBD	Reliability upgrade *4, *5
	Tsuruga Line/ North side improvement	275 kV	10 km→ 9 km*3	2	TBD	TBD	Aging management
Chugoku Electrc Power Transmission & Distribution, Inc.	Kasaoka Bulk Line extension	220 kV	15 km*3	2	Nov. 2024	Nov. 2027	Demand coverage Generator connection
Kyushu Electric Power Transmission & Distribution, Inc.	Sendai Nuclear North Line	220 kV	1 km→ 1 km	2	Dec. 2025	Nov. 2026	Economic upgrade
J-POWER Transmission Network Co.,Ltd.	Nabari Bulk Line Reihoku-Kunimi san Branch Line(prov.)	187 kV	0.1 km	1	FY 2025	FY 2026	Generator connection

Table 4-4 Decommissioning Plans

Company	Line[37]	Voltage	Length	Circuit	Decommission	Purpose[40]
Hokkaido Electric Power Network, Inc.	Plant D Access Line*1	275 kV	0.6 km	1	Jun. 2023	Generator conncection (withdrawal)
TEPCO Power Grid, Inc.	Kashima Thermal Power Line No.1, No.2	275 kV	△5.0 km	2	Dec. 2024	Economic upgrade
Kansai Electric Power Transmission and Distribution, Inc.	M Line decommission*1	275 kV	△28 km	2	FY 2028	Generator connection
Kyushu Electric Power Transmission and Distribution, Inc.	Sensatsu Switching Station	220 kV	-	4	Nov. 2026	Economic upgrade
J-POWER Transmission Network Co.,Ltd.	Shin Toyone-Toei Line	275 kV	△3 km	1	Apr. 2027	Reliability upgrade*4
	Sakuma Nishi Bulk Line	275 kV	△58 km	2	Apr. 2027	Economic upgrade

2. Development Plans for Major Substations

Table 4-5 Development Plans Under Construction

Company	Substation[41]	Voltage	Capacity	Unit	Under construction	In service	Purpose [40]
Hokkaido Electric Power Network, Inc.	Hokuto C.S.	—	300 MW	—	Sep. 2023	Mar. 2028	Reliability upgrade*4
	Imabetsu C.S.	—	300 MW	—	Sep. 2023	Mar. 2028	Reliability upgrade*4
Tohoku Electric Power Network, Inc.	Higashi Hanamaki	275/154 kV	300 MVA	1	Apr. 2023	Oct. 2028	Demand coverage
TEPCO Power Grid, Inc.	Chiba Inzai*6	275/66 kV	300 MVA×2	2	Jun. 2022	Jun. 2024	Demand coverage
	Kashima	275/66 kV	300 MVA	1	Aug. 2023	Jun. 2024	Generator connection
	Naka Tokyo	275/154 kV	200 MVA→ 300 MVA	2→2	Mar. 2024	Jan. 2025 (1B) Jun. 2025 (2B)	Aging management
Chubu Electric Power Grid Co., Inc.	Shimo Ina*6	500/154 kV	300 MVA×2	2	Oct. 2021	Oct. 2027	Demand coverage
	Ena*6	500/154 kV	200 MVA×2	2	Oct. 2022	Oct. 2027	Demand coverage
	Toei	500/275 kV	800 MVA×1→ 1,500 MVA×2	1→2	Jun. 2022	Oct. 2024 (N 2B) Mar. 2027 (1B)	Reliability upgrade*4
	Higashi Shimizu	—	300 MW→ 900 MW	—	May 2021	Mar. 2028	Reliability upgrade*4
Kansai Transmission and Distribution, Inc.	Itami	275/154 kV	300 MVA	1	Apr. 2023	Jun. 2024	Aging management
	Kainanko	275/77 kV	300 MVA×1、 200 MVA×2→ 300 MVA×2	3→2	Dec. 2022	May 2024	Aging management
	Shin Kobe	275/77 kV	300 MVA×1、 200 MVA×1→ 200 MVA×1	2→1	Feb. 2023	Mar. 2025	Aging management
Kyushu Electric Power Transmission & Distribution Co., Inc.	Yuge	220/110/ 66 kV	300/100/250 MVA	1	Feb. 2024	Jun. 2025	Demand coverage
	Wakamatsu	220/66 kV	250 MVA	1	Jan. 2023	Oct. 2024	Generator connection
	Oosumi	110/66 kV→ 220/110/ 66 kV	60 MVA→ 250/100/ 200 MVA	1→1	Apr. 2022	Feb. 2025	Generator connection
	Kojaku	220/66 kV	150 MVA→ 200 MVA	1→1	Oct. 2023	Jun. 2025	Aging management
The Okinawa Electric Power Co., Inc.	Tomoyose	132/66 kV	125 MVA×2→ 200 MVA×2	1→1	Jul. 2018	Jun. 2026(2B)	Aging management
J-POWER Transmission Network Co.,Ltd.	Minami Kawagoe	275/154 kV	264 MVA×3, 300 MVA×1→ 300 MVA×2, 450 MVA×1	4→3	Sep. 2023	Mar. 2024(6B) Mar. 2025(2B) Mar. 2026(1B)	Aging management
Fukushima souden	Abukumaminami*6	154/66/ 33 kV	170 MVA	1	Sep. 2022	Jun. 2024	Generator connection

[41] A substation with *6 denotes a newly installed substation or a converter station, including an uprated electric facility.

Table 4-6 Development Plans in Planning Stages

Company	Substation [33,37]	Voltage	Capacity	Unit	Under construction	In service	Purpose [36]
Hokkaido Electric Power Network, Inc.	Kita Memuro	187/66 kV	60 MVA→ 150 MVA	1→1	Aug. 2024	Mar. 2025	Aging management
	Nishi Asahikawa	187/66 kV	60 MVA→ 100 MVA	1→1	Apr. 2024	Oct. 2024	Aging management
	Kita Shizunai	187/66/11 kV	45 MVA→ 60 MVA	1→1	May 2024	Nov. 2025	Aging management, Generator connection
	Eniwa	187/66 kV	200 MVA	1	Jul. 2024	Jun. 2025	Demand coverage
	Nishi Sapporo	187/66 kV	200 MVA	1	May 2025	Jun. 2026	Demand coverage
	Nishi Otaru	187/66 kV	100 MVA→ 150 MVA	1→1	Sep. 2025	Jun. 2026	Aging management
	Nishi Otaru	187/66 kV	100 MVA→ 150 MVA	1→1	Nov. 2026	Jun. 2027	Aging management
	Minami Chitose*6	187/66 kV	450 MVA×2	2	May 2025	Oct. 2027	Demand coverage
	Uenbetsu	187/66 kV	75 MVA→ 100 MVA	1→1	Apr. 2026	May 2027	Aging management Generator connection
	Kita Ebetsu	187/66 kV	100 MVA→ 150 MVA	1→1	Jun. 2026	Jul. 2027	Aging management
Tohoku Electric Power Network Co., Inc.	Iwate	500/275 kV	1,000 MVA	1	Beyond FY 2025	Beyond FY 2028	Generator connection
	Echigo*6	500/275 kV	1,500 MVA×3	3	Beyond FY 2025	Beyond FY 2030	Generator connection
	Yawata*6	500/154 kV	750 MVA	1	Beyond FY 2027	Beyond FY 2031	Generator connection
	Kawabe*6	500/275kV	1,500 MVA×3	3	Beyond FY 2025	Beyond FY 2031 (Beyond FY 2029)	Generator connection
	Nishi Yamagata*6	275/154 kV →500/154 kV	300 MVA×2 →450 MVA×2	2→2	Beyond FY 2025	Beyond FY 2031 (Beyond FY 2030)	Generator connection
TEPCO Power Grid, Inc.	Shin Fuji	500/154 kV	750 MVA	1	Jul. 2024	Feb. 2027	Reliability upgrade*4
	Kashima	275/66 kV	200 MVA×2 →300 MVA×2	2→2	Jun. 2025	Feb. 2026 (7B) Feb. 2027 (8B)	Aging management
	Toyooka	275/154 kV	450 MVA	1	Aug. 2024	Jun. 2026	Demand coverage
	Shin Toyosu	275/66 kV	300 MVA	1	Oct. 2024	Jan. 2026	Demand coverage
	Koto	275/66 kV	150 MVA→ 300 MVA	1→1	Oct. 2025	Jun. 2026	Demand coverage
	Kita Sagami	275/66 kV	300 MVA×2	2	Aug. 2024	Jun. 2027	Demand coverage
	Kita Tama	275/66 kV	200 MVA×2 →300 MVA×2	2→2	Feb. 2025	Jun. 2026 (2B) Jun. 2027 (3B)	Aging management
	Chiba Inzai	275/66 kV	300 MVA×2	2	Oct. 2024	Nov. 2025 (4B) Feb. 2027 (1B)	Demand coverage
	Shin Tokorozawa	500/275 kV	1,000,MVA×2 →1,500 MVA×2	2→2	Jun. 2025	Apr. 2026 (4B) Jun. 2027 (5B)	Aging management
	Keihin	275/154 kV	450MVA	1	Apr. 2025	Mar. 2028	Generator connection
	Boso	275/154 kV	200MVA→ 450MVA	1→1	Mar. 2026	Nov. 2027	Demand coverage
	Shin Hanno	500/275 kV	1,500MVA	1	Nov. 2025	Mar. 2029	Demand coverage
Chubu Electric Power Grid Co., Inc.	Nakase	275/77 kV	150 MVA→ 250 MVA	1→1	Oct. 2024	Mar. 2025	Aging management
	Sunen	275/77 kV	150 MVA→ 250 MVA	1→1	Oct. 2025	Dec. 2026	Aging management
	Seino	275/154 kV	300 MVA →450 MVA	1→1	Oct. 2025	Sep. 2026	Aging management
	Shizuoka	500/275 kV	1,000 MVA	1	Feb. 2025	Mar. 2027	Reliability upgrade*4

Company	Substation[33,37]	Voltage	Capacity	Unit	Under construction	In service	Purpose[36]
	Kita Yokkaichi*6	275/154 kV	450 MVA×3	3	Oct. 2024	Jan. 2029	Demand coverage, Economic upgrade
	Shin Mikawa	500/275 kV	1,500 MVA	1	Mar. 2031	Jan. 2033	Generator connection
Kansai Transmission and Distribution, Inc.	Gobo	500/154 kV	750 MVA×2	2	Aug. 2024	Nov. 2027	Generator connection
	Shin Ikoma	275/77 kV	300 MVA				
	Shin Ayabe	500/275 kV →500/77 kV	1,000 MVA				
	Takasago	275/77 kV					
Kyushu Electric Power Transmission & Distribution Co., Inc.	Kumamoto	500/220 kV	1,000 MVA	1	Dec. 2024	Jun. 2027	Demand coverage
	Hitoyoshi	220/110/66kV	300/150/150MVA	1	Feb. 2025	Dec. 2026	Generator connection
	Demizu	220/66 kV	250 MVA	1	Jun. 2026	Nov. 2027	Generator connection
	Miike	220/110/66kV	180/180/120MVA → 250/200/250MVA	1→1	Jan. 2025	Jun. 2026	Aging management
	Hitoyoshi	220/110/66kV	180/180/120MVA → 250/200/250MVA	1	Feb. 2026	Oct. 2027	Aging management
J-POWER Transmission Network Co.,Ltd.	Shin Satkuma FC*6	—	300 MW	—	Mar. 2025	Mar. 2028	Reliability upgrade*4
	Sameura*6	187/13 kV	25 MVA	1	Feb. 2025	Oct. 2025	Demand coverage

Table 4-7 Decommissioning Plans

Company	Substation	Voltage	Capacity	Unit	Decommission	Purpose
TEPCO Power Grid, Inc.	Ageo	275/66 kV	300 MVA	1	Jun. 2024	Economic upgrade
	Shin Fuji	275/154 kV	200 MVA	1	Oct. 2026	Economic upgrade*4
	Shin Tokorozawa	500/275 kV	1,000 MVA	1	Dec. 2027	Aging management
Chubu Electric Power Grid Co., Inc.	Abe	275/77 kV	250 MVA	1	Apr. 2025	Economic upgrade
	Mikawa	275/154 kV	450 MVA	1	Apr. 2025	Aging management
	Minami Fukumitsu	—	300 MW	—	Apr. 2026	Aging management*4
	Seino	275/154 kV	300 MVA	1	Sep. 2026	Aging management
	Chushin	275/154 kV	300 MVA	1	Nov. 2026	Aging management
	Sunen	275/77 kV	150 MVA	1	Feb. 2027	Aging management
Kansai Transmission and Distribution, Inc.	Shin Ayabe	275/77 kV	200 MVA×2, 300 MVA×2	4	Sep. 2029	Aging management
	Koto	275/77 kV	100 MVA×2	2	Oct. 2024	Aging management
	Higashi Osaka	275/154 kV	300 MVA	1	Jul. 2025	Aging management
	Inagawa	500/154 kV	750 MVA	1	Mar. 2026	Aging management
	Konan	275/77 kV	100 MVA	1	Oct. 2025	Aging management
J-POWER Transmission Network Co.,Ltd.	Nagoya	275/154 kV	300 MVA×3	3	Feb. 2025	Economic upgrade

3. Summary of Development Plans for Transmission Lines and Substations

Tables 4-8 to 4-11 summarize the development or extension plans of major transmission lines and substations (transformers and converter stations) up to FY 2032. These are submitted by GT&D and transmission companies.

Table 4-8 Development Plans for Major Transmission Lines

Category	Voltage	Lines	Length [42]	Extended Length [43]	Total Length	Total Extended Length
Newly Installed or Extended	500 kV	Overhead	524 km*	1,047 km*	524 km*	1,048 km*
		Underground	1 km	1 km		
	275 kV	Overhead	△183 km	△366 km	△134 km	△248 km
		Underground	49 km	119 km		
	220 kV	Overhead	4 km	7 km	4 km	7 km
		Underground	0 km	0 km		
	187 kV	Overhead	11 km	21 km	25 km	48 km
		Underground	13 km	27 km		
	154 kV	Overhead	0 km	0 km	24 km	24 km
		Underground	24 km	24 km		
	Total	Overhead	356 km*	709 km*	443 km*	879 km*
		Underground	87 km	171 km		
To be Decommissioned	275 kV	Overhead	△94 km	△185 km	△94 km	△185 km
		Underground	0 km	0 km		
	220 kV	Overhead	0 km	0 km	0 km	0 km
		Underground	0 km	0 km		
	Total	Overhead	△94 km	△185 km	△94 km	△185 km
		Underground	0 km	0 km		

[42] Length denotes the increased length due to newly installed or extended plans and the decreased length due to decommissioning. Development plans corresponding to changes in the line category or number of circuits were not included in the increased length of transmission lines shown in Table 4-8 and are treated as "no change in length." Due to independent rounding, the total and overall lengths are not necessarily equal.

[43] The total length denotes the aggregation of length multiplied by the number of circuits. Development plans that correspond to changes in the line category or number of circuits are not included in the increased length of transmission lines in Table 4-8 and are treated as "no change in length."

Table 4-9 Revised Plans for Line Category and the Numbers of Circuits[44]

Voltage	Length Extended	Total Extended Length
500 kV	0 km	0 km
275 kV	276 km*	587 km*
220 kV	30 km	45 km
187 kV	19 km	38 km
DC 250 kV	122 km	245 km
Total	447 km	914 km

Table 4-10 Development Plans for Major Substations

Category [45]	Voltage [46]	Increased Numbers	Increased Capacity
Newly Installed or Extended	500 kV	22 [11]	22,100 MVA [10,750 MVA]
	275 kV	14 [5]	5,158 MVA [1,950 MVA]
	220 kV	5 [0]	1,560 MVA [0 MVA]
	187 kV	5 [3]	1,645 MVA [925 MVA]
	154 kV	1 [1]	170 MVA [170 MVA]
	132 kV	0 [0]	75 MVA [0 MVA]
	110 kV	△1 [0]	△60 MVA [0 MVA]
	Total	46 [20]	30,648 MVA [13,795 MVA]
To be Decommissioned	500 kV	△2	△1,750 MVA
	275 kV	△18	△4,550 MVA
	Total	△20	△6,300 MVA

The figures in square brackets indicate increases in the number of transformers resulting from new substation installations.

Table 4-11 Development Plans for AC/DC Converter Stations

Category	Company and Number of Sites	Capacity[47]
Newly Installed or Extended	Hokkaido Electric Power Network, Inc. 2	300 MW×2
	Chubu Electric Power Grid Co.,Inc. 1	600 MW
	J-POWER Transmission Network Co., Ltd. 1	300 MW
To be Decommissioned	Chubu Electric Power Grid Co.,Inc. 1	△300 MW

44 Table 4-9 aggregates the extended and total extended lengths that correspond to the revised plans for line category and number of circuits.
45 Decommissioning plans with transformer installations are included in "Newly Installed" or "Extended," while negative values are included in the increased numbers or increased capacity.
46 Voltage class by upstream voltage.
47 For DC transmission, the capacities of both converter stations are included.

4. Aging Management of Existing Transmission and Distribution Facilities

Existing transmission and distribution facilities installed after the economic expansion (from the 1960s to the 1970s) are nearing replacement. While the replacement of facilities is an increasing trend, significant facilities will not be replaced. Proper decisions for the replacement schedule are inevitable for securing a stable electricity supply in the future. Figures 4-2 to 4-4 present the actual installation years of existing transmission and distribution facilities:

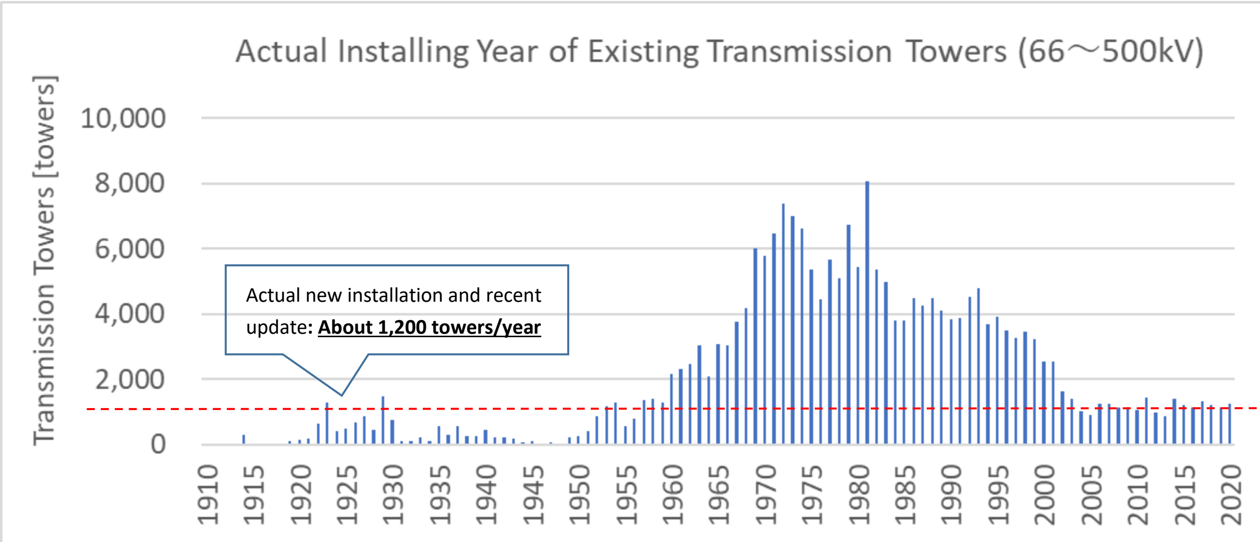


Figure 4-2 Actual Installation Years of Existing Transmission Towers (66–500 kV)

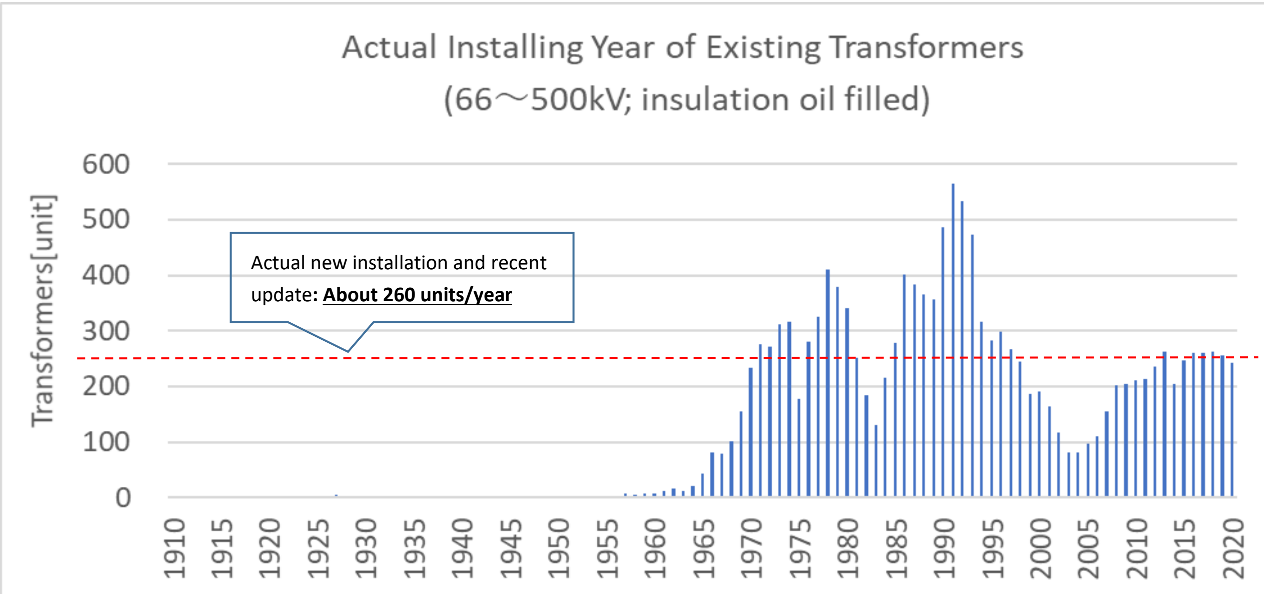


Figure 4-3 Actual Installation Years of Existing Transformers (66–500 kV; Insulating Oil-Filled)

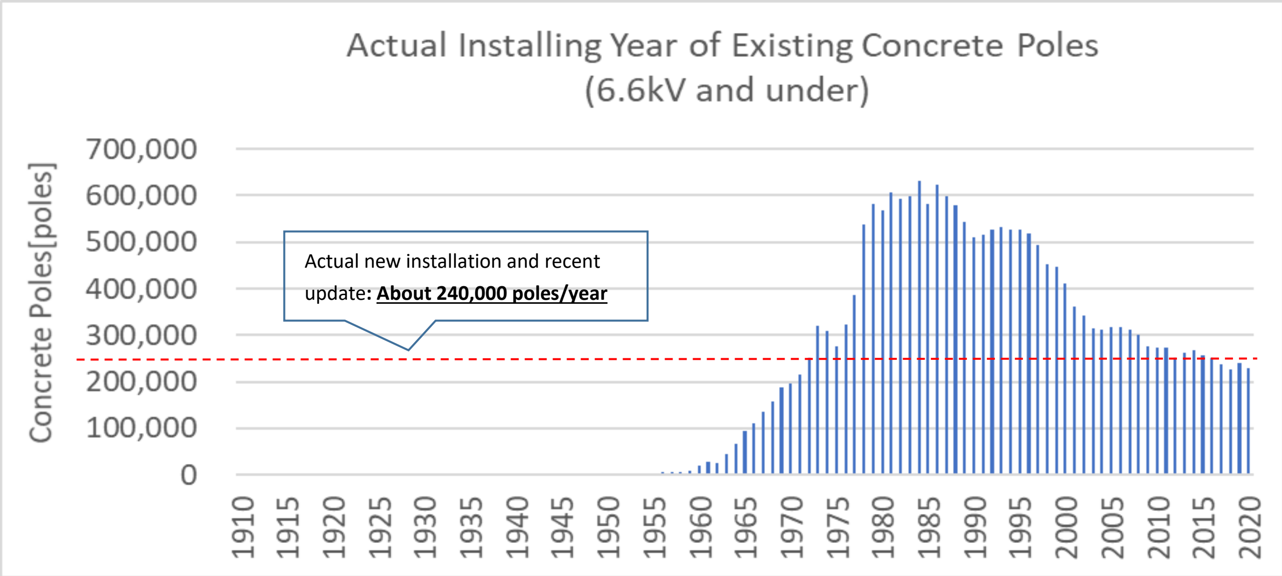


Figure 4-4 Actual Installation Years of Existing Distribution Concrete Poles (Under 6.6 kV)

V. Cross-Regional Operation

Retail companies procure the supply capacity for customers in their regional service areas. Four figures illustrate the scheduled procurement from external service areas during August 2023; Figures 5-1 and 5-2 show the supply capacity and the ratio of the supply capacity, respectively. Figures 5-3 and 5-4 show the energy supply and the ratio of the energy supply, respectively, in FY 2023. These figures are shown for calculating values offset procurement (received) and sales (sent) for each regional service area.

Higher ratios for procurement from external regional service areas are observed in the Tokyo and Chugoku areas. By contrast, higher sales to external regional service areas are observed in the Tohoku, Kansai, and Shikoku areas.

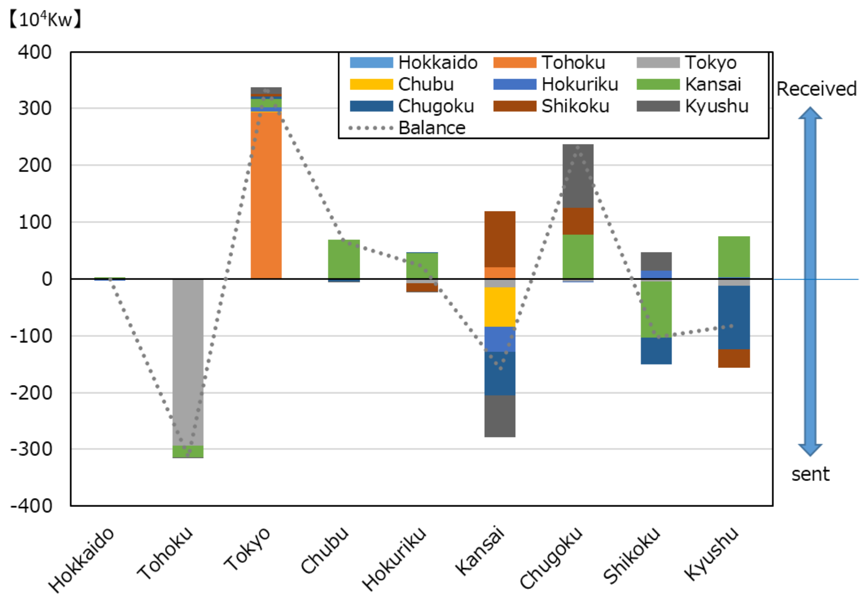


Figure 5-1 Scheduled Procurement of Supply Capacity from External Regional Service Areas

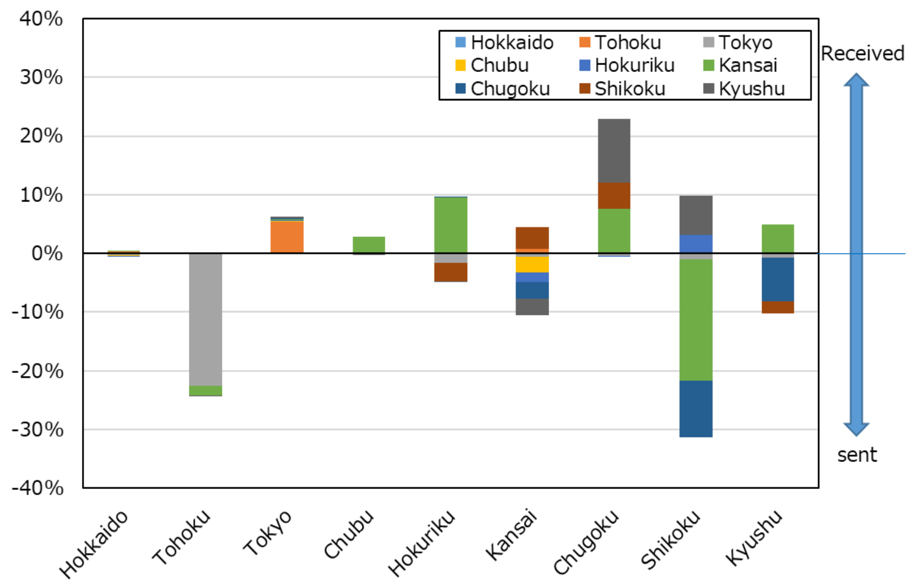


Figure 5-2 Ratio of Scheduled Procurement of Supply Capacity from External Regional Service Areas

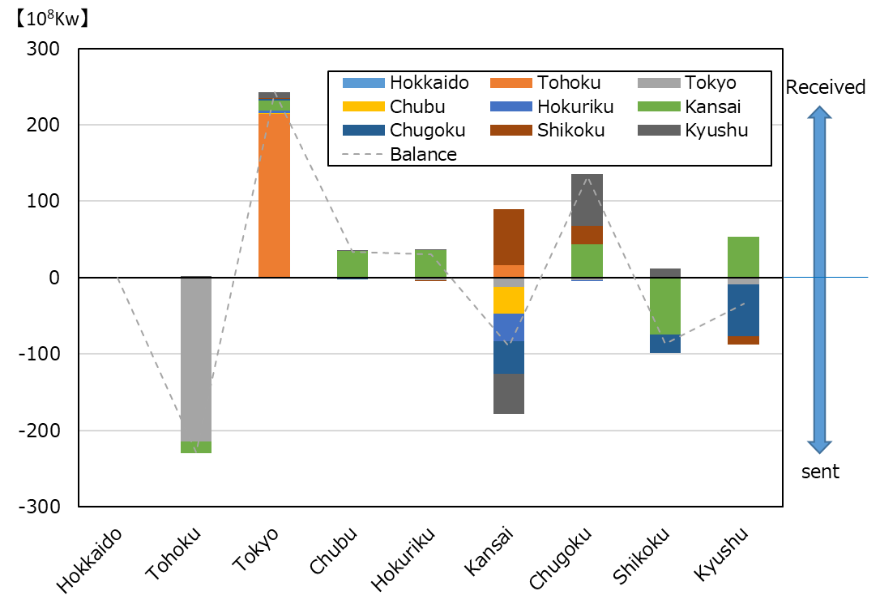


Figure 5-3 Scheduled Procurement of Energy Supply from External Regional Service Areas

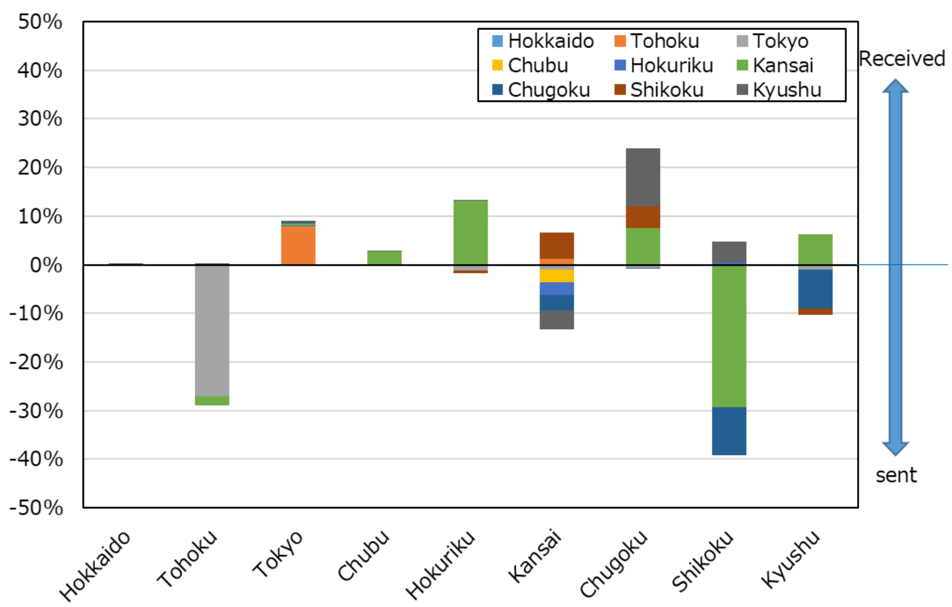


Figure 5-4 Ratio of Scheduled Procurement of Energy Supply from External Regional Service Areas

VI. Analysis of the Characteristics of EPCOs

1. Distribution of Retail Companies by Business Scale (Retail Demand)

In total, 680 retail companies submitted their electricity supply plans, which were classified by the corresponding companies' business scale of the retail demand forecast. Figures 6-1 and 6-2 present the distributions of the business scale of retail demand and the accumulated retail demand forecast by said companies, respectively. Retail companies under 1 GW account for the majority throughout the projected period; however, more than half of the accumulated retail demand was accounted for by retail companies whose businesses are 10 GW and over.

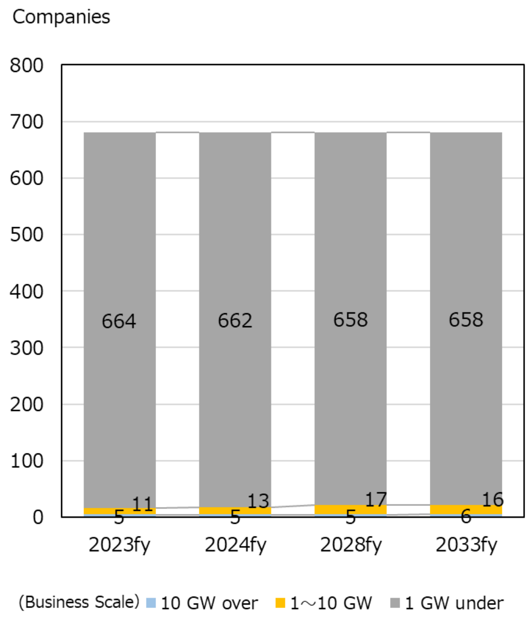


Figure 6-1 Distribution of the Retail Demand by Retail Companies by Business Scale

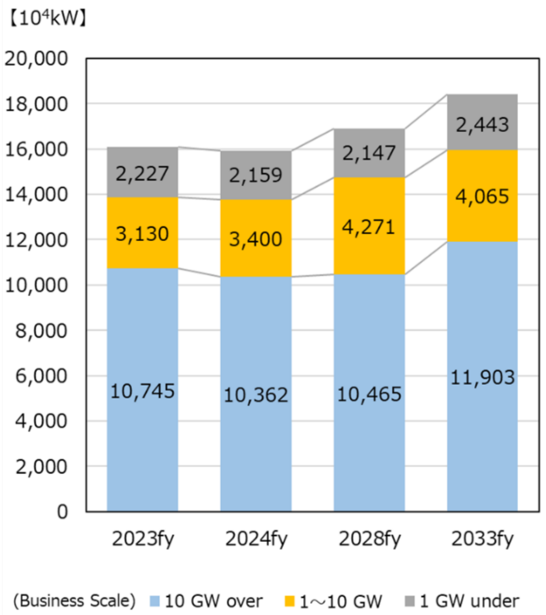


Figure 6-2 Distribution by Accumulated Retail Demand by Retail Companies

Retail companies are classified by the corresponding companies' business scale of the retail energy sales forecast. Figures 6-3 and 6-4 present the distributions of the business scale of retail company energy sales and their accumulated energy sales forecast, respectively. Similarly, retail companies, under 1 TWh account for the majority throughout the projected period; however, over half of accumulated retail energy sales were accounted for by retail companies whose businesses are 10 TWh and over.

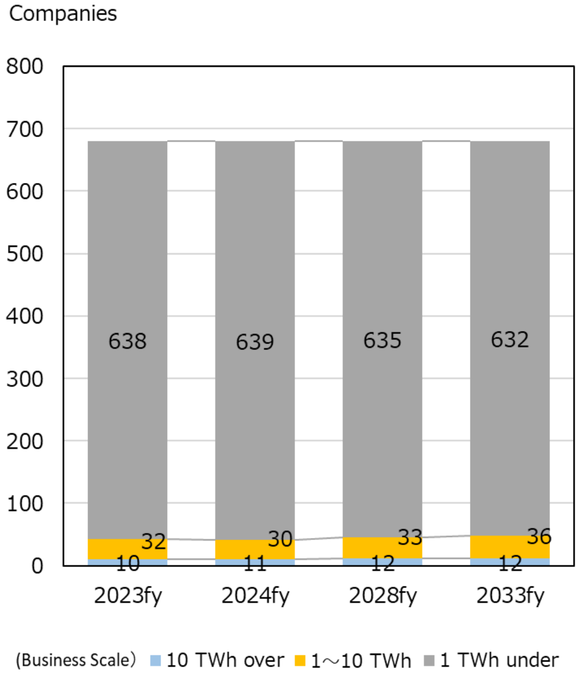


Figure 6-3 Distribution of Retail Company Energy Sales by Business Scale

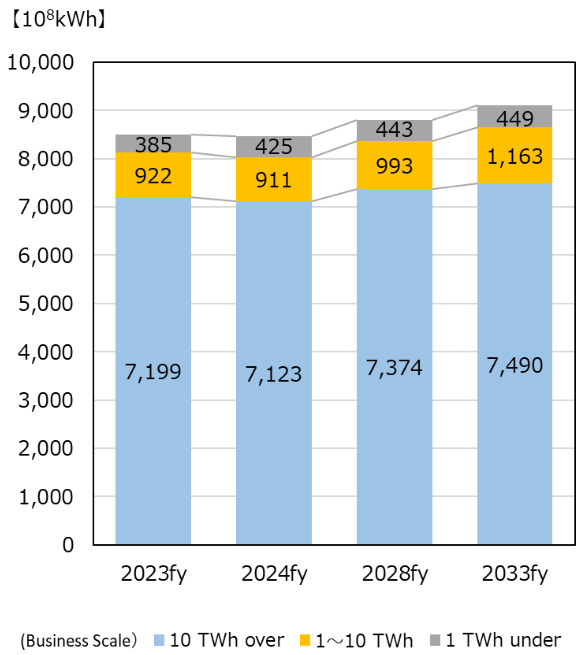


Figure 6-4 Distribution by Retail Companies of Accumulated Energy Sales

2. Retail Companies' Business Areas

Figure 6-5 presents the ratio of retail companies by the number of areas in which they plan to conduct business, while Figure 6-6 presents the number of retail companies by their business planning areas as of August 2024. Half of the retail companies have planned their business activities in a single area.

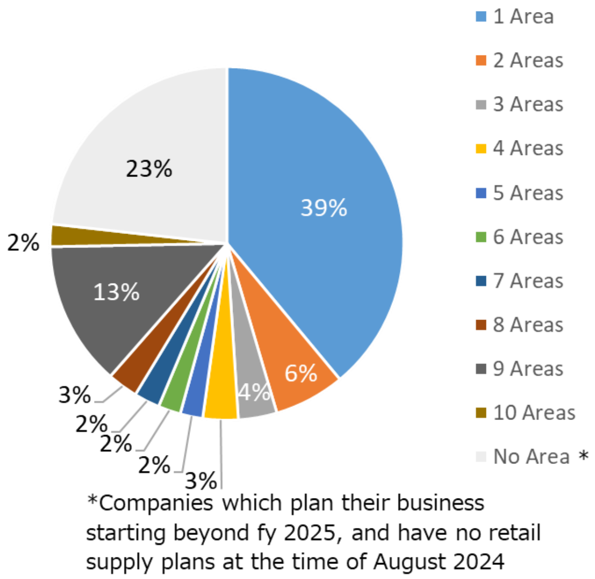


Figure 6-5 Ratio of Retail Companies by the Number of Planned Business Areas as of August 2024

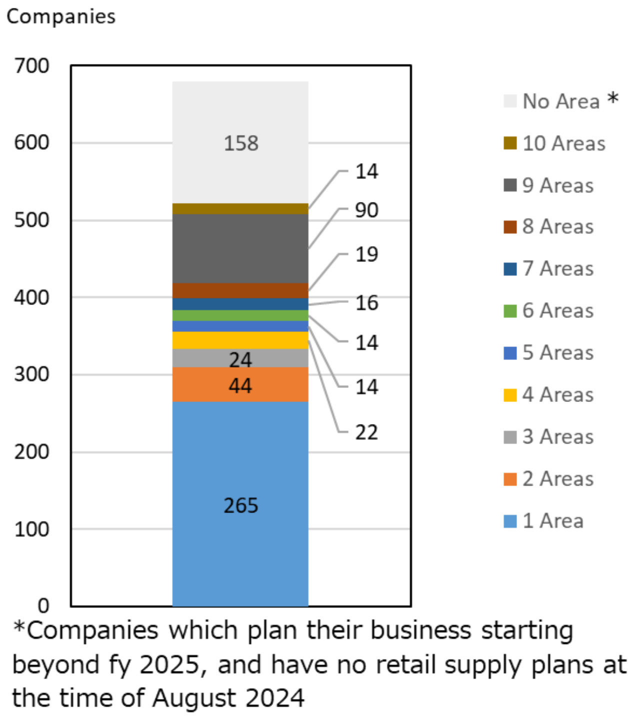


Figure 6-6 Number of Retail Companies by Their Planned Business Areas as of August 2024

Figure 6-7 presents the number and retail demand of retail companies in each regional service area for GT&D companies as of August 2024. The number of retail companies has decreased compared with FY 2023; however, some areas exhibit an increased number.

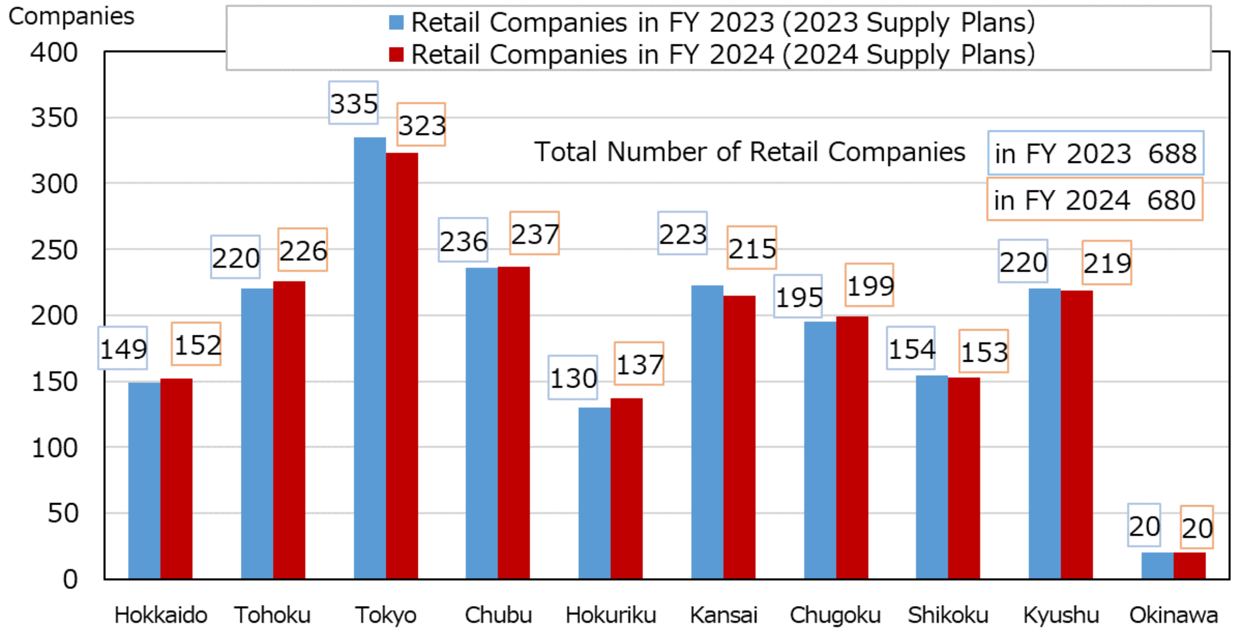


Figure 6-7 Number and Retail Demand of Retail Companies in Each Regional Service Area

3. Supply Capacity Procurement by Retail Companies

Figure 6-8 presents the transition of the procured supply capacity (i.e., bilateral contracts) in regional service areas by retail company. For FY 2024, the bilateral contracts are made in a certain capacity; however, after FY 2025, they are projected to decrease. The generation departments of former general electric utility companies are selling their energy production trades based on the wholesale standard menu for one to five years. Such trades have been applied to retail departments of the same business group[48]; therefore, the ratio of the procured supply capacity will decrease for the retail departments of the former general electric utility companies. By contrast, the procured supply capacity of other retail companies is projected to remain the same during the 10-year period.

[48] This group is composed of the retail department of the former general electric utilities and the retail company whose capital are dominated by the former general electric utilities.

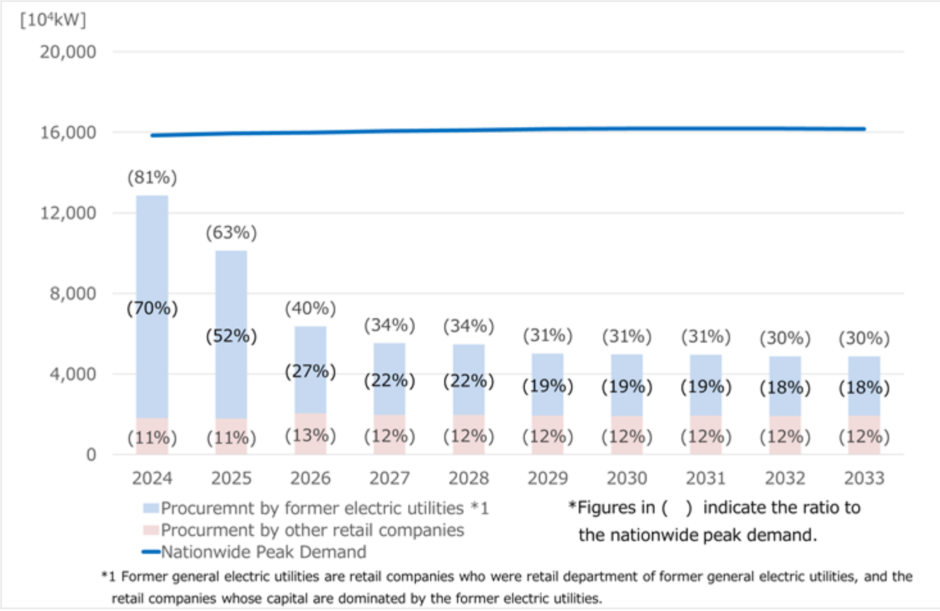


Figure 6-8 Ratio of Secured Supply Capacity to Forecast Retail Demand for Former General Electric Utility Companies (in August, at the Sending End)

4. Distribution of Generation Companies by Business Scale (Installed Capacity)

In total, 1,108 generation companies submitted electricity supply plans, which were classified by the corresponding companies' business scale of the installed capacity. Figure 6-9 presents the distribution by business scale, while Figure 6-10 presents the installed capacity operated by the corresponding companies.

Generation companies with an installed capacity under 10 GW account for the majority throughout the projected period; however, more than half of the accumulated supply capacity was accounted for by generation companies with an installed capacity of 10 GW and over.

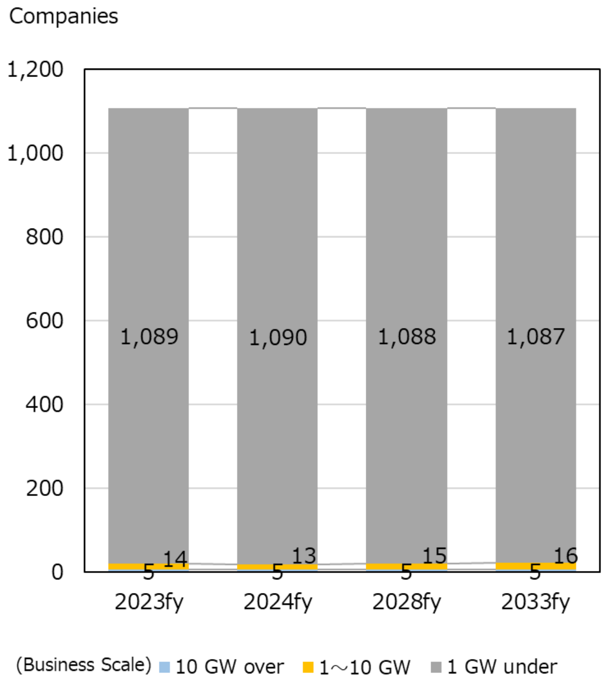


Figure 6-9 Distribution by Business Scale of a Generation Company's Installed Capacity

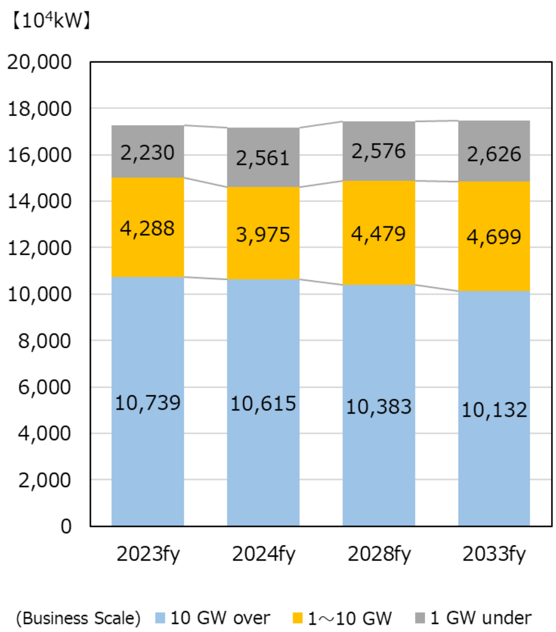


Figure 6-10 Distribution by a Generation Company's Accumulated Installed Capacity

Similarly, generation companies are classified by the business scale of the corresponding company's energy supply forecast. Figure 6-11 presents the distribution according to the business scale of the energy supply, while Figure 6-12 presents the distribution according to the corresponding company's accumulated energy supply forecast.

Generation companies with an energy supply under 1 TWh account for the majority throughout the projected period; however, more than half of the accumulated energy supply was accounted for by generation companies with an energy supply of 10 TWh and over.

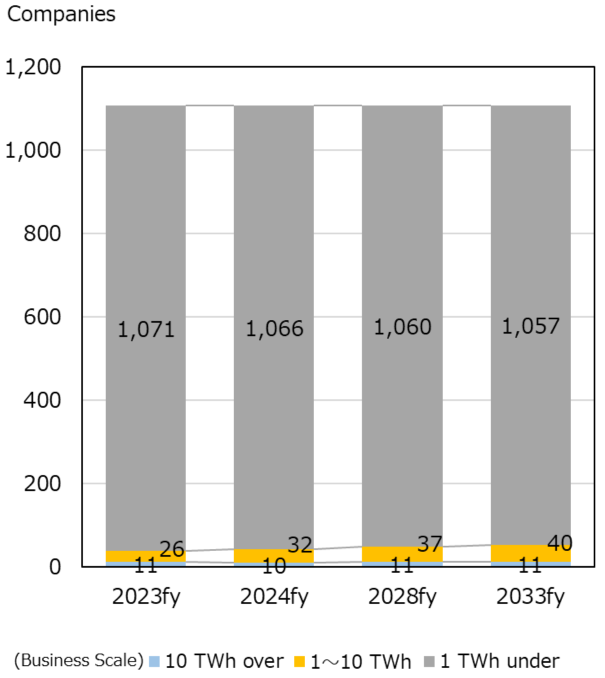


Figure 6-11 Generation Companies' Distribution of Energy Supply by Business Scale

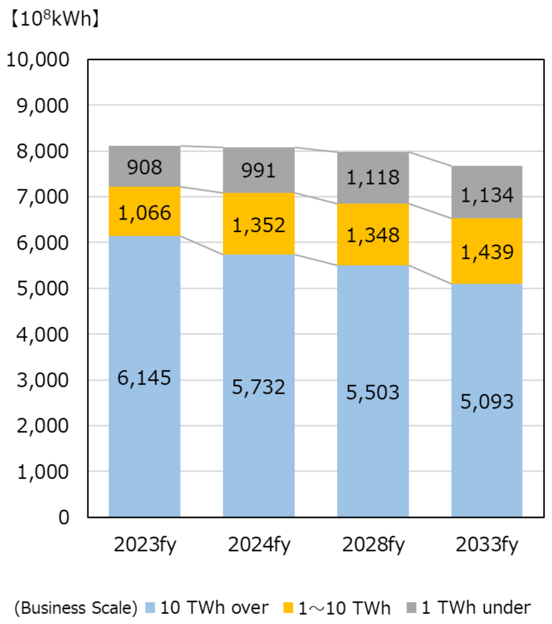
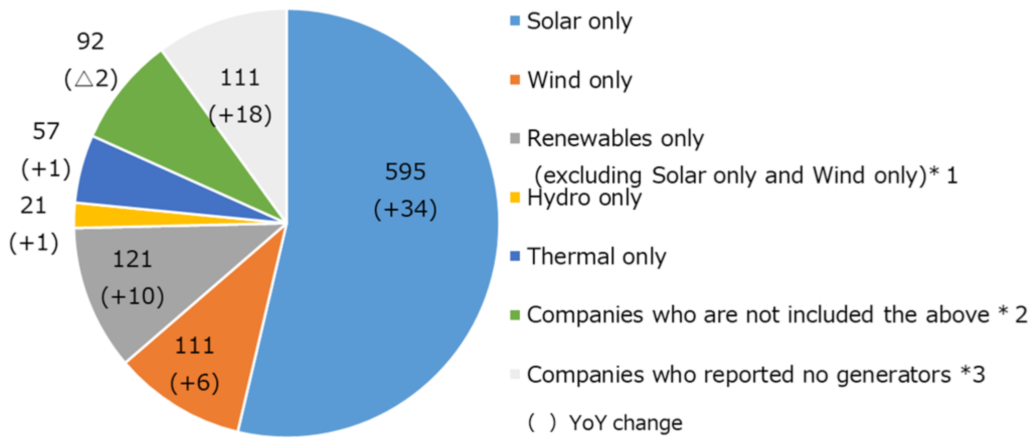


Figure 6-12 Generation Companies' Distribution by Accumulated Energy Supply

Figure 6-13 presents the number of generation companies at the end of FY 2024 by the power generation sources of their generators. The number of generation companies that use renewable energy (particularly solar power) is increasing, with new generation companies leading with a stronger introduction of renewable energy.



*1 Subject to the companies which own only geothermal, biomass and waste, or companies which own several types of Renewables generating facilities including solar and wind
*2 Include the companies which own only multifuel facilities of fossil fuel and biomass etc.
*3 Companies which plan their business starting beyond fy 2025, and have no generators in fy 2024

Figure 6-13 Number of Generation Companies by Power Generation Sources

5. Generation Companies' Business Areas

Figure 6-14 presents the ratio of generation companies to the number of areas in which they plan to conduct business, while Figure 6-15 presents the number of generation companies by their business planning areas as of August 2024.

Eighty percent of generation companies plan their business in a single area.

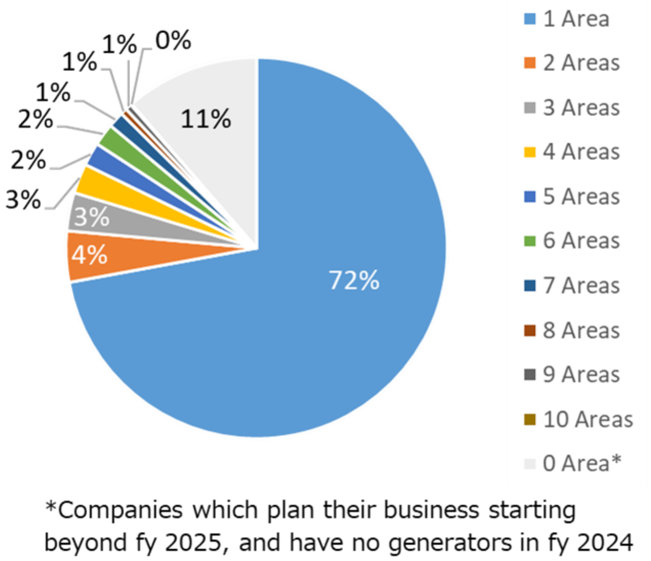


Figure 6-14 Ratio of Generation Companies by the Number of Planned Business Areas

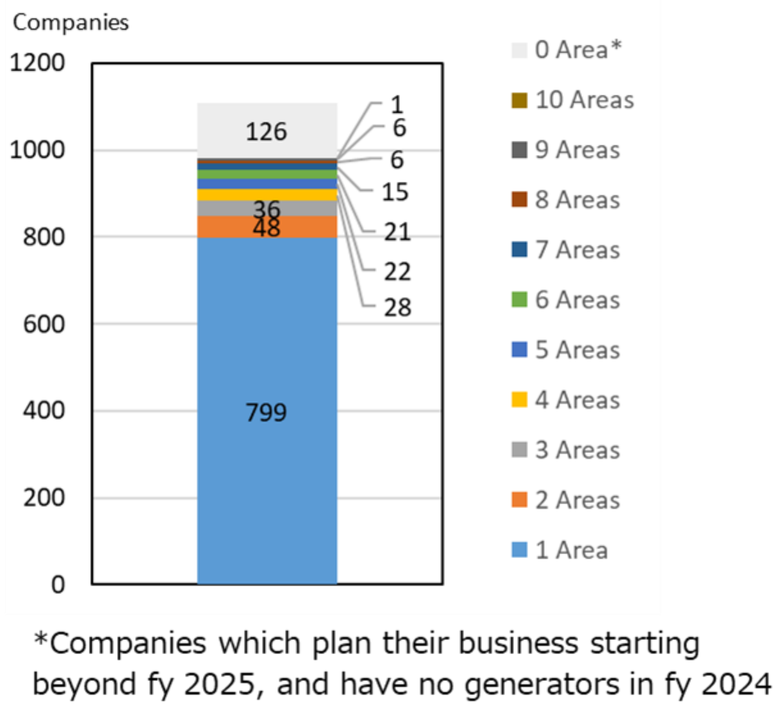


Figure 6-15 Number of Generation Companies by Their Business Planning Areas

Figure 6-16 presents the number and installed capacity of generation companies in each regional service area for GT&D companies in August 2024. In some regional service areas, the number of generation companies has increased compared with FY 2023.

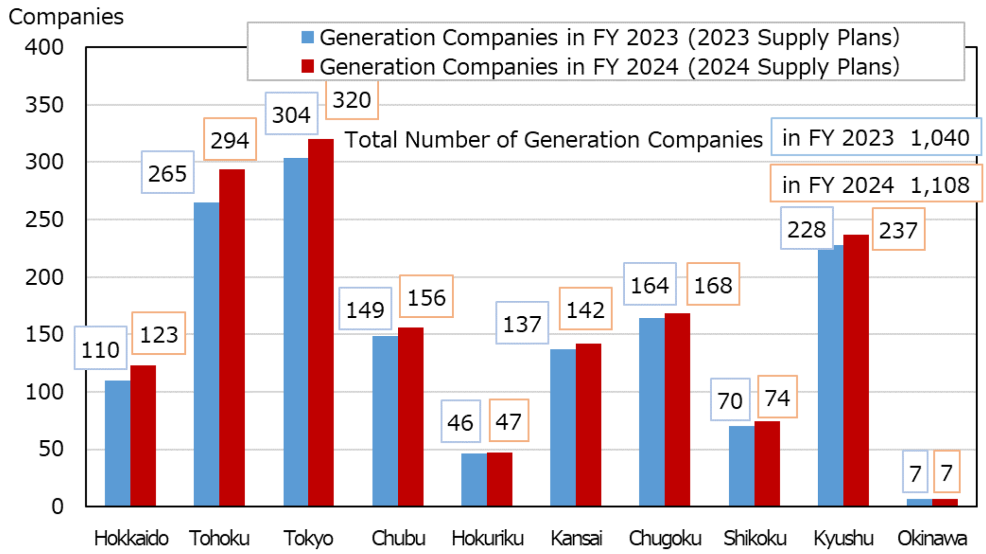


Figure 6-16 Number and Installed Capacities of Generation Companies in Each Regional Service Area

VII. Findings and Current Challenges

Current challenges that relate to the aggregation of electricity supply plans are described as follows:

1. Challenges regarding the procurement of supply and balancing capacity in the mid-to-long term

The concept of the obligation to procure supply and balancing capacity for retail companies has changed, as the necessary supply capacity nationwide has been secured in the capacity market since FY 2024. Additionally, the procured supply capacity of retail companies with long-term bilateral contracts has tended to decrease, as the generation departments of former general electric utility companies have sold their generated energy in the standard menu for one to five years due to them not discriminating between their retail departments and other retail companies (see Figure 6-8).

Under these circumstances, severe supply–demand is observed in some years and areas in the mid-to-long term. This is also observed in most of the unsuccessful bids in the capacity market's main auction belonging to LNG-fired generators,[49] the offset capacity between new and added installations, and suspension and decommissioning. Furthermore, this observation is also led by trends such as the LNG-fired capacity of unsuccessful bids, ineffective coal-fired generators, and aged oil-fired generators being suspended and decommissioned toward the realization of the goal of carbon neutrality by 2050 (see Figure 3-4).

By listening to generation companies, the Organization understands that predictability for businesses has reduced because of difficulties in developing generation and fuel procurement plans, which are based on traditional long-term bilateral contracts with retail companies under the altered business circumstances.

However, generation companies are essentially expected to develop their business plans and expand their business upon their initiative in the mid-to-long term while providing a secure supply, realizing carbon neutrality, and utilizing their supply and balancing capacities

To contribute to the business expansion of generation companies, the Organization has implemented an investigation of future supply–demand scenarios, which promotes concrete generator development, and of long-term decarbonization capacity auctions, which will lead to improved predictability for generator investment. Thus, the Organization hopes to cooperate with the government and investigate concrete measures for the aforementioned challenges.

Additionally, the Organization will investigate concrete measures against the procurement of balancing capacity in the mid-to-long term, such as requirement settings of grid codes for balancing capacity and the procurement of balancing capacity by using the capacity market scheme. This is because the Organization expects shortages of balancing resources due to the increasing use of renewable energy and the suspension and decommissioning of thermal

[49] Contract result of the main auction of the capacity market (actual supply–demand for FY 2027) [written only in Japanese].
https://www.occto.or.jp/market-board/market/oshirase/2023/files/240124_mainauction_youryouyakujokekka_kouhyou_jitsujukyu2027.pdf

generators, which are the major balancing resources.
Furthermore, the Organization aims to investigate the co-optimization market (i.e., the simultaneous contracted market for electrical energy and balancing capacity), which will contribute to developing a steady and sustainable supply–demand, and a market system—even under increasing uncertainty for securing supply–demand operations triggered by the maximum introduction of renewable energy in the future. Lastly, the Organization hopes that the government will investigate measures for introducing the market's institutional aspects.

2. Challenges regarding changes to the supply–demand structure and network congestion

The demand for the aggregation of supply plans for FY 2024 is forecast to increase throughout the forecast period due to a growth in demand triggered by new and added installations of data centers and semiconductor factories.[50] In the future, there may be a possibility to change the structure of electricity demand to reflect progress toward electric vehicles, storage facilities (batteries), and the production of hydrogen for the demand side. The increasing trend of electricity demand is expected to occur in response to the increase in the number of customers who seek CO_2-free energy, the electrification of nonelectrified facilities, and a reduced amount of energy generated for autoproducers themselves.
On the supply side, the new integration of renewable energy generators into the network is increasing based on the Japanese concept of "connect and manage," which involves integrating more generators without enhancing the existing electricity network. In the aggregated FY 2024 Supply Plan, the trend of renewable energy (e.g., solar and wind power) is expected to grow steadily and successively (see Figure 3-1). Furthermore, existing aged thermal generators are projected to be forced to be suspended, decommissioned, and replaced with carbon-neutral generators (e.g., hydrogen and ammonia-fired thermal generators) based on the results of the long-term decarbonization capacity auction and the fading out of ineffective coal-fired generators.
The aforementioned changes emerging on the demand and supply sides will lead to a change in the power flow in the electricity network. In addition, network congestion due to the capacity constraints of transmission lines and transformers is predicted to occur and spread, triggered by the operation of variable renewable energy (VRE), the output of which fluctuates greatly by season and weather, and balancing capacity, which compensates for the fluctuations in VRE.
T To cope with the conditions, the Organization will endeavor to pursue accurate demand forecasts and grasp network conditions, such as the potential development of generators that collaborate with each GT&D company. Furthermore, the Organization will strive to mitigate network congestion through redispatching; however, challenges are posed by the possible shortage of alternative generators to dispatch for said process as well as the difficulty of providing incentives for generator siting. Regarding this point, the Organization has stated that it is important to

[50] Electricity Demand Forecast for Nationwide and Each Regional Service Area [written only in Japanese]. https://www.occto.or.jp/juyousoutei/2023/files/240124_juyousoutei.pdf

suppress the total cost, including network investments, as well as to optimize the siting of generators and demand in the long-term policy of cross-regional network development (the master plan for cross-regional networks, published March 2023). For the market-led congestion management of the network, the pace of which is expected to increase for concrete investigations, the Organization hopes to cooperate with the government on the institutional aspects.

Moreover, the value of electricity is segmented into electrical energy (kWh), supply capacity (kW), and balancing capacity (delta kW), which are traded in a specific market. Thus, evaluations are expected of the effects of supply and balancing capacity by network congestion, with the price signal as the countermeasure, as well as the mechanisms of inducting generators and demand siting. The Organization is closely watching the trends of future network congestion in terms of electrical energy, supply capacity, and balancing capacity while cooperating with GT&D companies. Moreover, it is developing mechanisms for managing congestion and sending price signals. The Organization hopes that the government will develop energy policy and the institutional structure, which should lead to the optimization of the entire electricity system through the combination of generators and demand.

3. Challenges regarding changes in the supply–demand balance and coordinated scheduled maintenance

The volume of coordinated scheduled maintenance[51] has significantly increased due to generator shutdown, among other factors,[52] compared with the aggregation of the FY 2023 Supply Plan (see Figure 2-4). In that volume are the generators that successfully bid in the main auction of the capacity market, coordinated their scheduled maintenance before two years of actual supply–demand, and increased their maintenance volume after the coordination of scheduled maintenance among the bid capacity.[53]

At a committee meeting in November 2023, the Organization highlighted that supply–demand in the off-peak period (spring and autumn) sometimes becomes more severe than during the peak period (summer and winter). This is due to the supply capacity decreasing through increased scheduled maintenance, as opposed to decreased demand.[54] Under these circumstances, a possibility of a tight supply–demand balance exists if the demand increases due to severe weather or a supply capacity shortage due to a generator shutdown.

Conversely, by listening to generation and GT&D companies, the Organization has learned that the workforce required for generator maintenance will grow, while the scheduled coordination will

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[51] Includes factors other than generation facilities, such as simultaneous maintenance with transmission and distribution facilities.

[52] Includes submitting the supply capacity as zero due to an undetermined restoration date upon submission of the supply plan.

[53] In the requirement rules for the capacity market, if capacity providers make the scheduled maintenance period longer than the submitted maintenance schedule and this threatens the supply reliability, such capacity providers may be penalized. Source: Item 1, Paragraph 1 of Article 16, Terms and Conditions for Supply Capacity Procurement Contract (published in Janauary 2024) [written only in Japanese].
https://www.occto.or.jp/market-board/market/jitsujukyukanren/files/240124_kakuhokeiyaku.pdf

[54] Source: Material 3, 92nd meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (November 17, 2023) [written only in Japanese].
https://www.occto.or.jp/iinkai/chouseiryoku/2023/files/chousei_92_03.pdf

become more difficult after the coordination is implemented two years before the actual supply–demand. Under these circumstances, effective measures for responding to the possible change in supply–demand balance after the coordination of scheduled maintenance must be investigated. Therefore, the Organization has implemented the verification of supply–demand and kW monitoring as before to grasp the coordination of scheduled generator maintenance as well as the change in conditions after an incremental auction. If there is a possibility of a tight supply–demand balance, the Organization will deepen its investigations to ensure that it can publish more accurate information for grasping the preparedness and action of EPCOs, especially during the off-peak period.

For generation and retail companies, the Organization hopes to thoroughly grasp and analyze this information and coordinate maintenance schedules in case of a tight supply–demand, thus ensuring the security of supply as responsible EPCOs, as well as to consider occasions for the chance of sales.

It might be possible that the security of supply cannot be maintained by the business efforts of EPCOs in the case of generator shutdown due to, among other events, a major natural disaster one year before the actual supply–demand. To ensure preparedness for this possibility, a strategic generator reserve scheme is under review by the government.

The Organization is designated to be the host of the procurement process of the strategic generator reserve and has proceeded to investigate the introduction of the scheme in cooperation with the government. The Organization hopes that the government will investigate the measures for the introduction as well as measures of the early operation process of the scheme in parallel.

VIII. Conclusions

1. Electricity Demand Forecast

The AAGR of peak demand nationwide in the mid-to-long term is forecast to increase by 0.3%. The AAGR is forecast to be positive, which is attributable to several major increasing factors, such as economic growth and a boost in demand through new and added installations of data centers and semiconductor factories. This is notwithstanding decreasing factors, such as a shrinking population, and efforts to reduce electricity use.

2. Electricity Supply and Demand

The Organization applied EUE as a reliability criterion to the electric supply plan. For FY 2024, whole areas fall within the target outage volume, while for FY 2025, the Hokkaido, Tokyo, and Kyushu service areas are outside of the criteria due to suspension and decommissioning or the scheduled maintenance of generators. In the long term, the calculated results for the EUE indices exceed the target for Hokkaido and Tokyo from FY 2026 to 2029; Tohoku for FY 2026, 2028, and 2029; Kyushu from FY 2026 to 2033; and Okinawa in FY 2026 and 2028 due to the suspension or decommissioning of generation facilities.

The conventional approach's supply–demand balance evaluation reveals that the reserve margin is secured for 10% in FY 2024 and 2025 in every area and for all months.

For the evaluation of energy supply requirements, the energy supply will be 1.3 TWh/month in volume below the forecast energy requirement (equivalent to 1.8% against the forecast energy requirement) in some months of FY 2024.

As stated above, for FY 2025, the Organization shall coordinate with the government and corresponding EPCOs regarding supply–demand measures, such as the coordination of maintenance schedules, considering the necessity of the incremental auction discussed at the governmental council as well as its results.

Beyond FY 2026, the Organization shall carefully re-examine the supply capacity in future supply plans based on the continuous watch on generation facility development in the mid to long term. It will also determine the necessity of incremental auctions as required with coordinated results of the maintenance schedule, which is implemented two years in advance of the actual supply.

3. Analysis of the Transition of Power Generation Sources Nationwide

Renewable energy, such as solar and wind power, is projected to increase regarding the transition of installed power generation capacity and net electricity generation. Supply capacity (kW) and electrical energy (kWh) are automatically calculated in the supply plan with given estimations.

4. Development Plans for Transmission and Distribution Facilities

Regarding the development plans for major transmission lines and substations, significant new generators that include renewable energy as well as newly demanded facility access lines are planned for the Hokkaido and Tohoku service areas. In addition, development plans are required for cross-regional interconnection lines, including the facilities necessary for cross-regional operation.

5. Cross-Regional Operation

The aggregated results for procuring supply capacity (planned as of August 2024) or energy from external service areas (planned for FY 2024) are stated as follows: Higher ratios for procurement from external regional service areas are observed in the Tokyo and Chugoku service areas, whereas higher sales to external regional service areas are observed in the Tohoku, Kansai, and Shikoku service areas.

6. Analysis of EPCOs' Characteristics

Distributions are calculated for retail and generation companies according to business scale and business areas, and they are aggregated to the projection for 10 years. For FY 2024, the supply capacity of retail companies is procured at a certain level; however, after FY 2025, they are projected to decrease. That is attributable to the indiscriminate treatment of the generation departments of former general electric utility companies between the retail companies of said utilities and other retail companies.

7. Findings and Challenges

The Organization has communicated its opinions to METI regarding three significant challenges that concern the aggregation of electricity supply plans for FY 2024.

Appendices regarding the aggregation of electricity supply plans are attached as follows:

APPENDIX 1 Short-Term Supply–Demand Balance for FY 2024 and 2025

i) Projection for FY 2024

Tables A1-1 presents the peak demand, while Table A1-2 presents the monthly supply capacity (including the generator development plans according to the provisions of Article 48 of the Act) for each regional service area in FY 2024.

Table A1-3 presents monthly projections of supply capacity for each regional service area recalculated with power exchanges, while Table A1-4 presents the cross-regional reserve margin calculated from the supply capacity shown in Table A1-3. In Okinawa, the figures in these tables are at the smallest reserve margin. Furthermore, Table A1-5 presents the monthly peak demand, supply capacity, reserve capacity, and reserve margin at the designated time in the Okinawa service area.

Table A1-1 Monthly Peak Demand Forecast for Each Regional Service Area in FY 2024 (10^4kW at the Sending End)

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	395	353	359	408	418	387	387	444	481	501	499	453
Tohoku	1,053	978	1,068	1,277	1,301	1,151	1,022	1,149	1,286	1,335	1,330	1,225
Tokyo	3,713	3,593	4,186	5,395	5,395	4,549	3,827	3,945	4,358	4,752	4,752	4,174
50Hz areas Total	5,161	4,924	5,613	7,080	7,114	6,087	5,236	5,538	6,125	6,588	6,581	5,852
Chubu	1,774	1,778	2,002	2,409	2,409	2,162	1,855	1,848	2,137	2,314	2,314	2,013
Hokuriku	365	336	391	475	475	420	347	376	449	487	487	417
Kansai	1,709	1,766	2,045	2,647	2,647	2,209	1,830	1,807	2,242	2,411	2,411	2,004
Chugoku	710	716	828	1,039	1,039	908	756	795	978	995	995	845
Shikoku	322	330	384	478	478	423	358	340	459	459	459	379
Kyushu	976	1,076	1,213	1,538	1,538	1,342	1,123	1,151	1,382	1,448	1,448	1,197
60Hz areas Total	5,856	6,002	6,863	8,586	8,586	7,464	6,269	6,317	7,647	8,114	8,114	6,855
Interconnected	11,017	10,926	12,476	15,666	15,700	13,551	11,505	11,855	13,772	14,702	14,695	12,707
Okinawa	102	129	147	156	154	152	134	112	96	104	96	94
Nationwide	11,119	11,055	12,623	15,821	15,854	13,704	11,639	11,967	13,868	14,806	14,790	12,801

Table A1-2 Monthly Projected Supply Capacity for Each Regional Service Area in FY 2024 (10^4kW at the Sending End)

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	508	483	499	501	578	539	530	555	617	607	608	537
Tohoku	1,639	1,702	1,652	2,049	2,087	1,795	1,577	1,708	1,957	2,007	1,989	1,856
Tokyo	4,224	3,976	4,477	5,840	5,818	5,387	3,995	3,959	5,255	5,462	5,433	5,346
50Hz areas Total	6,372	6,161	6,628	8,390	8,482	7,722	6,103	6,223	7,829	8,076	8,030	7,739
Chubu	2,106	2,224	2,477	2,825	2,807	2,532	2,190	2,080	2,328	2,546	2,568	2,503
Hokuriku	474	443	459	536	521	474	428	419	475	481	475	494
Kansai	2,236	2,315	2,449	2,955	2,999	2,933	2,394	2,438	2,707	2,656	2,753	2,486
Chugoku	727	822	979	1,220	1,227	1,052	881	799	1,021	1,160	1,120	1,079
Shikoku	666	710	768	740	732	655	714	556	637	680	703	584
Kyushu	1,466	1,462	1,681	1,919	1,931	1,842	1,639	1,611	1,871	1,894	1,883	1,705
60Hz areas Total	7,675	7,975	8,813	10,195	10,218	9,488	8,247	7,902	9,039	9,417	9,502	8,853
Interconnected	14,047	14,137	15,441	18,584	18,700	17,210	14,350	14,125	16,868	17,493	17,532	16,592
Okinawa	172	184	194	213	215	203	200	185	189	173	164	167
Nationwide	14,219	14,321	15,635	18,797	18,915	17,413	14,550	14,311	17,057	17,666	17,696	16,759

Table A1-3 Monthly Projected Supply Capacity Recalculated with Power Exchange for Each Regional Service Area in FY 2024 (10^4kW at the Sending End)

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	494	472	453	493	535	492	481	504	605	603	598	564
Tohoku	1,318	1,308	1,343	1,544	1,546	1,462	1,194	1,305	1,616	1,606	1,593	1,611
Tokyo	4,645	4,476	4,924	6,385	6,412	5,777	4,472	4,482	5,477	5,717	5,690	5,489
50Hz areas Total	6,457	6,257	6,720	8,422	8,494	7,730	6,147	6,292	7,698	7,926	7,880	7,664
Chubu	2,263	2,329	2,538	2,851	2,863	2,746	2,418	2,282	2,563	2,728	2,753	2,622
Hokuriku	474	440	495	562	565	533	455	466	538	574	577	542
Kansai	2,220	2,313	2,592	3,133	3,146	2,806	2,398	2,245	2,689	2,842	2,868	2,610
Chugoku	923	938	1,050	1,230	1,235	1,153	991	988	1,173	1,173	1,184	1,101
Shikoku	418	450	508	566	568	537	469	422	550	541	546	494
Kyushu	1,291	1,409	1,538	1,821	1,828	1,705	1,472	1,430	1,657	1,708	1,723	1,559
60Hz areas Total	7,590	7,880	8,720	10,162	10,206	9,480	8,203	7,833	9,170	9,567	9,652	8,928
Interconnected	14,047	14,137	15,441	18,584	18,700	17,210	14,350	14,125	16,868	17,493	17,532	16,592
Okinawa	172	184	194	213	215	203	200	185	189	173	164	167
Nationwide	14,219	14,321	15,635	18,797	18,915	17,413	14,550	14,311	17,057	17,666	17,696	16,759

Table A1-4 Monthly Projected Cross-Regional Reserve Margin for Each Regional Service Area in FY 2024

Note: Power exchanges through cross-regional interconnection lines and generation facilities are not included at the sending end of the electricity supply plans.

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	23.4%	46.4%	50.8%	24.0%	25.3%	36.4%	27.1%	28.2%	20.3%	15.4%	16.0%	24.4%
Tohoku	16.4%	16.0%	21.3%	18.2%	24.1%	36.4%	25.2%	28.2%	20.3%	15.4%	16.0%	24.1%
Tokyo	16.4%	12.0%	12.3%	8.7%	9.7%	18.9%	22.0%	8.5%	15.0%	15.3%	15.0%	21.1%
Chubu	26.8%	24.8%	28.1%	18.7%	20.8%	22.0%	22.0%	14.8%	15.3%	15.3%	15.0%	21.1%
Hokuriku	26.8%	27.5%	28.1%	18.7%	20.8%	22.0%	22.0%	14.8%	15.3%	15.3%	15.0%	21.7%
Kansai	26.8%	27.5%	28.1%	18.7%	20.8%	22.0%	22.0%	14.8%	15.3%	15.3%	15.0%	21.7%
Chugoku	26.8%	27.5%	28.1%	18.7%	20.8%	22.0%	22.0%	14.8%	15.3%	15.3%	15.0%	21.7%
Shikoku	26.8%	27.5%	28.1%	18.9%	22.4%	22.0%	22.0%	14.8%	15.3%	15.3%	15.0%	39.4%
Kyushu	33.0%	30.2%	28.1%	18.7%	20.8%	29.9%	44.7%	23.3%	15.3%	15.3%	15.0%	21.7%
Okinawa	42.6%	42.6%	27.7%	30.5%	26.9%	22.1%	41.5%	44.4%	72.6%	61.9%	60.4%	81.3%

* Reserve margins with the same value are shown in the same background color after utilization of cross-regional interconnection line.

Table A1-5 Monthly Projected Supply–Demand Balance in Okinawa in FY 2024 (10^4kW at the Sending End)

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Peak Demand	102	129	149	157	157	152	134	112	96	104	96	94
Supply Capacity	177	189	197	217	220	211	204	190	191	175	166	171
Reserve Capacity	74	60	48	59	63	59	70	78	95	70	71	77
Reserve Margin	72.5%	46.3%	32.5%	37.8%	40.1%	38.6%	52.3%	70.0%	99.4%	67.5%	73.6%	82.0%

ii) Projection for FY 2025

Table A1-6 presents the peak demand, while Table A1-7 presents the monthly supply capacity (including the generator development plans according to the provisions of Article 48 of the Act) for each regional service area in FY 2025.

Table A1-8 presents the monthly projection of the supply capacity for each regional service area recalculated with power exchanges, while Table A1-9 presents the cross-regional reserve margin calculated from the supply capacity shown in Table A1-8. For Okinawa, the figures in these tables are at the smallest reserve margin. Furthermore, Table A1-10 presents the monthly peak demand, supply capacity, reserve capacity, and reserve margin at the designated time in the Okinawa service area.

Table A1-6 Monthly Peak Demand Forecast for Each Regional Service Area in FY 2025 (10^4kW at the Sending End)

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	397	355	361	411	420	390	390	447	483	503	501	455
Tohoku	1,059	983	1,073	1,284	1,308	1,158	1,027	1,155	1,293	1,342	1,336	1,232
Tokyo	3,773	3,652	4,245	5,455	5,455	4,609	3,886	4,004	4,416	4,810	4,810	4,233
50Hz areas Total	5,229	4,990	5,679	7,150	7,183	6,157	5,303	5,606	6,192	6,655	6,647	5,920
Chubu	1,776	1,780	2,005	2,412	2,412	2,165	1,858	1,850	2,140	2,318	2,318	2,016
Hokuriku	365	336	391	475	475	420	347	376	449	487	487	417
Kansai	1,719	1,778	2,058	2,656	2,656	2,223	1,840	1,815	2,249	2,417	2,417	2,012
Chugoku	710	715	827	1,038	1,038	907	756	794	977	994	994	844
Shikoku	321	328	382	475	475	421	356	338	457	457	457	377
Kyushu	980	1,080	1,217	1,544	1,544	1,347	1,128	1,159	1,391	1,458	1,458	1,205
60Hz areas Total	5,871	6,017	6,879	8,600	8,600	7,483	6,285	6,332	7,663	8,131	8,131	6,870
Interconnected	11,100	11,007	12,558	15,750	15,783	13,640	11,588	11,938	13,855	14,786	14,778	12,790
Okinawa	103	130	148	156	155	153	135	113	97	105	96	94
Nationwide	11,203	11,136	12,706	15,907	15,939	13,793	11,722	12,050	13,951	14,891	14,874	12,885

Table A1-7 Monthly Projected of Supply Capacity for Each Regional Service Area in FY 2025 (10^4kW at the Sending End)

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	531	515	526	536	520	468	474	522	622	606	622	531
Tohoku	1,587	1,469	1,605	1,900	1,978	1,779	1,592	1,657	1,810	1,912	1,914	1,731
Tokyo	4,023	3,836	4,470	5,823	5,848	5,457	3,806	4,025	5,118	5,286	5,119	4,929
50Hz areas Total	6,141	5,820	6,602	8,259	8,346	7,704	5,872	6,205	7,550	7,805	7,655	7,191
Chubu	2,176	2,165	2,388	2,692	2,746	2,587	2,446	2,218	2,269	2,292	2,565	2,520
Hokuriku	558	548	535	640	647	611	535	541	607	599	591	523
Kansai	2,129	2,193	2,484	2,914	2,977	2,792	2,217	2,269	2,747	2,880	2,914	2,786
Chugoku	899	1,007	1,165	1,322	1,308	1,133	941	875	1,097	1,154	1,131	1,080
Shikoku	603	632	709	867	859	796	669	626	731	808	797	770
Kyushu	1,312	1,310	1,657	1,899	1,848	1,763	1,592	1,503	1,691	1,753	1,667	1,577
60Hz areas Total	7,677	7,855	8,938	10,334	10,386	9,683	8,398	8,033	9,143	9,485	9,665	9,256
Interconnected	13,818	13,674	15,539	18,592	18,732	17,387	14,270	14,237	16,692	17,290	17,321	16,447
Okinawa	165	182	206	203	217	206	192	177	160	168	168	173
Nationwide	13,983	13,857	15,745	18,795	18,949	17,593	14,462	14,414	16,853	17,458	17,489	16,620

Table A1-8 Monthly Projected Supply Capacity Recalculated with Power Exchange for Each Regional Service Area in FY 2025 (10^4kW at the Sending End)

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	474	460	483	506	496	476	459	504	582	581	586	560
Tohoku	1,264	1,153	1,253	1,503	1,543	1,471	1,209	1,301	1,558	1,550	1,563	1,515
Tokyo	4,502	4,284	4,958	6,387	6,437	5,856	4,308	4,511	5,320	5,555	5,627	5,206
50Hz areas Total	6,240	5,897	6,695	8,396	8,475	7,803	5,976	6,315	7,460	7,686	7,775	7,281
Chubu	2,292	2,327	2,569	2,824	2,846	2,751	2,427	2,289	2,578	2,677	2,714	2,693
Hokuriku	471	439	500	557	561	534	453	465	540	580	576	556
Kansai	2,219	2,324	2,637	3,113	3,134	2,824	2,404	2,246	2,710	2,878	2,859	2,687
Chugoku	916	935	1,060	1,216	1,225	1,153	988	983	1,177	1,184	1,176	1,127
Shikoku	414	442	519	677	669	611	549	506	551	548	541	510
Kyushu	1,265	1,311	1,560	1,809	1,822	1,712	1,474	1,434	1,676	1,737	1,680	1,592
60Hz areas Total	7,578	7,777	8,845	10,196	10,257	9,584	8,295	7,922	9,233	9,603	9,545	9,166
Interconnected	13,818	13,674	15,539	18,592	18,732	17,387	14,270	14,237	16,692	17,290	17,321	16,447
Okinawa	165	182	206	203	217	206	192	177	160	168	168	173
Nationwide	13,983	13,857	15,745	18,795	18,949	17,593	14,462	14,414	16,853	17,458	17,489	16,620

Table A1-9 Monthly Projected Cross-Regional Reserve Margin for Each Regional Service Area in FY 2025

Note: Power exchanges through cross-regional interconnection lines and generation facilities are not included at the sending end of the electricity supply plans.

[%]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	19.3%	29.6%	33.9%	23.2%	18.0%	22.0%	17.7%	12.7%	20.5%	15.5%	17.0%	23.0%
Tohoku	19.3%	17.3%	16.8%	17.1%	18.0%	27.1%	17.7%	12.7%	20.5%	15.5%	17.0%	23.0%
Tokyo	19.3%	17.3%	16.8%	17.1%	18.0%	27.1%	10.9%	12.7%	20.5%	15.5%	17.0%	23.0%
Chubu	29.1%	30.7%	28.1%	17.1%	18.0%	27.1%	30.7%	23.7%	20.5%	15.5%	17.1%	33.6%
Hokuriku	29.1%	30.7%	28.2%	17.2%	18.0%	27.1%	30.7%	23.7%	20.5%	19.1%	18.3%	33.6%
Kansai	29.1%	30.7%	28.2%	17.2%	18.0%	27.1%	30.7%	23.7%	20.5%	19.1%	18.3%	33.6%
Chugoku	29.1%	30.7%	28.2%	17.2%	18.0%	27.1%	30.7%	23.7%	20.5%	19.1%	18.3%	33.6%
Shikoku	29.1%	34.6%	35.8%	42.5%	40.7%	45.0%	54.1%	49.6%	20.5%	19.8%	18.3%	35.2%
Kyushu	29.1%	21.3%	28.2%	17.2%	18.0%	27.1%	30.7%	23.7%	20.5%	19.1%	15.2%	32.1%
Okinawa	60.1%	40.7%	38.8%	29.8%	39.7%	34.7%	42.3%	57.3%	66.2%	60.5%	74.2%	83.8%

* Reserve margins with the same value are shown in the same background color after utilization of cross-regional interconnection line.

Table A1-10 Monthly Projected Supply–Demand Balance in Okinawa in FY 2025 (10^4kW at the Sending End)

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Peak Demand	103	130	150	158	158	153	135	113	97	105	96	94
Supply Capacity	170	187	209	207	222	215	196	182	163	170	170	177
Reserve Capacity	67	58	59	49	64	62	61	69	66	65	74	82
Reserve Margin	64.7%	44.3%	39.5%	31.1%	40.4%	40.3%	45.1%	61.5%	68.7%	62.4%	76.5%	87.4%

APPENDIX 2 Long-Term Supply–Demand Balance for 10 Years: FY 2024–2033

Tables A2-1 and A2-2 present a 10-year projection of the annual peak demand and annual supply capacity for each regional service area from FY 2024 to 2033, respectively. For Okinawa, the figures in these tables are at the smallest reserve margin. Tables A2-3 and A2-4 present a 10-year projection of the annual peak demand and annual supply capacity for winter peak areas of Hokkaido, Tohoku, and Hokuriku, respectively. Furthermore, Table A2-5 presents Okinawa's annual projected supply–demand balance.

Table A2-1 Annual Peak Demand Forecast for Each Regional Service Area (in August, 10^4kW at the Sending End)

[10^4kW]

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Hokkaido	418	420	424	425	432	443	447	446	446	445
Tohoku	1,301	1,308	1,307	1,306	1,305	1,304	1,303	1,301	1,300	1,299
Tokyo	5,395	5,455	5,507	5,564	5,604	5,631	5,645	5,655	5,664	5,666
50Hz areas Total	7,114	7,183	7,238	7,295	7,341	7,378	7,395	7,402	7,410	7,410
Chubu	2,409	2,412	2,406	2,400	2,393	2,388	2,381	2,375	2,368	2,362
Hokuriku	475	475	475	474	474	473	473	473	472	472
Kansai	2,647	2,656	2,655	2,661	2,666	2,665	2,661	2,656	2,652	2,646
Chugoku	1,039	1,038	1,040	1,044	1,058	1,083	1,092	1,100	1,103	1,103
Shikoku	478	475	473	470	467	465	462	459	456	454
Kyushu	1,538	1,544	1,551	1,556	1,557	1,560	1,558	1,556	1,553	1,551
60Hz areas Total	8,586	8,600	8,600	8,605	8,615	8,634	8,627	8,619	8,604	8,588
Interconnected	15,700	15,783	15,838	15,900	15,956	16,012	16,022	16,021	16,014	15,998
Okinawa	154	155	159	160	161	162	163	164	165	166
Nationwide	15,854	15,939	15,997	16,060	16,117	16,173	16,185	16,185	16,179	16,163

Table A2-2 Annual Projected Supply Capacity for Each Regional Service Area (in August, 10^4kW at the Sending End)

[10^4kW]

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Hokkaido	535	496	485	546	525	547	546	557	558	559
Tohoku	1,546	1,543	1,481	1,625	1,472	1,471	1,485	1,479	1,473	1,468
Tokyo	6,412	6,437	5,909	6,265	6,320	6,353	6,436	6,427	6,419	6,403
50Hz areas Total	8,494	8,475	7,875	8,437	8,317	8,371	8,467	8,463	8,450	8,429
Chubu	2,863	2,846	2,729	2,703	2,699	2,694	2,715	2,699	2,684	2,669
Hokuriku	565	561	539	534	535	534	539	538	535	533
Kansai	3,146	3,134	3,011	2,997	3,007	3,007	3,034	3,019	3,006	2,990
Chugoku	1,235	1,225	1,180	1,176	1,193	1,222	1,245	1,250	1,250	1,247
Shikoku	568	669	538	544	540	540	542	541	542	543
Kyushu	1,828	1,822	1,759	1,753	1,756	1,760	1,777	1,769	1,760	1,753
60Hz areas Total	10,206	10,257	9,755	9,706	9,730	9,758	9,852	9,817	9,777	9,735
Interconnected	18,700	18,732	17,630	18,143	18,047	18,129	18,319	18,280	18,227	18,164
Okinawa	215	217	212	227	212	227	227	228	228	230
Nationwide	18,915	18,949	17,842	18,369	18,259	18,357	18,546	18,507	18,455	18,394

* The supply capacity for Okinawa in FY 2024 and 2025 indicates that the supply capacity falls to the smallest reserve margin.

Table A2-3 Annual Peak Demand Forecast for Winter Peak Areas of Hokkaido, Tohoku, and Hokuriku (in January, 10^4kW at the Sending End)

[10^4kW]

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Hokkaido	501	503	508	515	519	526	529	529	529	528
Tohoku	1,335	1,342	1,341	1,340	1,338	1,337	1,336	1,335	1,334	1,333
Hokuriku	487	487	486	486	485	485	485	485	484	484

Table A2-4 Annual Projected Supply Capacity for Winter Peak Areas of Hokkaido, Tohoku, and Hokuriku (in January, 10^4kW at the Sending End)

[10^4kW]

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Hokkaido	603	581	636	597	619	626	634	637	637	637
Tohoku	1,606	1,550	1,687	1,813	1,723	1,734	1,744	1,760	1,764	1,777
Hokuriku	574	580	681	687	670	639	638	639	639	639

Table A2-5 Annual Projected Supply–Demand Balance in Okinawa (10^4kW at the Sending End)

[10^4kW]

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Peak Demand	157	158	159	160	161	162	163	164	165	166
Supply Capacity	220	222	212	227	212	227	227	228	228	230
Reserve Capacity	63	64	53	67	51	66	65	64	63	65
Reserve Margin	40.1%	40.4%	33.2%	41.9%	32.0%	40.5%	39.8%	39.1%	38.4%	39.0%

V. Review of the Adequate Level of Balancing Capacity in Each Regional Service Area

Evaluation of Proper Standard of Soliciting Balancing Capacity for FY 2025

[written only in Japanese]

https://www.occto.or.jp/houkokusho/2024/240627_2025chouseiryokukoubo.html

June 2024

Organization for Cross-regional Coordination of Transmission Operators, Japan

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VI. Research and Study

“Research on Nodal Pricing in European Countries and USA” *[written only in Japanese]*

https://www.occto.or.jp/iinkai/chouseiryoku/files/nordal_kaigaicyousa_houkokusyo.pdf

“Research on Evaluating Method for Supply Reliability in Australia” *[written only in Japanese]*

https://www.occto.or.jp/houkokusho/2024/files/shinraidohyokashuhou_23itakuchousa.pdf

Organization for Cross-regional Coordination of Transmission Operators, Japan (OCCTO)
http://www.occto.or.jp/en/index.html