Organization for Cross-regional Coordination of Transmission Operators, Japan

Annual Report

- Fiscal Year 2019 -

February 2020

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

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 of Electricity Supply and Demand (Data for FY 2018)”, “Report on the Quality of Electricity Supply (Data for FY 2018)”, and . “Outlook of of Cross-regional Interconnection Lines (Data for FY 2018)”.
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 2018”.
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 2019 to 2028” and “Review of the Adequate Level of Balancing Capacity in Each Regional Service Area” (Evaluation of Proper Standard of Soliciting Balancing Capacity for FY 2020).

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.

CONTENTS

I. Actual Electric Supply and Demand

Outlook of Electricity Supply and Demand

- Actual Data for FY 2018 -

September 2019

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 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 completion of actual data collection up to fiscal year 2018 (FY 2018).

SUMMARY

This report is presented to review the outlook of electricity supply–demand and cross-regional interconnection lines in FY 2018, based on Article 181 of the Operational Rules of the Organization.

The report consists of two parts: the situation of electricity supply and demand, and interconnection lines.

Regarding supply and demand, the peak demand nationwide, 164,820 MW, was recorded in August, and the monthly electric energy requirement nationwide, 86,276 GWh, was recorded in July due to a severe heat wave across all of Japan.

The reserve margin against summer and winter peak demand was 13.8% and 10.3%, respectively.

Power exchange instructions were issued by the Organization 25 times; 16 of them were dispatched for improvements of supply and demand due to the Hokkaido Eastern Iburi Earthquake.
In addition, long-cycle frequency control was requested for the first time on September 30, and implemented 56 times during the year in the Kyushu EPCO service area.

There were 116 requests to shed power generation of renewables in FY 2018, which occurred on isolated islands as well as on the Kyushu mainland.

We hope this report provides useful information.

CONTENTS

Note:
The text of the Operational Rules was obtained from the amended version of April 1, 2019. 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.

CHAPTER I: ACTUAL ELECTRICITY SUPPLY AND DEMAND

1. Regional Service Areas for 10 General Transmission and Distribution Companies, and the Definition of a Season

(1) Regional Service Areas for 10 General Transmission and Distribution Companies

A regional service area describes the specific area to which a general transmission and distribution (GT&D) company transmits its electricity through cross-regional interconnection lines. Japan is divided into 10 regional service areas as shown in Figure 1-1. Regional service areas served by GT&D companies other than the Okinawa Electric Power Company (EPCO), are connected by cross-regional interconnection lines.

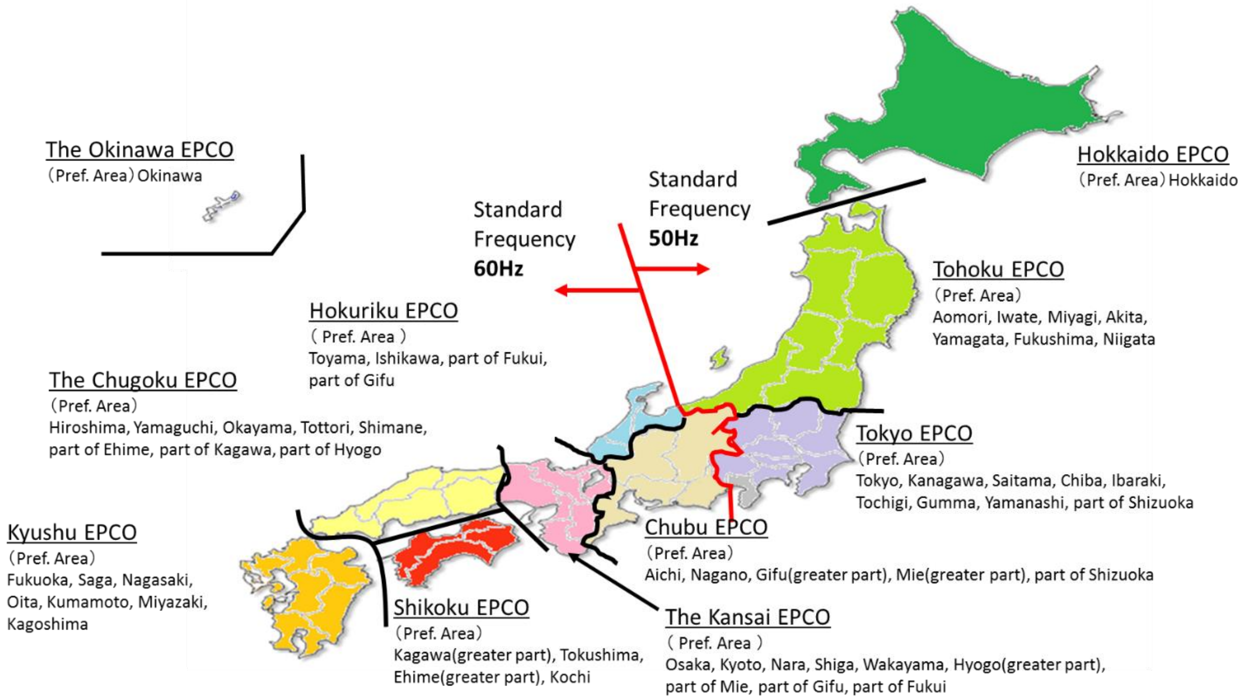


Figure 1-1: The 10 Regional Service Areas in Japan and their Prefectural Distribution

(2) The Definition of Seasons

The report divides the seasons into summer and winter periods. The summer period is defined as July –September and the winter as December–February.

2. Outlook of Actual Weather Nationwide

(1) Weather during the Summer Period (June to August)*

Table 1-1 shows anomalies in the temperature and precipitation ratios from June to August in FY 2018.

(a) Greater expansion of both the Pacific high-pressure system and the Tibetan high-pressure system brought more sunny and hot days, and the seasonal mean temperature in the eastern and western regions became significantly higher. In particular, the eastern region was +1.7 ˚C above the climatological normal, which represents the highest recorded mean temperature since the compilation of meteorological statistics began in 1946; in addition, 48 of 153 local meteorological stations in the county recorded the highest mean temperatures.

(b) The active seasonal stationary front and typhoon No. 7/2018 (Prapiroon) brought record-breaking heavy rain to wide areas across the country; especially in the western region, the heavy rainfall led to a major disaster referred to as the "Heavy Rain Event of July 2018." In addition to this disaster, typhoons and the seasonal stationary front brought heavy rainfalls across the entire country.

(c) Rainfall during the period was significant on the Japan Sea coast along the northern region due to the early summer stationary front and the autumnal stationary front, as well as in on the Pacific Sea coast along the western region and the Okinawa/Amami region, which experienced record-breaking heavy rainfalls due to typhoons and the stationary front. In particular, the Okinawa/Amami region recorded the highest rainfall since compilation of meteorological statistics began in 1946.

Table 1-1: Anomalies in Temperature and Precipitation by Weather Region from June to August

Weather Region	Mean Temperature Anomaly[℃]	Precipitation Ratio[%]
Northern	+0.6	+43
Eastern	+1.7	-7
Western	+1.1	+16
Okinawa/Amami	±0.0	+77

Source: Japan Meteorological Agency (JMA), Tokyo Climate Center.
Seasonal Climate Report over Japan for Summer (FY 2018).
http://ds.data.jma.go.jp/tcc/tcc/products/japan/climate/index.php?kikan=3mon&month=8&year=2018
http://www.data.jma.go.jp/gmd/cpd/cgi-bin/view/kikohyo/en.php?kikan=3mon&month=8&year=2018
* JMA defines the summer period as June to August.

(2) Weather during the Winter Period (December 2018 to February 2019)

Table 1-2 shows the anomalies in temperature and the ratios of rainfall and snowfall from December to February in FY 2018.

(a) Seasonal mean temperatures were very high throughout the nation except in the northern region due to a mild winter. In particular, the mean temperature in the Okinawa/Amami region was +1.8 ˚C above the climatological normal, which represents the highest recorded mean temperature.

(b) Precipitation during the period was quite scarce on the Pacific Sea coast along the northern region and scarce in the northern and eastern regions due to the mild effect of a low pressure system and wet air flows. In contrast, the Okinawa/Amami region had much rain due to warm and wet air flows.

(c) Snowfall during the period was very scarce on the Japan Sea coast along the northern, eastern, and western regions. In particular, the Japan Sea coast along the western region experienced record-breaking low snowfall.

Table 1-2: Anomalies in Temperature, Precipitation, and Snowfall by Weather Region from December to February

Weather Region	Mean Temperature Anomaly[℃]	Precipitation Ratio[%]	Snowfall Ratio[%]
Northern	+0.4	-24	-36
Eastern	+1.1	-26	-74
Western	+1.3	+4	-89
Okinawa/Amami	+1.8	+19	-

Source：Japan Meteorological Agency, Tokyo Climate Center.
Seasonal Climate Report over Japan for Winter (FY 2018).
http://ds.data.jma.go.jp/tcc/tcc/products/japan/climate/index.php?kikan=3mon&month=2&year=2019
http://www.data.jma.go.jp/gmd/cpd/cgi-bin/view/kikohyo/en.php?kikan=3mon&month=2&year=2019

3. Actual Nationwide Peak Demand

Peak demand describes the highest consumption of electricity during a given period, such as day, month, or year. Table 1-3 shows the monthly peak demand for regional service areas in FY 2018. Figures 1-2 and 1-3 show the nationwide monthly peak demand, and the annual peak demand by regional service areas, respectively. In this report, "peak demand" refers to the maximum hourly value of electric energy requirement.

The values in red are the maximum monthly peak demand (i.e., the annual peak demand) and the values in blue are the lowest monthly peak demand for each regional service area.

Table 1-3: Monthly Peak Demand for Regional Service Areas[1]

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	407	362	364	442	416	383	396	447	504	517	542	431
Tohoku	1,049	1,014	1,178	1,357	1,426	1,173	1,034	1,143	1,303	1,367	1,361	1,185
Tokyo	3,638	3,971	4,727	5,653	5,614	4,766	4,123	3,824	4,702	4,918	4,868	4,303
Chubu	1,777	1,936	2,130	2,607	2,622	2,248	1,911	1,833	2,148	2,345	2,230	2,034
Hokuriku	404	395	440	517	521	455	375	399	468	494	503	433
Kansai	1,831	1,993	2,315	2,865	2,801	2,400	1,932	1,904	2,231	2,432	2,346	2,084
Chugoku	772	769	875	1,106	1,086	960	787	818	971	999	964	852
Shikoku	332	354	426	536	525	443	368	359	422	448	426	395
Kyushu	1,085	1,145	1,273	1,601	1,588	1,394	1,156	1,129	1,319	1,336	1,311	1,166
Okinawa	104	131	150	144	145	151	114	106	115	96	94	95
Nationwide	10,969	**11,967**	**13,584**	**16,432**	**16,482**	**13,871**	**11,541**	**11,819**	**13,768**	**14,603**	**14,417**	**12,457**

[1] "Nationwide peak demand" means the maximum of the aggregated demand in a given period for regional service areas of the 10 GT&D companies, not the addition of each regional peak demand.

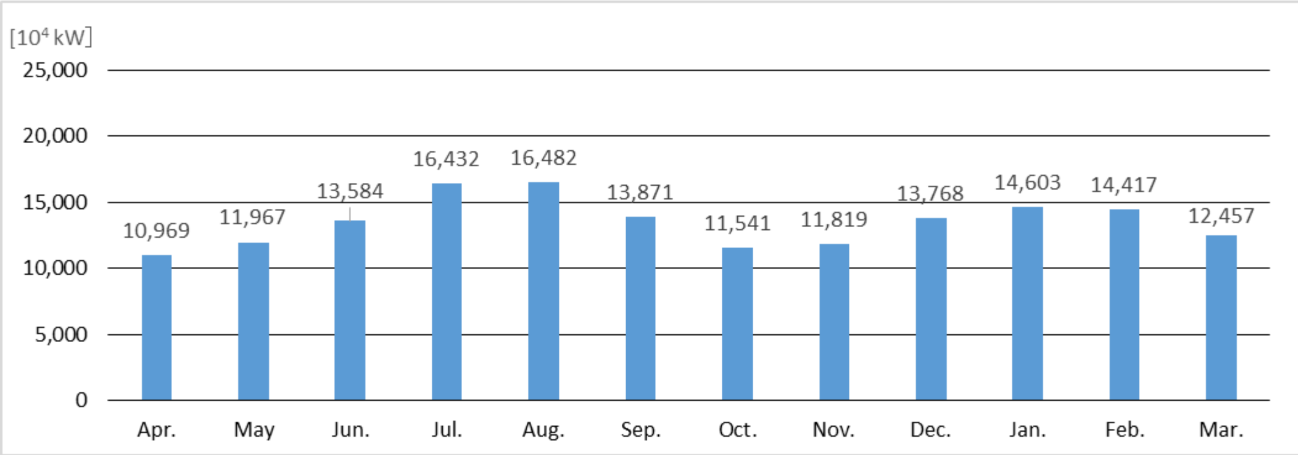


Figure 1-2: Nationwide Monthly Peak Demand

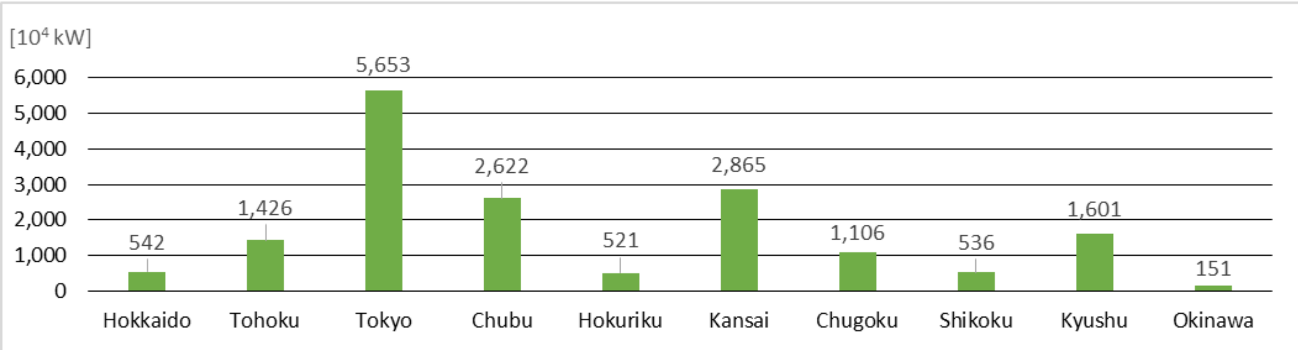


Figure 1-3: Annual Peak Demand for Regional Service Areas

4. Actual Nationwide Electric Energy Requirements

Table 1-4 shows the monthly electric energy requirements for regional service areas in FY 2018. Figures 1-4 and 1-5 show the nationwide monthly electric energy requirements, and annual electric energy requirements for regional service areas, respectively.

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

Table 1-4: Monthly Electric Energy Requirements for Regional Service Areas[2]

[GWh]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
Hokkaido	2,383	2,276	2,195	2,396	2,368	2,051	2,314	2,532	3,146	3,246	2,914	2,762	30,583
Tohoku	6,240	6,109	6,233	7,235	6,963	6,093	6,311	6,645	7,906	8,369	7,434	7,250	82,787
Tokyo	20,762	21,348	22,570	28,795	28,083	22,928	22,040	21,700	25,794	27,320	24,290	23,758	289,387
Chubu	9,947	10,053	10,753	13,143	12,782	10,922	10,611	10,487	11,837	12,537	11,375	11,509	135,957
Hokuriku	2,263	2,200	2,268	2,739	2,648	2,267	2,303	2,377	2,763	2,914	2,618	2,592	29,953
Kansai	10,514	11,000	11,299	14,331	14,187	11,462	10,872	11,015	12,668	13,465	12,084	12,100	144,997
Chugoku	4,501	4,458	4,665	5,735	5,840	4,818	4,688	4,795	5,530	5,775	5,183	5,084	61,073
Shikoku	1,994	2,033	2,134	2,640	2,668	2,199	2,110	2,086	2,414	2,538	2,272	2,294	27,382
Kyushu	6,283	6,506	6,827	8,450	8,702	7,001	6,466	6,572	7,663	7,905	6,991	7,064	86,431
Okinawa	571	692	780	811	836	784	631	587	590	567	519	556	7,924
Nationwide	65,458	**66,677**	**69,723**	**86,276**	**85,076**	**70,524**	**68,345**	**68,795**	**80,311**	**84,636**	**75,681**	**74,970**	**896,473**

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

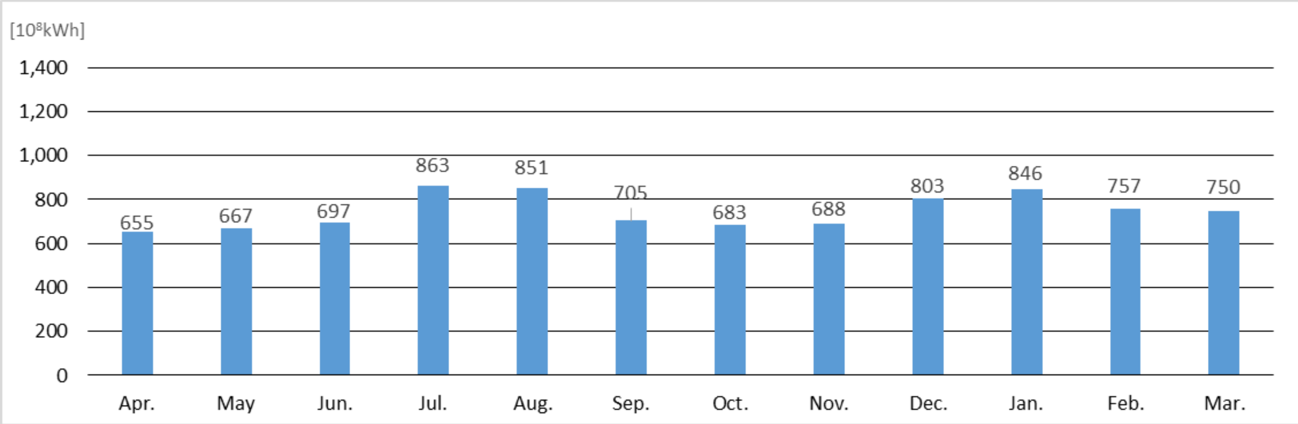


Figure 1-4: Nationwide Monthly Electric Energy Requirements

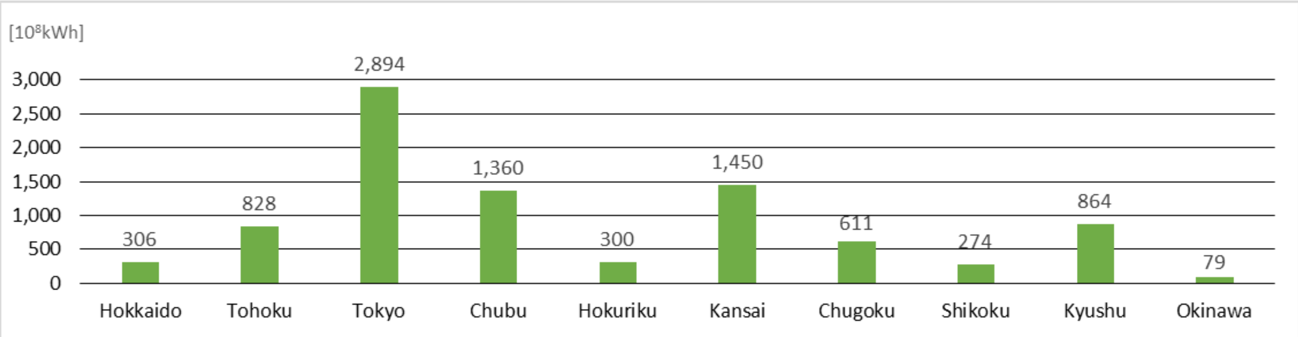


Figure 1-5: Annual Electric Energy Requirements for Regional Service Areas

5. Nationwide Load Factor

The load factor describes the ratio of average demand to peak demand in a given period. Table 1-5 shows the monthly load factor for regional service areas in FY 2018, and Figures 1-6 and 1-7 show the nationwide monthly load factor, and the annual load factor for regional service areas, respectively.

The values in red are the highest monthly load factor and the values in blue are the lowest monthly load factor for each regional service area.

Table 1-5: Monthly Load Factor for Regional Service Areas[3]

[%]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
Hokkaido	81.4	84.5	83.7	72.8	76.4	80.0	78.5	78.7	83.9	84.4	80.0	86.2	**65.0**
Tohoku	82.6	80.9	73.5	71.7	65.6	72.1	82.1	80.8	81.6	82.3	81.3	82.2	**66.3**
Tokyo	79.3	72.3	66.3	68.5	67.2	66.8	71.8	78.8	73.7	74.7	74.3	74.2	**58.4**
Chubu	77.7	69.8	70.1	67.8	65.5	67.5	74.6	79.4	74.1	71.9	75.9	76.0	**59.2**
Hokuriku	77.8	74.9	71.5	71.2	68.3	69.2	82.5	82.7	79.4	79.2	77.4	80.5	**65.6**
Kansai	79.8	74.2	67.8	67.2	68.1	66.3	75.7	80.3	76.3	74.4	76.7	78.0	**57.8**
Chugoku	81.0	77.9	74.1	69.7	72.3	69.7	80.1	81.5	76.6	77.7	80.0	80.2	**63.1**
Shikoku	83.5	77.1	69.6	66.2	68.3	68.9	77.1	80.6	77.0	76.1	79.4	78.0	**58.3**
Kyushu	80.4	76.4	74.5	70.9	73.7	69.8	75.2	80.8	78.1	79.6	79.3	81.4	**61.6**
Okinawa	76.3	71.2	72.4	75.5	77.3	72.3	74.1	77.2	68.9	79.5	81.9	78.5	**60.1**
Nationwide	**82.9**	**74.9**	**71.3**	**70.6**	**69.4**	**70.8**	**79.6**	**80.8**	**78.4**	**77.9**	**78.1**	**80.9**	**62.1**

The load factors in Hokkaido and Nationwide exclude the period of "energy saving to the maximum extent possible" (September 6–19) after Hokkaido Eastern Iburi Earthquake.[4]

For reference, the load factors that include the above period are:

September: 74.3% in Hokkaido, 70.6% in Nationwide.

Annual: 64.4% in Hokkaido, 62.1% in Nationwide.

[3] "Nationwide load factor" refers to the load factor calculated for Japan, and not the average of each regional load factor.

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

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

[4] Energy saving in Hokkaido moved from "energy saving to the maximum extent possible" to "energy saving as far as is reasonable" after September 20, when Unit #1 of the Tomato-Atsuma Thermal Power Plant confirmed its operation at nameplate-rated capacity. See the press release "Effort to save energy in Hokkaido" by the Agency of Natural Resources and Energy, published on September 21, 2018 (in Japanese only).

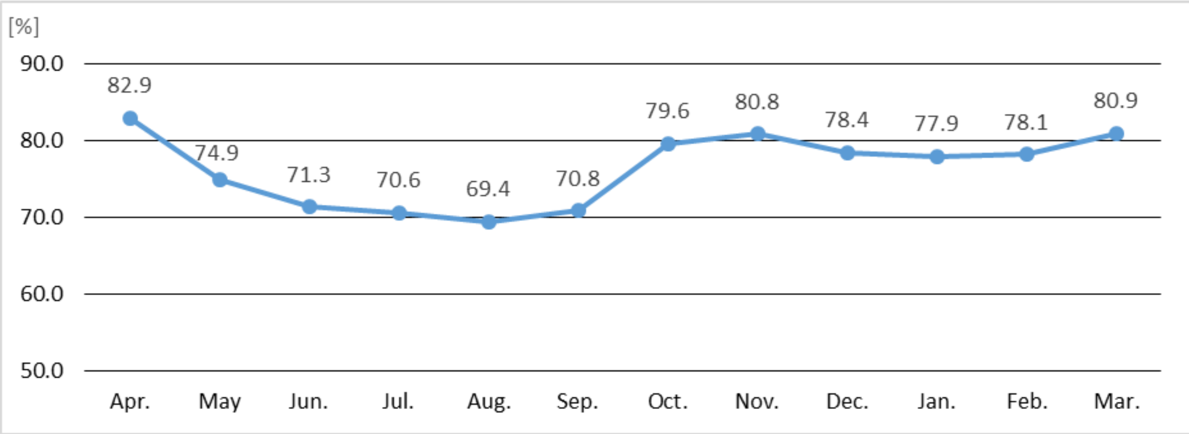


Figure 1-6: Nationwide Monthly Load Factor

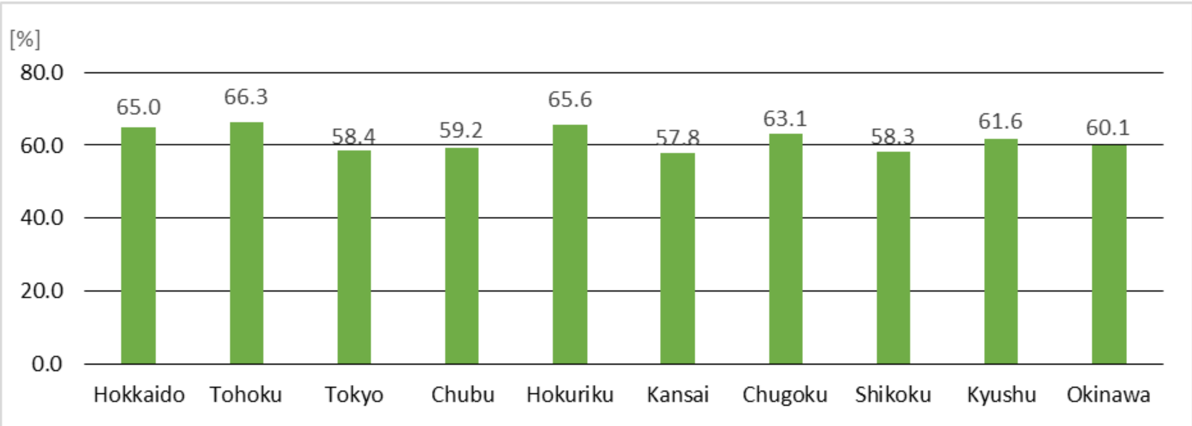


Figure 1-7: Annual Load Factor for Regional Service Areas

6. Nationwide Supply–Demand Status during Peak Demand

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

Table 1-6 shows the supply–demand status during the summer peak demand period for regional service areas in FY 2018.

Table 1-6: Supply–Demand Status during the Summer Peak Demand Period for Regional Service Areas[5]

	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	442	7/31	Tue.	17	33.9	561	118	26.8	8,779	82.7%
Tohoku	1,426	8/23	Thur.	15	34.3	1,691	265	18.6	27,301	79.8%
Tokyo	5,653	7/23	Mon.	15	39.0	6,091	438	7.7	107,220	79.0%
Chubu	2,622	8/6	Mon.	15	39.4	2,847	225	8.6	48,120	76.5%
Hokuriku	521	8/22	Wed.	15	39.5	574	53	10.2	10,048	80.4%
Kansai	2,865	7/19	Thur.	17	38.0	3,018	153	5.3	54,187	78.8%
Chugoku	1,106	7/23	Mon.	17	35.4	1,228	122	11.0	20,855	78.6%
Shikoku	536	7/24	Tue.	17	37.7	583	46	8.6	9,820	76.3%
Kyushu	1,601	7/26	Thur.	15	35.3	1,928	327	20.4	31,402	81.7%
Okinawa	151	9/21	Fri.	12	32.1	204	53	35.2	2,900	80.2%
Nationwide	**16,482**	**8/3**	**Fri.**	**15**	-	**18,749**	**2,267**	**13.8**	**315,434**	**79.7%**

5 The daily maximum temperatures are provided by the Japan Meteorological Agency based on the data for the cities where the headquarters of GT&D companies (except for the Okinawa EPCO) are located. (For the regional service area of the Okinawa EPCO, the data from Naha, 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 peak demand. This capacity is the addition of installed generating capacity including the deducted portion, such as generator suspension for maintenance work, derating with the decrease in river flow, and unplanned generator outages.

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

Table 1-7 shows the supply–demand status during the winter peak demand period for regional service areas in FY 2018.

Table 1-7: Supply–Demand Status during the Winter Peak Demand Period for Regional Service Areas[5]

	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	542	2/8	Fri.	10	-11.5	600	58	10.7	12,193	93.7%
Tohoku	1,367	1/24	Thur.	18	0.3	1,616	248	18.2	29,905	91.1%
Tokyo	4,918	1/10	Thur.	19	2.0	5,212	294	6.0	102,477	86.8%
Chubu	2,345	1/10	Thur.	10	1.8	2,440	96	4.1	48,097	85.5%
Hokuriku	503	2/1	Fri.	10	1.2	601	97	19.3	10,700	88.6%
Kansai	2,432	1/10	Thur.	10	4.8	2,536	104	4.3	49,708	85.2%
Chugoku	999	1/10	Thur.	10	4.6	1,065	67	6.7	20,873	87.1%
Shikoku	448	1/10	Thur.	10	5.6	475	26	5.9	9,166	85.2%
Kyushu	1,336	1/17	Thur.	19	6.1	1,451	115	8.6	28,243	88.1%
Okinawa	115	12/4	Tue.	14	24.8	150	35	30.1	2,222	80.4%
Nationwide	**14,603**	**1/10**	**Thur.**	**10**	-	**16,104**	**1,501**	**10.3**	**308,436**	**88.0%**

7. Nationwide Bottom Demand Period

Table 1-8 shows the status of the bottom demand period for regional service areas (FY 2018).

Table 1-8: Bottom Demand Period for Regional Service Areas[6]

	Bottom Demand [10^4kW]	Occurrence Date & Time			Daily Mean Temperature [℃]	Daily Energy Supply [10^4kWh]
Hokkaido (excl. occurrence of earthquake)	246	6/10	Sun.	8	12.5	64,812
Tohoku	632	5/6	Sun.	1	18.1	16,986
Tokyo	1,984	5/6	Sun.	7	21.0	57,874
Chubu	880	5/4	Fri.	2	15.6	23,701
Hokuriku	208	5/6	Sun.	1	19.2	5,590
Kansai	1,053	5/6	Sun.	8	19.3	29,372
Chugoku	439	5/6	Sun.	1	15.7	12,254
Shikoku	195	5/6	Sun.	8	16.7	5,491
Kyushu	653	5/6	Sun.	1	18.2	18,309
Okinawa	45	9/30	Sun.	3	26.3	1,620
Nationwide	**6,496**	**5/6**	**Sun.**	**2**	-	**179,863**

Data for Hokkaido exclude the period during “energy saving to the maximum extent possible” after the Hokkaido Eastern Iburi Earthquake.

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

8. Nationwide Peak Daily Energy Supply

Tables 1-9 and 1-10 show the summer peak daily energy supply for regional service areas in FY 2018 (July–September) and the winter peak daily energy supply for regional service areas in FY 2018 (December–February), respectively.[7]

Table 1-9: Summer Peak Daily Energy Supply for Regional Service Areas

	Peak Daily Energy Supply [10^4kWh]	Occurrence Date		Daily Mean Temperature [°C]
Hokkaido	8,779	7/31	Tue.	27.9
Tohoku	27,301	8/23	Thur.	28.3
Tokyo	107,652	8/2	Thur.	31.2
Chubu	49,618	7/18	Wed.	32.0
Hokuriku	10,084	8/2	Thur.	30.3
Kansai	54,187	7/19	Thur.	31.9
Chugoku	21,341	7/24	Tue.	32.0
Shikoku	10,110	7/24	Tue.	32.6
Kyushu	31,402	7/26	Thur.	31.0
Okinawa	2,932	7/31	Tue.	29.3
Nationwide	**316,457**	**7/24**	Tue.	-

Table 1-10: Winter Peak Daily Energy Supply for Regional Service Areas

	Peak Daily Energy Supply [10^4kWh]	Occurrence Date		Daily Mean Temperature [°C]
Hokkaido	12,193	2/8	Fri.	-11.5
Tohoku	29,931	2/8	Fri.	-0.4
Tokyo	102,477	1/10	Thur.	2.0
Chubu	48,097	1/10	Thur.	1.8
Hokuriku	10,759	2/14	Thur.	0.9
Kansai	49,708	1/10	Thur.	4.8
Chugoku	20,873	1/10	Thur.	4.6
Shikoku	9,175	2/15	Fri.	4.3
Kyushu	28,243	1/17	Thur.	6.1
Okinawa	2,222	12/4	Tue.	24.8
Nationwide	**308,436**	**1/10**	Thur.	-

[7] See footnote 6.

9. Actual Power Exchange Instructions by the Organization

Instructions

According to the provisions of paragraph 1 of Article 28-44 of the Electricity Business Act, the Organization may, when it finds it necessary to improve the electricity supply–demand status, require members such as electric power companies 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.

During FY 2018, the Organization required EPCOs to exchange power as stated in Table 1-11 according to items 1 to 3, paragraph 1 of Article 111 of the Operational Rules.[8] [9]

In addition, according to items 4 and 5, paragraph 1 of Article 111, the Organization shall instruct the member to lend, deliver, borrow, or share electrical facilities to or from other members, and take the necessary steps to improve their supply–demand status, in addition to the directions; however, no actual instructions were issued.

Controls

The Organization implemented long-cycle cross-regional frequency control[10] on September 30, 2018 for the first time.[11] It was implemented to send surplus electric energy generated from renewable energy-generating facilities in the Kyushu EPCO area to the areas eastward of the Chugoku EPCO through cross-regional interconnection lines by utilizing their available transfer capability. The Organization received the request for control by Kyushu EPCO for measures against the shortage of ability to reduce power supply. Such controls were implemented 56 times in total during FY 2018.

---

8 http://www.occto.or.jp/oshirase/shiji/index.html (in Japanese only).

9 Numbers in the left cells in Table 1-11 are the order of publishing instructions on the website.

10 This means that frequency control by utilizing the balancing capacity of members that are GT&D companies of other regional service areas through interconnection lines when balancing capacity for redundancy becomes or might become insufficient in regional service areas.

11 http://www.occto.or.jp/oshirase/sonotaoshirase/2018/181001_sagechouseiryoku_yousei.html (in Japanese only).

Table 1-11: Actual Power Exchange Instructions by the Organization

[1]	Date	July 18, 2018 at 15:41
	Instruction	・TEPCO PG shall supply 70 MW of electricity to the Kansai EPCO from 16:00 till 17:00 on July 18. ・Chubu EPCO shall supply 500 MW of electricity to the Kansai EPCO from 16:00 till 17:00 on July 18. ・Chubu EPCO shall supply 100 MW of electricity to the Kansai EPCO from 16:00 till 17:00 on July 18. ・The Chugoku EPCO shall supply 200 MW of electricity to Kansai EPCO from 16:00 till 17:00 on July 18. ・Shikoku EPCO shall supply 130 MW of electricity to the Kansai EPCO from 16:00 till 17:00 on July 18. ・The Kansai EPCO shall be supplied 1,000 MW of electricity by TEPCO PG, Chubu, Hokuriku, Chugoku and Shikoku EPCO from 16:00 till 17:00 on July 18.
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of unexpected demand growth caused by higher temperature.
[2]	Date	September 7, 2018 at 4:44
	Instruction	・Tohoku EPCO shall supply 300 MW of electricity at most to Hokkaido EPCO from 5:30 till 24:00 on September 7. ・TEPCO PG shall supply 100 MW of electricity to Hokkaido EPCO from 15:00 till 17:00 and 22:00 till 24:00, respectively on September 7. ・Hokkaido EPCO shall be supplied 300 MW of electricity at most by Tohoku EPCO, and TEPCO PG from 5:30 till 24:00 on September 7.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[3]	Date	September 7, 2018 at 19:54
	Instruction	・TEPCO PG shall supply 280 MW of electricity at most to Hokkaido EPCO from 21:00 till 24:00 on September 7. ・Hokkaido EPCO shall be supplied 280 MW of electricity at most by TEPCO PG from 21:00 till 24:00 on September 7.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[4]	Date	September 7, 2018 at 22:36
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity to Hokkaido EPCO from 0:00 till 24:00 on September 8. ・TEPCO PG shall supply 400 MW of electricity to Hokkaido EPCO from 0:00 till 24:00 on September 8. ・Hokkaido EPCO shall be supplied 600 MW of electricity by Tohoku EPCO and TEPCO PG from 0:00 till 24:00 on September 8.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.

Table 1-11(continued): Actual Power Exchange Instructions by the Organization

[5]	Date	September 8, 2018 at 20:31
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity to Hokkaido EPCO from 0:00 till 24:00 on September 9. ・TEPCO PG shall supply 400 MW of electricity to Hokkaido EPCO from 0:00 till 24:00 on September 9. ・Hokkaido EPCO shall be supplied 600 MW of electricity by Tohoku EPCO and TEPCO PG from 0:00 till 24:00 on September 9.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[6]	Date	September 9, 2018 at 19:45
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 10. ・TEPCO PG shall supply 400 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 10. ・Hokkaido EPCO shall be supplied 600 MW of electricity at most by Tohoku EPCO and TEPCO PG from 0:00 till 24:00 on September 10.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[7]	Date	September 10, 2018 at 22:20
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 11. ・TEPCO PG shall supply 400 MW of electricity at most to Hokkaido EPCO from 7:00 till 23:00 on September 11. ・Hokkaido EPCO shall be supplied 600 MW of electricity at most by Tohoku EPCO and TEPCO PG from 0:00 till 24:00 on September 11.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[8]	Date	September 11, 2018 at 19:18
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 3:00 till 24:00 on September 12. ・TEPCO PG shall supply 200 MW of electricity at most to Hokkaido EPCO from 3:00 till 23:00 on September 12. ・Hokkaido EPCO shall be supplied 400 MW of electricity at most by Tohoku EPCO and TEPCO PG from 3:00 till 24:00 on September 12.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.

Table 1-11(continued): Actual Power Exchange Instructions by the Organization

[9]	Date	September 12, 2018 at 19:26
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 13. ・TEPCO PG shall supply 100 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 13. ・Hokkaido EPCO shall be supplied 300 MW of electricity at most by Tohoku EPCO and TEPCO PG from 0:00 till 24:00 on September 13.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[10]	Date	September 13, 2018 at 21:02
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 14. ・TEPCO PG shall supply 100 MW of electricity at most to Hokkaido EPCO from 14:00 till 22:00 on September 14. ・Hokkaido EPCO shall be supplied 300 MW of electricity at most by Tohoku EPCO and TEPCO PG from 0:00 till 24:00 on September 14.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[11]	Date	September 14, 2018 at 21:20
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 15. ・TEPCO PG shall supply 100 MW of electricity at most to Hokkaido EPCO from 14:00 till 21:00 on September 15. ・Hokkaido EPCO shall be supplied 300 MW of electricity at most by Tohoku EPCO and TEPCO PG from 0:00 till 24:00 on September 15.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[12]	Date	September 15, 2018 at 18:30
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 16. ・TEPCO PG shall supply 50 MW of electricity at most to Hokkaido EPCO from 16:00 till 23:00 on September 16. ・Hokkaido EPCO shall be supplied 250 MW of electricity at most by Tohoku EPCO and TEPCO PG from 0:00 till 24:00 on September 16.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[13]	Date	September 16, 2018 at 19:07
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 17. ・TEPCO PG shall supply 100 MW of electricity at most to Hokkaido EPCO from 15:00 till 22:00 on September 17. ・Hokkaido EPCO shall be supplied 300 MW of electricity at most by Tohoku EPCO and TEPCO PG from 0:00 till 24:00 on September 17.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.

Table 1-11(continued): Actual Power Exchange Instructions by the Organization

[14]	Date	September 17, 2018 at 18:47
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 0:00 till 24:00 on September 18. ・Hokkaido EPCO shall be supplied 200 MW of electricity at most by Tohoku EPCO from 0:00 till 24:00 on September 18.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[15]	Date	September 18, 2018 at 19:52
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 16:00 till 22:00 on September 19. ・Hokkaido EPCO shall be supplied 200 MW of electricity at most by Tohoku EPCO from 16:00 till 22:00 on September 19.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[16]	Date	September 19, 2018 at 19:50
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 16:00 till 22:00 on September 20. ・Hokkaido EPCO shall be supplied 200 MW of electricity at most by Tohoku EPCO from 16:00 till 22:00 on September 20.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[17]	Date	September 20, 2018 at 18:49
	Instruction	・Tohoku EPCO shall supply 200 MW of electricity at most to Hokkaido EPCO from 16:00 till 22:00 on September 21 ・Hokkaido EPCO shall be supplied 200 MW of electricity at most by Tohoku EPCO from 16:00 till 22:00 on September 21.
	Background	To increase supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.
[18] & [19]	Date	October 17, 2018 at 15:38 and 19:30
	Instruction	At 15:38 ・The Kansai EPCO shall supply 600 MW of electricity at most to Shikoku EPCO from 16:30 till 21:00 on October 17. ・Shikoku EPCO shall be supplied 600 MW of electricity at most by the Kansai EPCO from 16:30 till 21:00 on October 17. At 19:30 ・The Kansai EPCO shall supply 600 MW of electricity at most to Shikoku EPCO from 21:00 till 24:00 on October 17. ・Shikoku EPCO shall be supplied 600 MW of electricity at most by the Kansai EPCO from 21:00 till 24:00 on October 17.
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of generator shutdown.

Table 1-11(continued): Actual Power Exchange Instructions by the Organization

[20] & [21]	Date	October 17, 2018 at 22:43 and October 18, 2018 at 10:39
	Instruction	At 15:38 ・The Kansai EPCO shall supply 700 MW of electricity at most to Shikoku EPCO from 00:00 till 12:00 on October 18. ・Shikoku EPCO shall be supplied 700 MW of electricity at most by the Kansai EPCO from 00:00 till 12:00 on October 18. At 10:39 ・The Kansai EPCO shall supply 700 MW of electricity at most to Shikoku EPCO from 12:00 till 23:00 on October 18. ・Shikoku EPCO shall be supplied 700 MW of electricity at most by the Kansai EPCO from 12:00 till 23:00 on October 18.
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of generator shutdown.
[22]	Date	January 10, 2019 at 8:41
	Instruction	・Tohoku EPCO shall supply 300 MW of electricity to Chubu EPCO from 9:00 till 10:00 on January 10. ・TEPCO PG shall supply 1,000 MW of electricity at most to Chubu EPCO from 9:00 till 12:00 on January 10. ・Hokuriku EPCO shall supply 50 MW of electricity to Chubu EPCO from 9:00 till 12:00 on January 10. ・Chubu EPCO shall be supplied 1,050 MW of electricity by Tohoku EPCO, TEPCO PG, and Hokuriku EPCO from 9:00 till 12:00 on January 10.
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of demand growth and decreased solar power output due to bad weather.
[23] [24] & [25]	Date	January 10, 2019 at 12:50, 13:04, and 13:41
	Instruction	At 12:50 ・The Chugoku EPCO shall supply 200 MW of electricity to Chubu EPCO from 13:00 till 13:30 on January 10. ・Chubu EPCO shall be supplied 200 MW of electricity by the Chugoku EPCO from 13:00 till 13:30 on January 10. At 13:04 ・The Chugoku EPCO shall supply 200 MW of electricity to Chubu EPCO from 13:30 till 14:00 on January 10. ・Shikoku EPCO shall supply 300 MW of electricity to Chubu EPCO from 13:30 till 14:00 on January 10. ・Chubu EPCO shall be supplied 500 MW of electricity by the Chugoku, and Shikoku EPCO from 13:30 till 14:00 on January 10. At 13:41 ・Hokkaido EPCO shall supply 100 MW of electricity to Chubu EPCO from 14:00 till 20:00 on January 10. ・Tohoku EPCO shall supply 200 MW of electricity to Chubu EPCO from 17:00 till 20:00 on January 10. ・TEPCO PG shall supply 500 MW of electricity to Chubu EPCO from 14:00 till 20:00 on January 10. ・Hokuriku EPCO shall supply 100 MW of electricity to Chubu EPCO from 14:00 till 20:00 on January 10. ・The Chugoku EPCO shall supply 200 MW of electricity to Chubu EPCO from 14:00 till 17:00 on January 10. ・Shikoku EPCO shall supply 150 MW of electricity at most to Chubu EPCO from 14:00 till 16:00 on January 10. ・Kyushu EPCO shall supply 150 MW of electricity at most to Chubu EPCO from 14:30 till 20:00 on January 10. ・Chubu EPCO shall be supplied 1,050 MW of electricity by Tohoku EPCO, TEPCO PG, Hokuriku, the Chugoku, Shikoku, and Kyushu EPCO from 14:00 till 20:00 on January 10.
	Background	The supply–demand status may degrade without power exchanges through cross-regional interconnection lines because of demand growth and decreased solar power output due to bad weather.

10. Output Shedding of Renewable Energy-generating Facilities Operated by Electric Power Companies other than GT&D Companies

GT&D companies may order renewable energy-generating facilities from other electric power companies to shed their output in case of expected oversupply to demand for its regional service areas after shedding the output of generators other than renewable energy-generating facilities of the GT&D company 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 1-12 to 1-19 show the actual output shedding of renewable energy-generating facilities in FY 2018.[12] The bar in each table indicates that there was no output shedding for the day.

Output shedding of renewable energy-generating facilities was implemented in the case that balancing capacity for redundancy[13] might become insufficient; the shedding period was from 09:00 to 16:00 in each implementation.

Table 1-12: Actual Output Shedding of Renewable Energy-generating Facilities (April 2018)

Date	Location & Shed Capacity			
	Tanegashima (island: kW)	Iki (island: kW)	Tokunoshima (island: kW)	Kyushu (mainland: 10^4 kW)
4/1/(Sun)	120	120	-	-
4/2/(Mon)	570	-	-	-
4/3/(Tue)	1,650	-	-	-
4/5/(Thu)	1,160	-	-	-
4/8/(Sun)	1,610	650	-	-
4/9/(Mon)	1,790	-	-	-
4/10/(Tue)	1,580	420	-	-
4/11/(Wed)	840	-	-	-
4/13/(Fri)	2,470	-	-	-
4/15/(Sun)	640	900	-	-
4/16/(Mon)	2,170	-	-	-
4/18/(Wed)	2,510	120	-	-
4/19/(Thu)	3,250	1,220	-	-
4/20/(Fri)	3,560	450	-	-
4/21/(Sat)	3,630	710	-	-
4/22/(Sun)	1,490	-	-	-
4/25/(Wed)	650	-	-	-
4/27/(Fri)	1,490	-	-	-
4/28/(Sat)	4,120	1,160	-	-
4/29/(Sun)	2,570	760	-	-

12 https://www.occto.or.jp/oshirase/shutsuryokuyokusei/index.html (in Japanese only).

13 This means the ability to decrease power supply of generators such as thermal power generators. The output of renewable energy fluctuates over a short period; it is indispensable to control output of thermal power generators according to the fluctuation. Among such output controls, the range that can control the output of generators is generally called the "balancing capacity for redundancy."

.

Table 1-13: Actual Output Shedding of Renewable Energy-generating Facilities (May 2018)

Date	Location & Shed Capacity			
	Tanegashima (island: kW)	Iki (island: kW)	Tokunoshima (island: kW)	Kyushu (mainland: 10^4 kW)
5/3/(Thu)	120	1,440	-	-
5/4/(Fri)	3,320	1,450	-	-
5/5/(Sat)	1,140	960	-	-
5/10/(Thu)	2,710	270	-	-
5/11/(Fri)	2,860	-	-	-
5/12/(Sat)	1,520	-	-	-
5/13/(Sun)	500	-	-	-
5/14/(Mon)	2,450	420	-	-
5/15/(Tue)	400	-	-	-

Table 1-14: Actual Output Shedding of Renewable Energy-generating Facilities (June 2018)

Date	Location & Shed Capacity			
	Tanegashima (island: kW)	Iki (island: kW)	Tokunoshima (island: kW)	Kyushu (mainland: 10^4 kW)
6/2/(Sat)	760	-	-	-
6/12/(Tue)	370	-	-	-

Table 1-15: Actual Output Shedding of Renewable Energy-generating Facilities (October 2018)

Date	Location & Shed Capacity			
	Tanegashima (island: kW)	Iki (island: kW)	Tokunoshima (island: kW)	Kyushu (mainland: 10^4 kW)
10/13/(Sat)	-	-	-	42.7
10/14/(Sun)	-	-	-	61.8
10/18/(Thu)	210	-	-	-
10/20/(Sat)	-	-	-	70.3
10/21/(Sun)	780	-	-	117.6
10/27/(Sat)	610	-	-	-
10/28/(Sun)	200	-	-	-

Table 1-16: Actual Output Shedding of Renewable Energy-generating Facilities (November 2018)

Date	Location & Shed Capacity			
	Tanegashima (island: kW)	Iki (island: kW)	Tokunoshima (island: kW)	Kyushu (mainland: 10^4 kW)
11/3/(Sat)	-	-	-	55.1
11/4/(Sun)	-	680	-	120.7
11/10/(Sat)	-	-	-	63.4
11/11/(Sun)	-	-	-	100.2
11/20/(Tue)	700	-	-	-
11/23/(Fri)	400	-	-	-
11/25/(Sun)	410	-	-	-

Table 1-17: Actual Output Shedding of Renewable Energy-generating Facilities (January 2019)

Date	Location & Shed Capacity			
	Tanegashima (island: kW)	Iki (island: kW)	Tokunoshima (island: kW)	Kyushu (mainland: 10^4 kW)
1/3/(Thu)	1,190	-	-	63.1
1/14/(Mon)	530	-	-	-
1/18/(Fri)	910	-	-	-
1/21/(Mon)	470	-	-	-
1/23/(Wed)	810	-	-	-
1/24/(Thu)	1,540	-	-	-
1/25/(Fri)	100	-	-	-
1/27/(Sun)	1,290	-	-	-
1/29/(Tue)	160	-	-	-

Table 1-18: Actual Output Shedding of Renewable Energy-generating Facilities (February 2019)

Date	Location & Shed Capacity			
	Tanegashima (island: kW)	Iki (island: kW)	Tokunoshima (island: kW)	Kyushu (mainland: 10^4 kW)
2/2/(Sat)	490	-	-	-
2/4/(Mon)	520	-	-	-
2/6/(Wed)	780	-	-	-
2/24/(Sun)	-	-	-	138.4
2/26/(Tue)	1,880	-	-	-

Table 1-19: Actual Output Shedding of Renewable Energy-generating Facilities (March 2019)

Date	Location & Shed Capacity			
	Tanegashima (island: kW)	Iki (island: kW)	Tokunoshima (island: kW)	Kyushu (mainland: 10^4 kW)
3/1/(Fri)	2,860	-	-	-
3/2/(Sat)	-	-	-	110.6
3/5/(Tue)	2,300	-	-	78.6
3/8/(Fri)	2,290	-	-	124.3
3/11/(Mon)	2,770	-	-	52.7
3/12/(Tue)	2,690	-	-	121.3
3/13/(Wed)	2,890	-	370	104.7
3/14/(Thu)	720	-	-	-
3/15/(Fri)	-	-	-	37.4
3/16/(Sat)	3,520	-	-	125.6
3/17/(Sun)	4,050	750	-	179.8
3/18/(Mon)	780	-	-	-
3/19/(Tue)	-	410	-	-
3/20/(Wed)	1,910	-	-	98.2
3/23/(Sat)	620	-	-	144.4
3/24/(Sun)	4,370	830	-	194.0
3/26/(Tue)	4,120	-	-	132.1
3/27/(Wed)	4,360	-	240	102.4
3/30/(Sat)	-	-	-	75.4
3/31/(Sun)	2,730	340	410	183.2

CONCLUSION

Actual Electricity Supply–Demand

For actual electricity supply–demand, data on the peak demand, electric energy requirement, load factor, and supply–demand status during the peak demand period and the bottom demand period, and peak daily energy supply are collected. In addition, instructions concerning power exchange according to the provisions of paragraph 1 of Article 28-44 of the Electricity Business Act, and 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 are aggregated.

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

Report on the Quality of Electricity Supply

- Data for Fiscal Year 2018 -

February 2020

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

Introduction

Part of the role of the Organization for Cross-regional Coordination of Transmission Operators, Japan (OCCTO), is to evaluate supply reliability conditions in securing a stable electricity supply. For this purpose, OCCTO continuously gathers and publishes actual data on the quality of electricity supply according to the provisions of Article 181 of OCCTO's Operational Rules.

This report aggregates actual data for frequency, voltage, and interruptions under the title "Quality of Electricity Supply" and presents their evaluation of the data, which are collected from each regional service area for the fiscal year in 2018 (FY 2018). With these data, OCCTO evaluates and analyses whether frequencies or voltages have been maintained within certain parameters, or whether the occurrence of supply interruption has become more frequent. In addition, regarding supply interruption, although the data conditions are not uniform, a comparison with European Union (EU) countries and major states from the United States of America (US) was conducted as a reference.
OCCTO's objective is to facilitate the use of the aggregated data, evaluations, and analyses as a reference for the electricity business.

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

SUMMARY

The quality of nationwide electricity supply in FY 2018 was reviewed in this report based on Article 181 in OCCTO's Operational Rule.

Three aspects of the quality of electricity-supply, were evaluated in this report: i.e., frequency, standard voltage, and interruption.

Although indices are available for evaluating each item above, this report used the same indices as those in the previous reports to allow for historical comparison.

Frequency

Frequency was analyzed using the frequency time-kept ratio which is the ratio of time that the metered frequency is maintained within a given target control range. Four areas were grouped into synchronized frequency regions: Hokkaido, Eastern Japan, Central and Western Japan, and Okinawa. The transmission operators in the Eastern and Western areas of Japan use 50 Hz and 60 Hz, respectively.
This report checked the ratios in these four synchronized regions, and observed that a deviation beyond the target control range was recognized only in the Hokkaido region, which was probably due to the blackout caused by the Hokkaido Eastern Iburi Earthquake.

Standard Voltage

The standard voltage was evaluated using the number of points where the standard voltage did not satisfy the target values, as defined by the enforcement regulations of the Electricity Business Act, (hereafter, the Act), which sets the targets for transmission operators to maintain a standard voltage supply within a certain range of values.
Transmission operators handed in their data at OCCTO's request. No violation of standard voltage was observed nationwide among 6,603 points for 100 V and 6,533 points for 200 V, respectively.

Interruption

Finally, interruptions were monitored from three perspectives; i.e., the number of supply disturbances by the place of occurrence, the number of supply disturbances by cause, i.e., beyond the given standards in time duration and lost capacity, and System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI) values for low-voltage (LV) customers.
The first analysis indicated that the number of supply disturbances was 25,274 in total, which was almost double that in the previous year.

The second analysis divided the causes into two factors: i.e., maintenance problems or a natural disaster, irrelevant to the maintenance problem.
These analyses indicate that the number of supply disturbances that were reported was 31 in total, which was almost double that of the previous year. The number of supply disturbances caused by natural disasters was 20, which was also double the average of the last 5 years.
The final analysis was the historical monitoring of SAIFI and SAIDI values, which were both at their highest levels compared with the data from the past 5 years. In particular, a markedly significant increase was observed in SAIDI values, which was attributable to the blackout in the Hokkaido region and heavy rainfalls from typhoons and seasonal fronts in the Central and Western, and the Okinawa regions.

For reference, the report also compared SAIFI and SAIDI values with those of other countries and states, although the index definitions were not the same among these other countries and states.

We hope that this report will help you to understand the quality of electricity supply in Japan.

CONTENTS

<Errata>

2021/11/17	P7, P9	Table 8 & Figure 9 (Nationwide), Table 14 & Figure 15 (Kansai) Number of Supply Disturbances Where Interruptions Were Originated	Data for FY 2018 are partly altered.
	P16 P18	Table 34(Hokkaido), Table 42(Kyushu) Indices of System Average Interruption	Descripiton of data are partly corrected.

I. Frequency Data

1. Standard Frequency in Japan

In Japan, general transmission and distribution companies must endeavor to maintain the frequency value of the electricity supply at the levels specified by Ordinance of the Ministry of Economy, Trade and Industry in principle according to Article 26 of the Act. Figure 1 shows the regional service areas of the 10 general transmission and distribution companies and their standard frequencies.

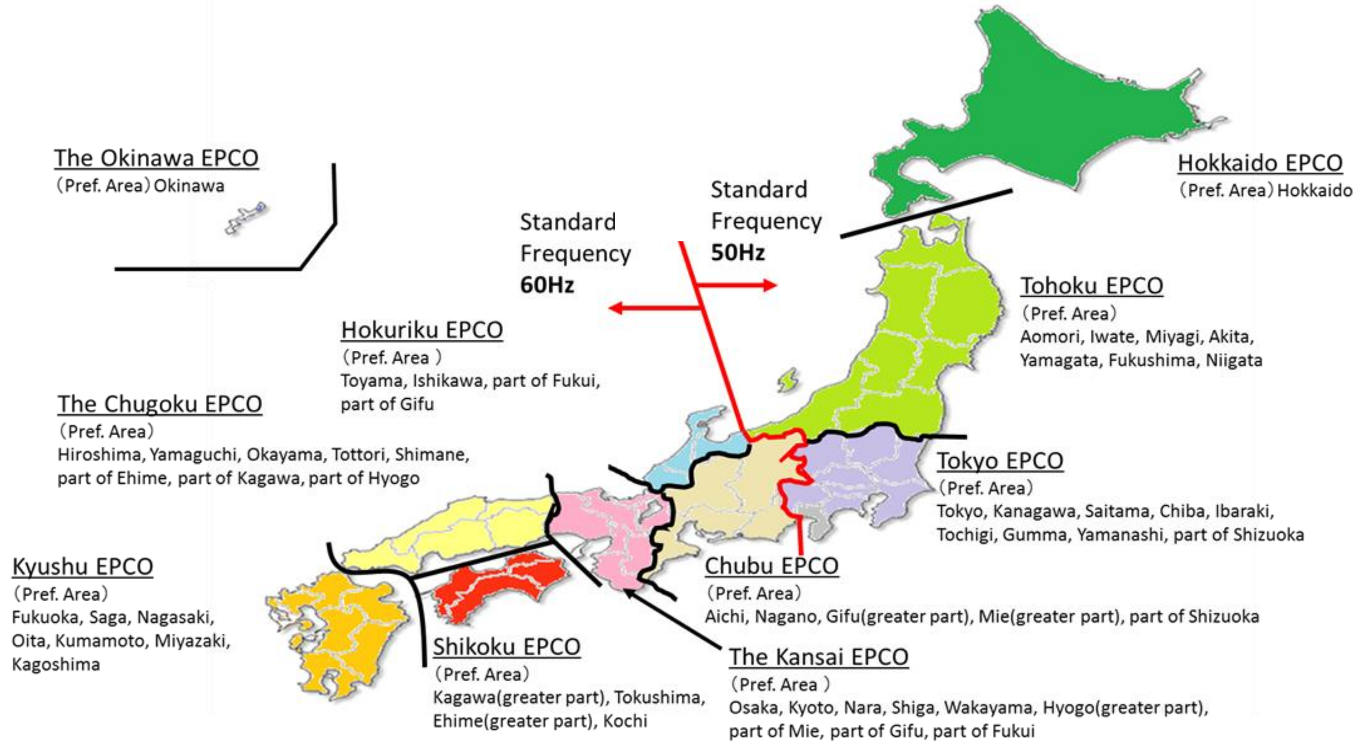


Figure 1 Regional Service Areas of the 10 General Transmission and Distribution Companies and their Standard Frequencies

2. Frequency Time-kept Ratio

The frequency time-kept ratio is the criterion of maintained frequency; i.e., the ratio of time that the metered frequency is maintained within a given variance of the standard, which is calculated by the following formula:

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

3. Frequency Control Rule

According to the indices of the frequency time-kept ratio formula, Table 1 shows the frequency control rule under normal conditions for the regional service areas.

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

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

4. Frequency Time-kept Ratio by Frequency-synchronized Region (FY 2014–2018)

Tables 2 to 5 show the frequency time-kept ratio by frequency-synchronized regions from FY 2014 to 2018 and Figures 2 to 5 show the trend of maintaining the frequency within 0.1 Hz variance.

The target frequency time-kept ratios within 0.1 Hz variance for FY 2018 were lower in three regions, including Hokkaido, Central and Western, and Okinawa regions compared with the previous year's data. They were at their second lowest values for the past 5 years.

For the Hokkaido region, the control target for the standard frequency became lower than the frequency time-kept ratio for the previous year, and under 100% for the past 5 years.

【Criteria】

(pink)	Control Target	···	100.00%
(light blue)	Target Time Kept Ratio within ±0.1Hz	···	95.00% Over

Table 2 Frequency Time Kept Ratio (Hokkaido, FY 2014–2018) [%]

Variance	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Within 0.1 Hz	99.91	99.83	99.96	99.97	99.86
Within 0.2 Hz	100.00	100.00	100.00	100.00	99.95
Within 0.3 Hz	100.00	100.00	100.00	100.00	99.98
Beyond 0.3 Hz	0.00	0.00	0.00	0.00	0.02

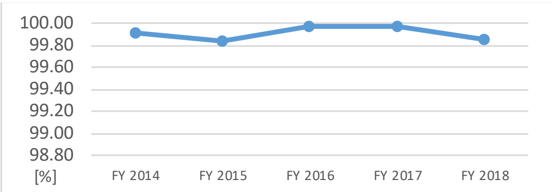


Figure 2 Time Kept Ratio within 0.1 Hz (Hokkaido, FY 2014-2018)

Table 3 Frequency Time Kept Ratio (Eastern region,[1] FY 2014–2018) [%]

Variance	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Within 0.1 Hz	99.84	99.85	99.78	99.80	99.84
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

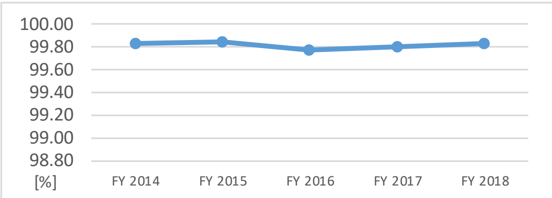


Figure 3 Time Kept Ratio within 0.1 Hz (Eastern region,[1] FY 2014-2018)

Table 4 Frequency Time Kept Ratio (Central & Western region,[2] FY 2014–2018) [%]

Variance	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Within 0.1 Hz	99.17	99.22	99.08	99.17	99.13
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

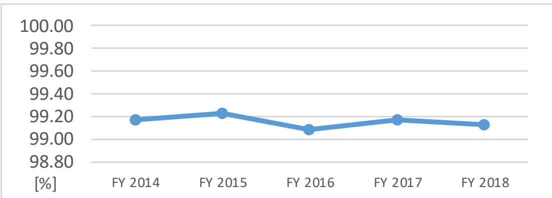


Figure 4 Time Kept Ratio within 0.1 Hz (Central & Western region,[2] FY 2014-2018)

Table 5 Frequency Time Kept Ratio (Okinawa, FY 2014–2018) [%]

Variance	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Within 0.1 Hz	99.87	99.89	99.94	99.92	99.89
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

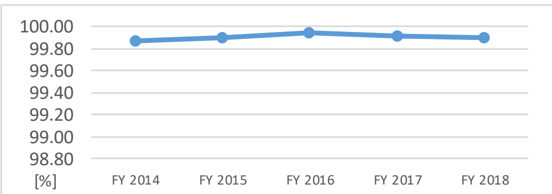


Figure 5 Time Kept Ratio within 0.1 Hz (Okinawa, FY 2014-2018)

---

[1] The Eastern region includes the regional service areas of the Tohoku electric power company (EPCO) and TEPCO PG. Actual data were collected from the area of TEPCO PG.

[2] The Central and Western regions of Japan include the regional service areas of Chubu, and Hokuriku, and the Kansai, and the Chugoku, and Shikoku, and Kyushu EPCOs. Actual data were collected from the area of the Kansai EPCO.

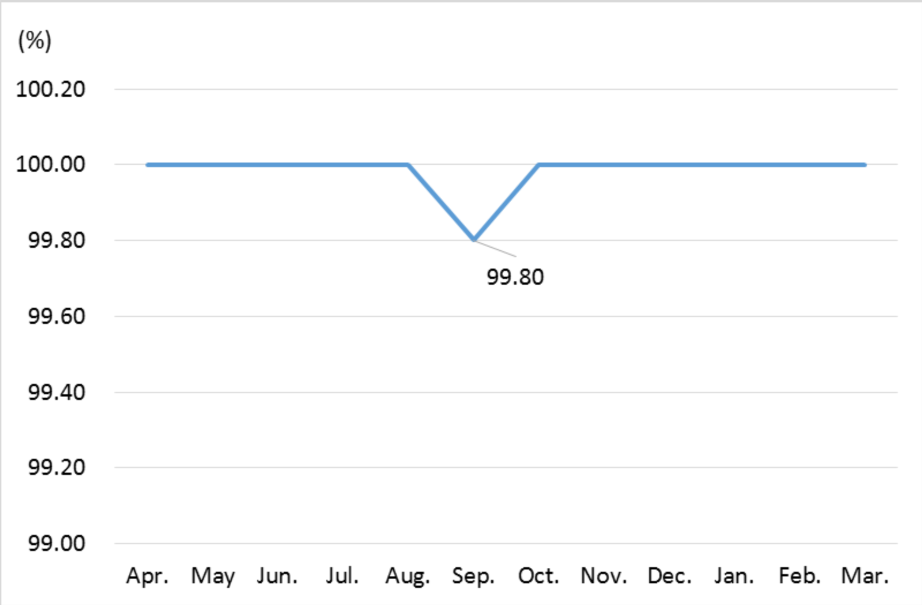


Figure 6 Monthly Frequency Time-kept Ratio against Control Target for the Standard Frequency

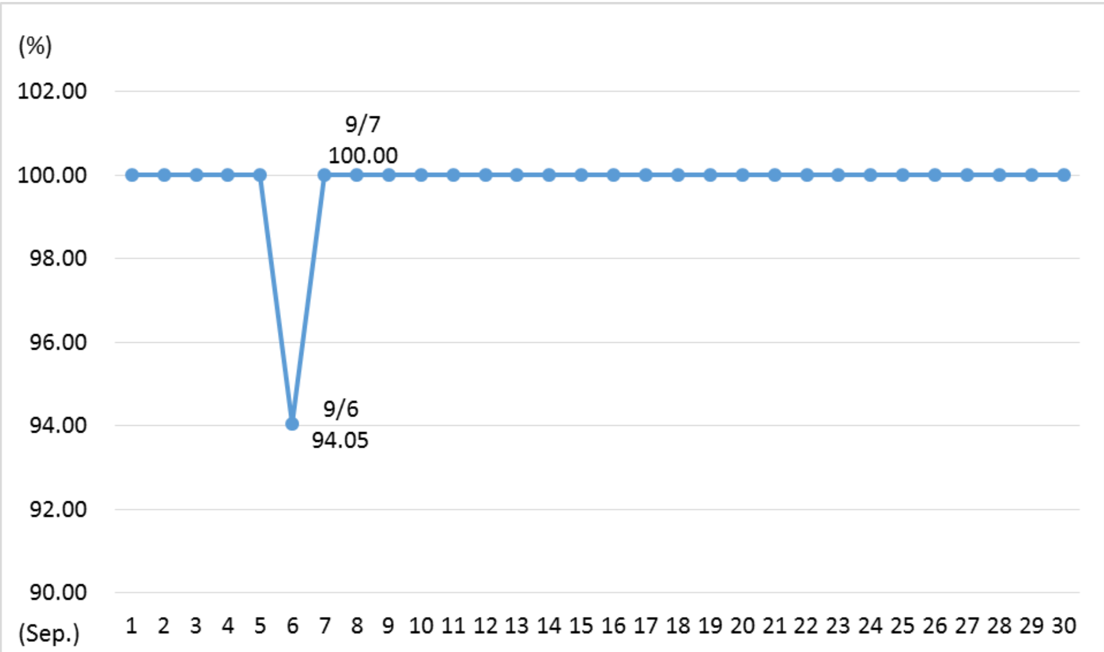


Figure 7 Daily Frequency Time-kept Ratio against Control Target for the Standard Frequency

Figures 6 and 7 show the monthly and daily frequency time-kept ratio in the Hokkaido region, respectively. The monthly frequency time-kept ratio fell under 100% only in September (Figure 6) and the only day which the daily frequency time-kept ratio fell was on September 6 (Figure 7). The Hokkaido Eastern Iburi Earthquake occurred on September 6; thus, the frequency fluctuation was possibly caused by the major supply interruption (i.e., a ‘blackout’) that spread over the whole region after the earthquake.

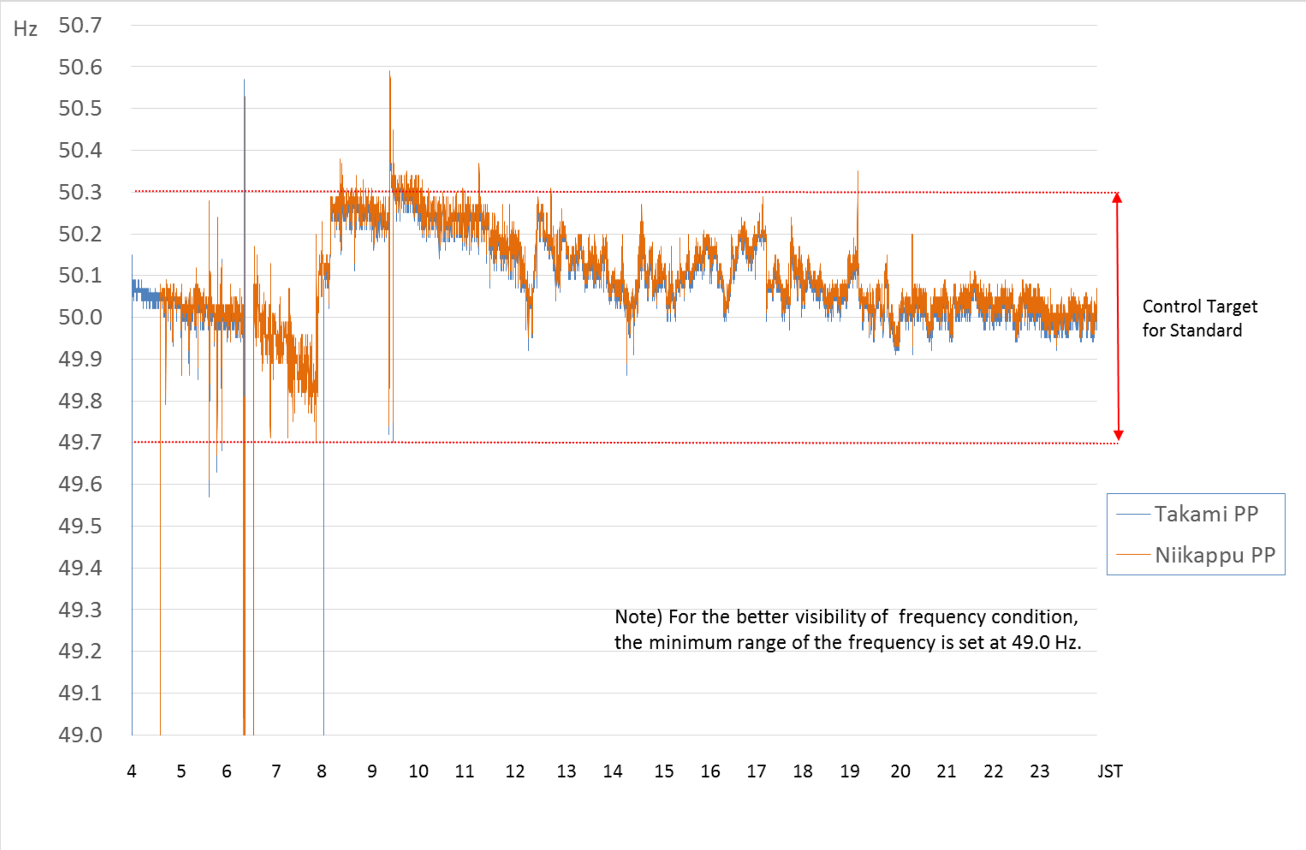


Figure 8 Bus Frequency at Takami Power Plant and Niikappu Power Plant of Hokkaido EPCO on Sep. 6, 2018 (Hz; sampling in every 3 seconds from 4:00 to 24:00 JST. Prepared anew from materials of Investigation Committee on the Major Blackout by the 2018 Hokkaido Eastern Iburi Earthquake by OCCTO)

Figure 8 shows the hourly frequency fluctuations on September 6. After the blackout, the central dispatching center of Hokkaido Electric Power Company Inc. (EPCO) directed black-start processes to restore system operation. The first and the second directions for the black start were given to Unit #1 of Takami Power Plant and to Units #1 and #2 of Niikappu Power Plant, respectively. As shown in Figure 8, the bus frequencies of both power plants temporarily fluctuated beyond the control target range after the second black-start attempt at 6:30 am: however, they gradually stabilized around 50 Hz according to the increased supply capability.

For details of the blackout, please see the report from the Investigation Committee on the Major Blackout by the 2018 Hokkaido Eastern Iburi Earthquake.[3]

[3] http://www.occto.or.jp/iinkai/hokkaido_kensho/files/Final_report_hokkaido_blackout.pdf
http://www.occto.or.jp/iinkai/hokkaido_kensho/files/Final_report_hokkaido_blackout_summarized.pdf

II. Voltage Data

1. Japanese Voltage Standard

General transmission and distribution companies should endeavor to maintain the voltage value of the electricity supply at the levels specified by Article 26 of the Act. Table 6 shows the nationwide voltage standard and target voltage control.

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 of the Ministerial Ordinance of the Act, general transmission and distribution companies should measure their voltage during the period designated by the Director General of the Regional Bureau of Economy, Trade, and Industry, who administrates regional service areas or supply points (for Hokuriku EPCO, Director General of Chubu Bureau of Economy, Trade, and Industry, Electricity and Gas Department Hokuriku) for once over 24 consecutive hours at selected measuring points, unless otherwise stated. General transmission and distribution companies must calculate the averages every 30 minutes, including the maximum and the minimum values, and review whether these values deviate from the average or not.

3. Nationwide Voltage Deviation Ratio (FY 2014–2018)

Table 7 shows the total measured points, deviated measured points, and nationwide deviation ratio from FY 2014 to 2018.

From the FY 2018 data, we see that no deviation from the voltage standard was observed and the nationwide voltage was maintained adequately with respect to the voltage standard.

Table7 Voltage Deviation Measurement (Nationwide, FY 2014-2018) [points]

Voltage		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
100V	Total Measured Points	6,561	6,554	6,590	6,593	6,603
	Deviated Points	0	0	0	0	0
200V	Total Measured Points	6,483	6,508	6,532	6,534	6,533
	Deviated Points	0	0	0	0	0

III. Interruption Data

1. Data of Number of Supply Disturbances Where Interruption Originated

(1) Indices and Definition of Supply Disturbances

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

A supply disturbance means the interruption of the electricity supply or emergency restriction of electricity use due to malfunction or misuse of electric facilities.[4] The case in which electricity supply is resumed by automatic reclosing[5] of the transmission line is not applicable to supply disturbance.[6]

(2) Data for the Number of Supply Disturbances Nationwide and by Regional Service Area (FY 2014–2018)

Table 8 and Figure 9 show the number of supply disturbances nationwide where interruptions originated in the period FY 2014–2018. Tables 9 to 18 and Figures 10 to 19 show the data from regional service areas. Further, the "Involving Accidents" category in the tables indicate the number of supply disturbances that were induced from the accidents of electric facilities other than the corresponding general transmission and distribution companies. The table columns were left blank if zero value or the data are not available.

An analysis of the FY 2018 data indicates the following points.

- The total number of supply disturbances increased by almost 10,000 compared to the 5-year average. Eight regional areas other than Hokkaido and Tohoku EPCOs, exceeded the 5-year average.
- A breakdown of the tables shows that most of the supply disturbances occurred in high-voltage (HV) overhead lines.
- The significant increase in supply disturbances at HV overhead lines were attributable to several natural disasters that occurred in FY 2018. They are;
  - ✓ A series of weather conditions from May to July that were designated as extreme disasters, such as heavy rainfalls and rainstorms, including heavy rainfall in July, typhoons no.5 (Maliksi), no.6 (Gaemi), no.7 (Prapiroon), and no.8 (Maria).

---

[4] Electric facilities include machinery, apparatus, dams, conduits, reservoirs, electric lines, and other facilities installed for the generation, transformation, transmission, distribution, or consumption of electricity as defined by the Article 38 of the Act.

[5] The automatic reclosing of a transmission line means the reconnection of a transmission line by re-switching of the circuit breaker after a given period, when an accident such as a lightning strike occurs to the transmission or distribution line and isolated fault section by opening of the circuit breaker due to the action of a protective relay.

[6] According to the provision of Item viii, Paragraph 2 of Article 1 of Reporting Rules of the Act, a 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, hereinafter, the same shall apply in this article) due to malfunction, misuse or disoperation of electric facility. However, the case in which electricity supply is resumed by automatic reclosing of the transmission line is not applicable to supply disturbance.

- ✓ Typhoon no.21 (Jebi) in September 2018 which powerfully hit the southern part of Tokushima Prefecture and crossed into the Kansai region for the first time in 25 years since 1993, was later designated as an extreme disaster.
- ✓ Typhoon no.24 (Trami) in September 2018 which also powerfully hit Wakayama Prefecture and crossed into mainland Japan with rapidly accelerating speed, was also later designated as an extreme disaster.

・In addition to the above disasters, a major blackout occurred in the Hokkaido region due to the 2018 Hokkaido Eastern Iburi Earthquake on September 6. This blackout might be included in the supply disturbance; however, the origin of the interruption could not be identified because of complex factors. Therefore, the number of supply disturbances does not include the case evoked by the blackout.

Table 8 Number of Supply Disturbances Where Interruption Originated (Nationwide, FY 2014–2018)

Occurrence in			FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities								
	Substations		42	45	70	45	65	53.4
	Transmission Lines & Extra High Voltage Lines	Overhead	186	204	230	278	409	261.4
		Under-ground	9	13	9	14	10	11.0
		Total	195	217	239	292	419	272.4
	High Voltage Lines	Overhead	11,532	10,370	10,235	12,679	20,729	13,109.0
		Under-ground	189	198	215	216	265	216.6
		Total	11,721	10,568	10,450	12,895	20,994	13,325.6
	Demand Facilities					1		0.2
Involvng Accidents			460	333	269	343	359	352.8
Total Disturbances			12,418	11,163	11,028	13,576	21,837	14,004.4

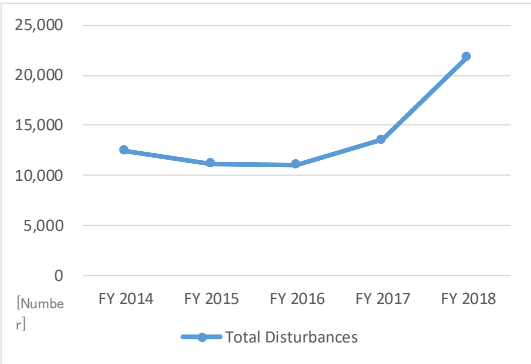


Figure 9 Transition of Supply Disturbances (Nationwide, FY 2014–2018)

Table 9 Number of Supply Disturbances Where Interruption Originated (Hokkaido, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		2	1	1		5	1.8
Transmission Lines & Extra High Voltage Lines	Overhead	15	20	24	30	25	22.8
	Under-ground	2					0.4
	Total	17	20	24	30	25	23.2
High Voltage Lines	Overhead	1,119	1,145	1,289	1,144	1,139	1,167.2
	Under-ground	13	10	13	19	13	13.6
	Total	1,132	1,155	1,302	1,163	1,152	1,180.8
Demand Facilities							
Involvng Accidents		34	24	28	17	12	23.0
Total Disturbances		1,185	1,200	1,355	1,210	1,194	1,228.8

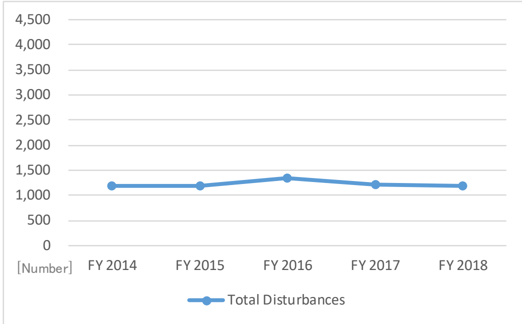


Figure 10 Transition of Supply Disturbances (Hokkaido, FY 2014–2018)

Table 10 Number of Supply Disturbances Where Interruption Originated (Tohoku, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		5	5	8	4	9	6.2
Transmission Lines & Extra High Voltage Lines	Overhead	19	7	11	16	11	12.8
	Under-ground				1		0.2
	Total	19	7	11	17	11	13.0
High Voltage Lines	Overhead	1,912	1,327	1,403	1,957	1,478	1,615.4
	Under-ground	6	5	12	5	11	7.8
	Total	1,918	1,332	1,415	1,962	1,489	1,623.2
Demand Facilities							
Involvng Accidents		43	22	22	26	20	26.6
Total Disturbances		1,985	1,366	1,456	2,009	1,529	1,669.0

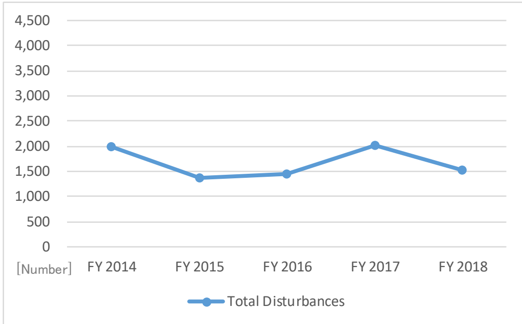


Figure 11 Transition of Supply Disturbances (Tohoku, FY 2014–2018)

Table 11 Number of Supply Disturbances Where Interruption Originated (Tokyo, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		10	10	14	17	16	13.4
Transmission Lines & Extra High Voltage Lines	Overhead	26	30	16	24	38	26.8
	Under-ground	2	5	2	4		2.6
	Total	28	35	18	28	38	29.4
High Voltage Lines	Overhead	1,854	1,755	2,204	2,311	3,841	2,393.0
	Under-ground	67	74	75	65	100	76.2
	Total	1,921	1,829	2,279	2,376	3,941	2,469.2
Demand Facilities							
Involvng Accidents		118	125	93	96	107	107.8
Total Disturbances		2,077	1,999	2,404	2,517	4,102	2,619.8

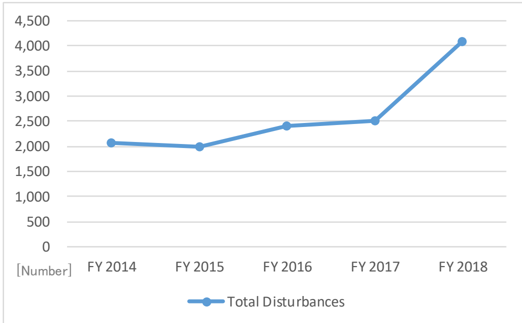


Figure 12 Transition of Supply Disturbances (Tokyo, FY 2014–2018)

Table 12 Number of Supply Disturbances Where Interruption Originated (Chubu, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		2	5	6	3	6	4.4
Transmission Lines & Extra High Voltage Lines	Overhead	12	8	16	9	26	14.2
	Under-ground						
	Total	12	8	16	9	26	14.2
High Voltage Lines	Overhead	1,592	1,066	1,069	1,607	4,053	1,877.4
	Under-ground	8	7	5	11	39	14.0
	Total	1,600	1,073	1,074	1,618	4,092	1,891.4
Demand Facilities							
Involvng Accidents		86	38	40	49	66	55.8
Total Disturbances		1,700	1,124	1,136	1,679	4,190	1,965.8

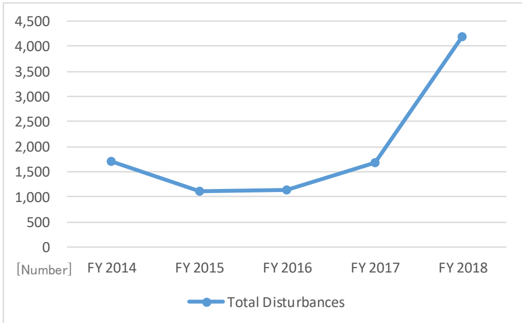


Figure 13 Transition of Supply Disturbances (Chubu, FY 2014–2018)

Table 13 Number of Supply Disturbances Where Interruption Originated (Hokuriku, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		4		3	1		1.6
Transmission Lines & Extra High Voltage Lines	Overhead	6	5	7	4	7	5.8
	Under-ground		1			2	0.6
	Total	6	6	7	4	9	6.4
High Voltage Lines	Overhead	364	258	303	542	385	370.4
	Under-ground	4	7	10	5	3	5.8
	Total	368	265	313	547	388	376.2
Demand Facilities							
Involvng Accidents		18	10	17	15	21	16.2
Total Disturbances		396	281	340	567	418	400.4

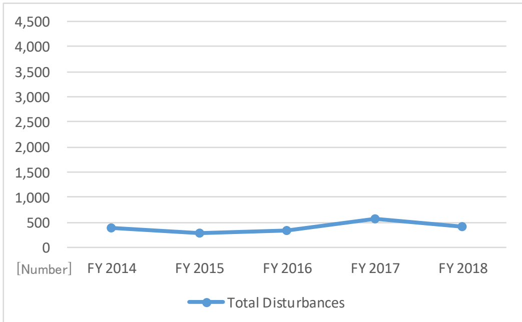


Figure 14 Transition of Supply Disturbances (Hokuriku, FY 2014–2018)

Table 14 Number of Supply Disturbances Where Interruption Originated (Kansai, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		2	7	13	9	8	7.8
Transmission Lines & Extra High Voltage Lines	Overhead	44	42	80	102	190	91.6
	Under-ground	4	6	3	7	6	5.2
	Total	48	48	83	109	196	96.8
High Voltage Lines	Overhead	1,127	943	1,171	1,695	5,270	2,041.2
	Under-ground	45	51	63	48	56	52.6
	Total	1,172	994	1,234	1,743	5,326	2,093.8
Demand Facilities							
Involvng Accidents		59	43		65	70	47.4
Total Disturbances		1,281	1,092	1,330	1,926	5,600	2,245.8

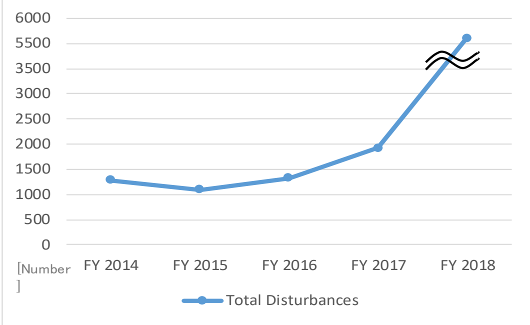


Figure 15 Transition of Supply Disturbances (Kansai, FY 2014–2018)

Table 15 Number of Supply Disturbances Where Interruption Originated (Chugoku, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		11	10	7	2	8	7.6
Transmission Lines & Extra High Voltage Lines	Overhead	13	14	16	16	14	14.6
	Under-ground	1			1	1	0.6
	Total	14	14	16	17	15	15.2
High Voltage Lines	Overhead	1,122	1,211	960	1,066	1,172	1,106.2
	Under-ground	23	23	13	24	20	20.6
	Total	1,145	1,234	973	1,090	1,192	1,126.8
Demand Facilities					1		0.2
Involvng Accidents		36	37	25	33	31	32.4
Total Disturbances		1,206	1,295	1,021	1,143	1,246	1,182.2

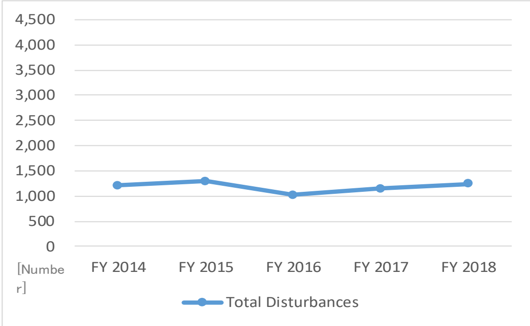


Figure 16 Transition of Supply Disturbances (Chugoku, FY 2014–2018)

Table 16 Number of Supply Disturbances Where Interruption Originated (Shikoku, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		1	3		6	4	2.8
Transmission Lines & Extra High Voltage Lines	Overhead	4	3	5	3	4	3.8
	Under-ground						
	Total	4	3	5	3	4	3.8
High Voltage Lines	Overhead	673	425	357	630	616	540.2
	Under-ground	3	5	4	9	8	5.8
	Total	676	430	361	639	624	546.0
Demand Facilities							
Involvng Accidents		14	8	6	5	5	7.6
Total Disturbances		695	444	372	653	637	560.2

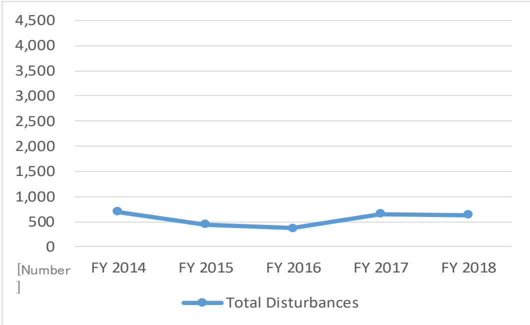


Figure 17 Transition of Supply Disturbances (Shikoku, FY 2014–2018)

Table 17 Number of Supply Disturbances Where Interruption Originated (Kyushu, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		4	3	15	3	1	5.2
Transmission Lines & Extra High Voltage Lines	Overhead	12	24	21	32	42	26.2
	Under-ground		1	4		1	1.2
	Total	12	25	25	32	43	27.4
High Voltage Lines	Overhead	1,088	1,751	1,237	1,349	1,888	1,462.6
	Under-ground	18	15	18	30	15	19.2
	Total	1,106	1,766	1,255	1,379	1,903	1,481.8
Demand Facilities							
Involvng Accidents		31	18	20	23	16	21.6
Total Disturbances		1,153	1,812	1,315	1,437	1,963	1,536.0

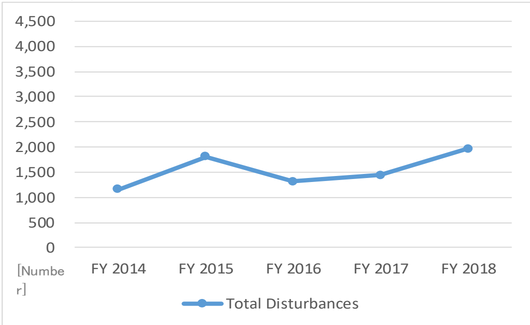


Figure 18 Transition of Supply Disturbances (Kyushu, FY 2014–2018)

Table 18 Number of Supply Disturbances Where Interruption Originated (Okinawa, FY 2014–2018)

Occurrence in		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years average
Disturbance of General Transmission & Distribution Companies' Facilities							
Substations		1	1	3		8	2.6
Transmission Lines & Extra High Voltage Lines	Overhead	35	51	34	42	52	42.8
	Under-ground				1		0.2
	Total	35	51	34	43	52	43.0
High Voltage Lines	Overhead	681	489	242	378	887	535.4
	Under-ground	2	1	2			1.0
	Total	683	490	244	378	887	536.4
Demand Facilities							
Involvng Accidents		21	8	18	14	11	14.4
Total Disturbances		740	550	299	435	958	596.4

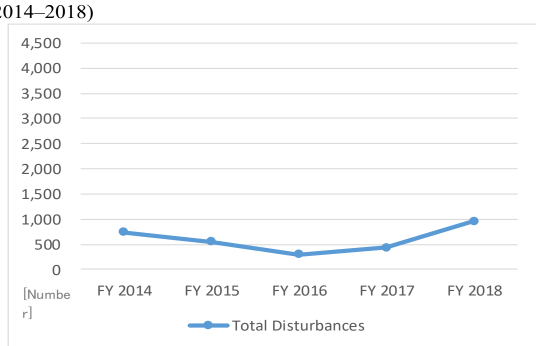


Figure 19 Transition of Supply Disturbances (Okinawa, FY 2014–2018)

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

(1) Data for Supply Disturbances over a Certain Scale

To obtain the data for supply disturbances where interruptions originated as described in the preceding section, the disturbances over a certain scale were reported with their causes. This section analyses their causes.

Figure 19 illustrates the number of supply disturbances where interruptions originated over a certain scale, while Table 19 shows the nationwide data for FY 2018.[7] The table columns were left blank if zero value or the data are not available.

- Capacity lost by disturbance was 7,000–70,000 kW with a duration longer than 1 hour
- Capacity lost by disturbance was over 70,000 kW with a duration longer than 10 minutes

It should be noted that the number of supply disturbances evoked by the September 6 blackout was not included in the statistics.

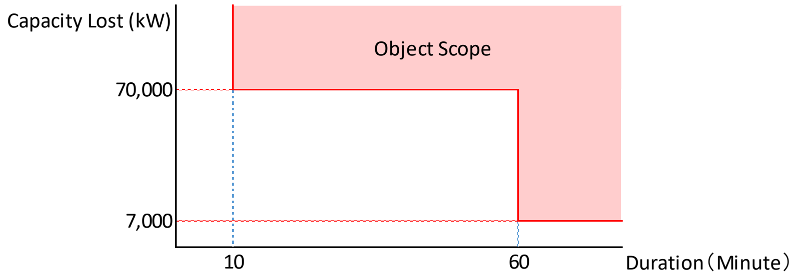


Figure 20 Image of Supply Disturbances over a Certain Scale

Table 19 Number of Supply Disturbances Where Interruption Originated by Scale of Interruption (Nationwide, FY 2018) [Number]

Occurrence at \ Scale of Disturbance [Duration & Capacity lost]		10 min. till 30 min.		30 min. till 1 hour		1hour till 3 hours			Longer than 3 hours			Total Disturbance
		70,000kW to 100,000kW under	100,000kW over[7]	70,000kW to 100,000kW under	100,000kW over[7]	7,000kW to 70,000kW under	70,000kW to 100,000kW under	100,000kW over[7]	7,000kW to 70,000kW under	70,000kW to 100,000kW under	100,000kW over[7]	
Accidents of Facilities of General Transmission /Distribution Companies												
Substations			1			3			2			6
Transmission Lines & Extra High Voltage Lines	Overhead					6	1		11			18
	Under-ground	1							1			2
	Total	1				6	1		12			26
High Voltage Lines	Overhead								3			3
	Under-ground					1			1			2
	Total					1			4			5
Demand Facilities												
Involved Accidents												
Total Disturbance		1	1			10	1		18			31

[7] Supply disturbance over a certain scale of 10 minutes and longer was reported for different destinations according to lost capacity under the provisions of Article 3 of the Reporting Rules of the Electricity Business. In the case the lost capacity is 70,000–100,000 kW, the loss is reported to the Director of Regional Industrial Safety and the Inspection Department that directs the area the disturbed electric facility is sited. In the case the lost capacity is over 100,000 kW, the loss is reported to the Ministry of Economy, Trade, and Industry. Thus, the reporting destination differs according to the lost capacity, Table 19 presents the number of disturbances by lost capacity.

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

Table 20 classifies and describes the causes of supply disturbances.

Table 20 Classification and Description of the Causes of Supply Disturbances

Classification of Causes		Description
Facility fault		Due to imperfect production (improper design, fabrication, or material of electric facilities) or imperfect installation (improper operation of construction or maintenance work).
Maintenance fault		Due to imperfect 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 over the rated capacity).
Accident/malice		Due to accident by worker, intentional act, or accident by public (stone throwing, wire theft, etc.). In case of accompanying electric shock, instances are classified under "Electric shock (worker)" or "Electric shock (public)."
Physical contact		Due to physical contact by tree, wildlife, or others (kite, model airplane).
Corrosion		Due to corrosion by leakage of current from DC electric railroad or by chemical action.
Vibration		Due to vibration from traffic of heavy vehicle traffic or construction work.
Involving an accident		Due to accident involving the electric facilities of another company.
Improper fuel		Due to accident with improper fuel of notably different ingredients from that designated.
Electric fire		Due to accident with electric fire caused by facility fault, maintenance fault, natural disaster, accident, or work without permission.
Electric shock (worker)		Due to workers' accident from electric shock caused by misuse of equipment, malfunction of electric facilities, accident by injured or third person, etc.
Electric shock (public)		Due to accident with electric shock of public by misuse of equipment, malfunction of electric facilities, accident by injured or third person, etc.
Natural disaster	Thunderbolt	Due to direct or indirect lightning strike.
	Rainstorm	Due to rain, wind, or rainstorm (including contact with fallen branches, etc.)
	Snowstorm	Due to snow, frazil, hail, sleet, or snowstorm.
	Earthquake	Due to earthquake.
	Flood	Due to flood, storm surge, or tsunami
	Landslide	Due to rock fall, avalanche, landslide, or ground subsidence.
	Dust/gas	Due to briny air, volcanic dust and ash, fog, offensive gas, or smoke and soot.
Unknown		Due to causes that remain unknown despite investigation.
Miscellaneous		Due to causes not categorized above.

(3) The Number and Causes of Supply Disturbances over a Certain Scale (FY 2014–2018)

For the number of supply disturbances where interruption originated over a certain scale, Table 21 and Figure 21 show the nationwide data, while Tables 22 to 31 show the data from each regional service area for the period FY 2014–2018.[8,9]

For the FY 2018 data, the number and the causes of supply disturbances over a certain scale were analyzed. There were 31 cases of supply disturbances over a certain scale nationwide, which was the highest during the 5-year period. The supply disturbances evoked by 2018 July heavy rainfall, typhoon no.8 (Maria) in August, no.21 (Jebi) and no.24 (Trami)[10] in September compromised more than half of the cases in FY 2018, and were the highest number of supply disturbances during the past 5-years. It should be noted that the number of supply disturbances which was evoked by the blackout, and could not be identified where the interruption originated was not included in the statistics.

Table 21 Causes of Disturbances over a Certain Scale (Nationwide, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance							
	Facility Fault	1	1	1	1	4	1.6
	Maintenance fault	2	1	3	4	1	2.2
	Accident/Malice			1	1	2	0.8
	Physical contact			3	2	2	1.4
	Involved accident		1	1		1	0.6
	Electric shock(worker)	1	1				0.4
	Subtotal	4	4	9	8	10	7.0
Natural Disaster							
	Thunderbolt	2		3	2	1	1.6
	Rainstorm	1		3	3	17	4.8
	Snowstorm	2		2	2		1.2
	Earthquake			6			1.2
	Dust/Gas			2		2	0.8
	Subtotal	5		16	7	20	9.6
Unknown		1	1				0.4
Miscellaneous				1		1	0.4
Total Disturbances		10	5	26	15	31	17.4

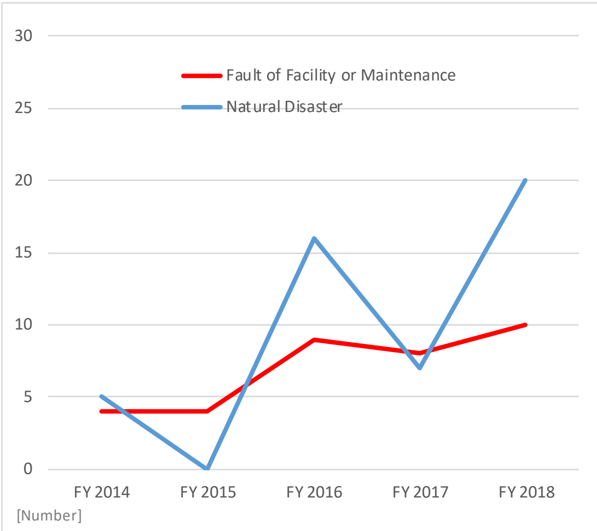


Figure 21 Transition of Disturbances by Causes (Nationwide, FY 2014–2018)

Table 22 Causes of Disturbances over a Certain Scale (Hokkaido, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance							
	Facility Fault					1	0.2
	Maintenance fault			1		1	0.4
	Accident/Malice						
	Physical contact					1	0.2
	Involved accident						
	Electric shock(worker)						
	Subtotal			1		3	0.8
Natural Disaster							
	Thunderbolt						
	Rainstorm			2			0.4
	Snowstorm				1		0.2
	Earthquake						
	Dust/Gas						
	Subtotal			2	1		0.6
Unknown							
Miscellaneous						1	0.2
Total Disturbances				3	1	4	1.6

Table 23 Causes of Disturbances over a Certain Scale (Tohoku, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance							
	Facility Fault						
	Maintenance fault						
	Accident/Malice			1			0.2
	Physical contact			2			0.4
	Involved accident						
	Electric shock(worker)		1				0.2
	Subtotal		1	3			0.8
Natural Disaster							
	Thunderbolt						
	Rainstorm						
	Snowstorm				1		0.2
	Earthquake						
	Dust/Gas						
	Subtotal				1		0.2
Unknown		1					0.2
Miscellaneous							
Total Disturbances		1	1	3	1		1.2

---

[8] Causes of the disturbances that did not occur in the period FY 2014–2018 are omitted from the tables.

[9] Column of the tables left blank if zero or the data are not available.

[10] Natural disasters occurred in FY 2018 and their response
Industrial and Product Safety Policy Group, Mar. 19, 2019 (in Japanese only)
https://www.meti.go.jp/shingikai/sankoshin/hoan_shohi/pdf/002_02_00.pdf

Table 24 Causes of Disturbances over a Certain Scale (Tokyo, FY 2014–2018)

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance						
Facility Fault	1	1	1	1	1	1.0
Maintenance fault		1				0.2
Accident/Malice					1	0.2
Physical contact			1	1	1	0.6
Involved accident		1				0.2
Electric shock(worker)						
Subtotal	1	3	2	2	3	2.2
Natural Disaster						
Thunderbolt			1	1	1	0.6
Rainstorm						
Snowstorm						
Earthquake						
Dust/Gas						
Subtotal			1	1	1	0.6
Unknown		1				0.2
Miscellaneous						
Total Disturbances	1	4	3	3	4	3.0

Table 25 Causes of Disturbances over a Certain Scale (Chubu, FY 2014–2018)

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance						
Facility Fault						
Maintenance fault	1					0.2
Accident/Malice						
Physical contact						
Involved accident						
Electric shock(worker)						
Subtotal	1					0.2
Natural Disaster						
Thunderbolt			1			0.2
Rainstorm					1	0.2
Snowstorm	2		2			0.8
Earthquake						
Dust/Gas					2	0.4
Subtotal	2		3		3	1.6
Unknown						
Miscellaneous						
Total Disturbances	3		3		3	1.8

Table 26 Causes of Disturbances over a Certain Scale (Hokuriku, FY 2014–2018)

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance						
Facility Fault						
Maintenance fault						
Accident/Malice						
Physical contact						
Involved accident						
Electric shock(worker)						
Subtotal						
Natural Disaster						
Thunderbolt						
Rainstorm						
Snowstorm						
Earthquake						
Dust/Gas						
Subtotal						
Unknown						
Miscellaneous						
Total Disturbances						

Table 27 Causes of Disturbances over a Certain Scale (Kansai, FY 2014–2018)

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance						
Facility Fault					2	0.4
Maintenance fault				3		0.6
Accident/Malice				1	1	0.4
Physical contact				1		0.2
Involved accident			1		1	0.4
Electric shock(worker)						
Subtotal			1	5	4	2.0
Natural Disaster						
Thunderbolt	1					0.2
Rainstorm			1	3	10	2.8
Snowstorm						
Earthquake						
Dust/Gas						
Subtotal	1		1	3	10	3.0
Unknown						
Miscellaneous						
Total Disturbances	1		2	8	14	5.0

Table 28 Causes of Disturbances over a Certain Scale (Chugoku, FY 2014–2018)

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance						
Facility Fault						
Maintenance fault	1					0.2
Accident/Malice						
Physical contact						
Involved accident						
Electric shock(worker)	1					0.2
Subtotal	2					0.4
Natural Disaster						
Thunderbolt				1		0.2
Rainstorm					2	0.4
Snowstorm						
Earthquake			1			0.2
Dust/Gas						
Subtotal			1	1	2	0.8
Unknown						
Miscellaneous			1			0.2
Total Disturbances	2		2	1	2	1.4

Table 29 Causes of Disturbances over a Certain Scale (Shikoku, FY 2014–2018)

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance						
Facility Fault						
Maintenance fault				1		0.2
Accident/Malice						
Physical contact						
Involved accident						
Electric shock(worker)						
Subtotal				1		0.2
Natural Disaster						
Thunderbolt						
Rainstorm	1					0.2
Snowstorm						
Earthquake						
Dust/Gas						
Subtotal	1					0.2
Unknown						
Miscellaneous						
Total Disturbances	1			1		0.4

Table 30 Causes of Disturbances over a Certain Scale (Kyushu, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance							
	Facility Fault			1			0.2
	Maintenance fault						
	Accident/Malice						
	Physical contact			1			0.2
	Involved accident						
	Electric shock(worker)						
	Subtotal			2			0.4
Natural Disaster							
	Thunderbolt	1					0.2
	Rainstorm					2	0.4
	Snowstorm						
	Earthquake			5			1.0
	Dust/Gas			2			0.4
	Subtotal	1		7		2	2.0
Unknown							
Miscellaneous							
Total Disturbances		1		9		2	2.4

Table 31 Causes of Disturbances over a Certain Scale (Okinawa, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
Fault of Facility or Maintenance							
	Facility Fault						
	Maintenance fault						
	Accident/Malice						
	Physical contact						
	Involved accident						
	Electric shock(worker)						
	Subtotal						
Natural Disaster							
	Thunderbolt			1			0.2
	Rainstorm					2	0.4
	Snowstorm						
	Earthquake						
	Dust/Gas						
	Subtotal			1		2	0.6
Unknown							
Miscellaneous							
Total Disturbances				1		2	0.6

3. Data of Interruptions for LV Customers

(1) Indices of System Average Interruption for LV Customers

The criteria for customer interruption include two indices that indicate frequency and duration of forced or planned outages that occurred for one customer and one year.

System Average Interruption Frequency Index (SAIFI/number)

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

System Average Interruption Duration Index (SAIDI/minute)

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

Table 32 shows the definitions of outage-related terms.

Table 32 Definition of Outage-related Terms

Term	Definition
Forced outage	Supply interruption occurred to end-use customers by accident, such as the malfunction of the electric facility, excluding resumption of electricity supply by automatic reclosing.[11][12]
Planned outage	Electric power company interrupts its electricity supply in planned manner to construct, improve, and maintain its electric facility.

[11] See footnote 5 for definitions.
[12] See footnote 6 for definitions.

(2) Data of System Average Interruption Nationwide and by Regional Service Area (FY 2014–2018)

Table 33 and Figure 22 show the nationwide data for system average interruptions for FY 2014–2018. Tables 34 to 43 and Figures 23 to 32 show the data for each regional service area. [13] Table 44 shows the nationwide data for system average interruptions for FY 2018, for which both the SAIFI and SAIDI values of forced outages became the highest during the 5-year average.

For the SAIFI value of forced outages, the four regional service areas of Hokkaido, Chubu, Kansai, and Okinawa EPCOs have marked their highest number of outages during the 5-year average period. For the SAIDI value of forced outages, the seven regional service areas of Hokkaido, Tokyo, Chubu, Kansai, Chugoku, Shikoku, and Okinawa EPCOs registered their longest outages during this period.

In particular, the area supplied by Hokkaido EPCO experienced a markedly significant increase for SAIDI from 10 minutes in FY 2017 to 2,154 minutes (almost 36 hours) in FY 2018. This figure includes the interrupted time of supply disturbances evoked by the blackout, which shows that the blackout was certain both in scale and time. In the Central and Western, and the Okinawa regions, the increased SAIDI values are mainly attributable to the very strong power of several typhoons, which were later designated as extreme disasters, and seasonal fronts causing heavy rainfalls.

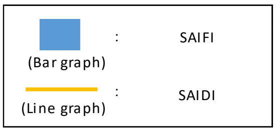


Table 33 Indices of System Average Interruption (Nationwide, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.13	0.10	0.14	0.11	0.28	0.15
	Planned	0.04	0.03	0.03	0.03	0.03	0.03
	Total ●	0.16	0.13	0.18	0.14	0.31	0.18
SAIDI [Minute]	Forced	16	18	21	12	221	58
	Planned	4	4	4	3	4	4
	Total ●	20	21	25	16	225	61

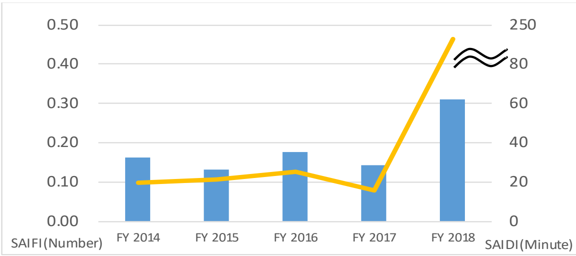


Figure 22 System Average Interruption Indices of LV Customers (Nationwide, FY 2014–2018)

Table 34 Indices of System Average Interruption (Hokkaido, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.13	0.15	0.17	0.13	1.19	0.35
	Planned	α	α	α	0.01	α	0.01
	Total ●	0.13	0.15	0.17	0.14	1.19	0.36
SAIDI [Minute]	Forced	8	10	35	10	2,154	443
	Planned	α	α	1	α	α	1
	Total ●	9	10	36	10	2,154	444

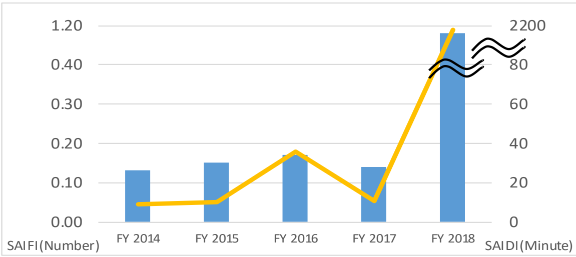


Figure 23 System Average Interruption Indices of LV Customers (Hokkaido, FY 2014–2018)

Table 35 Indices of System Average Interruption (Tohoku, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.12	0.08	0.11	0.13	0.09	0.10
	Planned	0.04	0.04	0.03	0.02	0.02	0.03
	Total ●	0.16	0.12	0.14	0.15	0.11	0.14
SAIDI [Minute]	Forced	9	11	24	10	7	12
	Planned	5	4	4	3	2	4
	Total ●	14	15	28	13	10	16

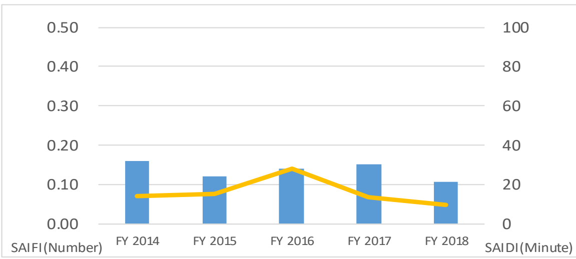


Figure 24 System Average Interruption Indices of LV Customers (Tohoku, FY 2014–2018)

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

Table 36 Indices of System Average Interruption (Tokyo, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.07	0.06	0.13	0.09	0.13	0.10
	Planned	0.01	0.01	0.02	0.01	0.01	0.01
	Total	0.08	0.07	0.15	0.10	0.14	0.11
SAIDI [Minute]	Forced	4	6	7	6	19	8
	Planned	α	1	1	1	3	1
	Total	4	6	8	7	22	9

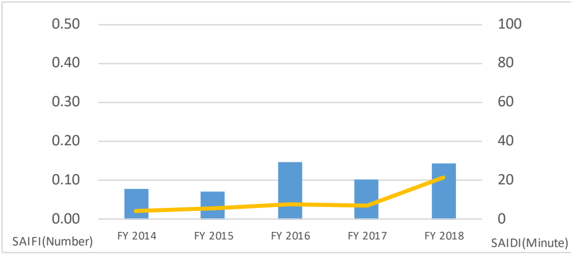


Figure 25 System Average Interruption Indices of LV Customers (Tokyo, FY 2014–2018)

Table 37 Indices of System Average Interruption (Chubu, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.16	0.07	0.17	0.08	0.39	0.17
	Planned	0.07	0.06	0.06	0.06	0.06	0.06
	Total	0.23	0.13	0.23	0.14	0.45	0.24
SAIDI [Minute]	Forced	18	4	5	10	348	77
	Planned	9	7	7	7	8	8
	Total	27	11	12	17	356	85

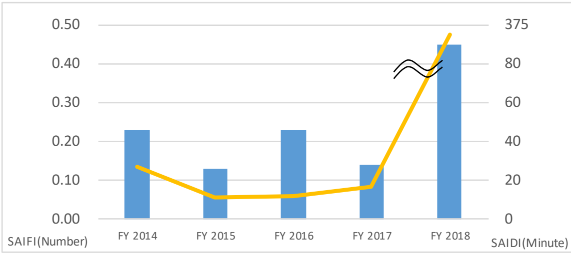


Figure 26 System Average Interruption Indices of LV Customers (Chubu, FY 2014–2018)

Table 38 Indices of System Average Interruption (Hokuriku, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.09	0.04	0.06	0.09	0.06	0.07
	Planned	0.10	0.10	0.10	0.09	0.09	0.10
	Total	0.20	0.14	0.16	0.17	0.15	0.17
SAIDI [Minute]	Forced	5	4	4	11	9	7
	Planned	17	16	17	15	15	16
	Total	22	20	21	26	24	23

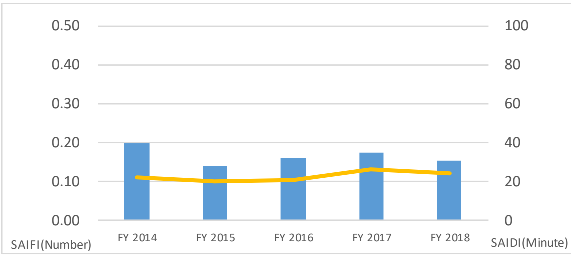


Figure 27 System Average Interruption Indices of LV Customers (Hokuriku, FY 2014–2018)

Table 39 Indices of System Average Interruption (Kansai, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.06	0.07	0.07	0.12	0.40	0.14
	Planned	0.02	0.01	0.01	0.01	0.01	0.01
	Total	0.08	0.08	0.09	0.13	0.41	0.16
SAIDI [Minute]	Forced	4	3	4	14	396	84
	Planned	1	1	1	1	1	1
	Total	5	4	5	15	397	85

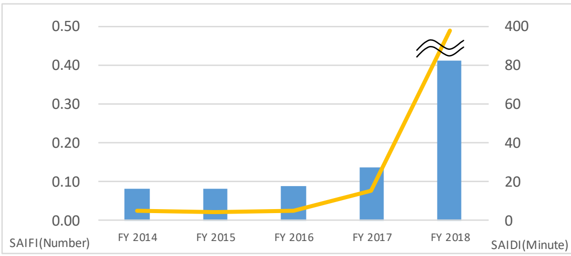


Figure 28 System Average Interruption Indices of LV Customers (Kansai, FY 2014–2018)

Table 40 Indices of System Average Interruption (Chugoku, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.19	0.18	0.15	0.12	0.14	0.16
	Planned	0.11	0.11	0.11	0.11	0.09	0.11
	Total	0.31	0.29	0.26	0.23	0.23	0.26
SAIDI [Minute]	Forced	10	17	6	7	24	13
	Planned	11	12	12	12	10	11
	Total	21	29	18	19	33	24

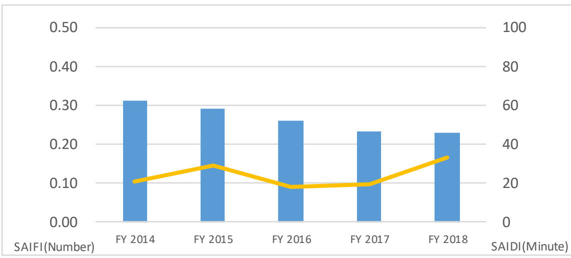


Figure 29 System Average Interruption Indices of LV Customers (Chugoku, FY 2014–2018)

Table 41 Indices of System Average Interruption (Shikoku, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.21	0.12	0.09	0.19	0.20	0.16
	Planned	0.20	0.19	0.18	0.16	0.14	0.18
	Total	0.40	0.31	0.27	0.36	0.34	0.34
SAIDI [Minute]	Forced	27	13	6	21	32	20
	Planned	20	21	20	17	15	19
	Total	47	34	26	38	47	38

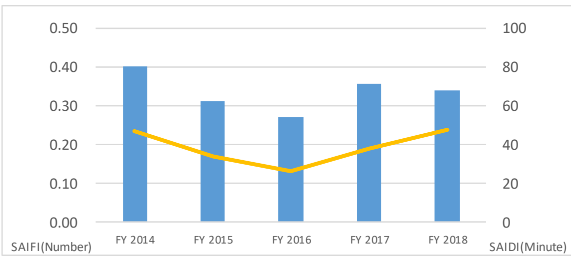


Figure 30 System Average Interruption Indices of LV Customers (Shikoku, FY 2014–2018)

Table 42 Indices of System Average Interruption (Kyushu, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	0.09	0.16	0.24	0.08	0.14	0.14
	Planned	0	0	0	0	0	0
	Total	0.09	0.16	0.24	0.08	0.14	0.14
SAIDI [Minute]	Forced	45	101	128	25	103	80
	Planned	0	0	0	0	0	0
	Total	45	101	128	25	103	80

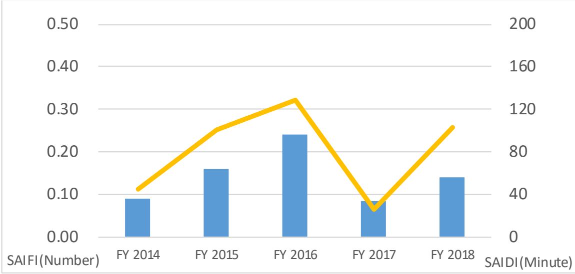


Figure 31 System Average Interruption Indices of LV Customers (Kyushu, FY 2014–2018)

Table 43 Indices of System Average Interruption (Okinawa, FY 2014–2018)

		FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	5-years Average
SAIFI [Number]	Forced	2.58	1.04	0.57	0.98	3.62	1.76
	Planned	0.08	0.08	0.08	0.07	0.07	0.08
	Total	2.67	1.12	0.65	1.05	3.69	1.84
SAIDI [Minute]	Forced	437	150	35	117	1,269	402
	Planned	8	8	8	7	6	8
	Total	445	158	43	124	1,275	409

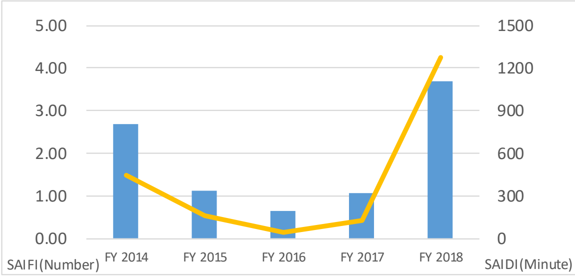


Figure 32 System Average Interruption Indices of LV Customers (Okinawa, FY 2014–2018)

Table 44 System Average Disturbances Where Interruption Originated by Outages (Nationwide, FY 2018)[14]

		Hokkaido	Tohoku	Tokyo	Chubu	Hokuriku	Kansai	Chugoku	Shikoku	Kyushu	Okinawa	Nationwide
SAIFI [Number]	Forced Outage											
	Generators	1.09	α	0.05	0.04	α	0.05	0.02	0.01	0.02	0.22	
	HV Lines	0.10	0.08	0.08	0.35	0.06	0.34	0.12	0.18	0.11	3.39	
	LV Lines	α	α	α	0.01	α	0.01	0.00	α	α	0.01	
	Subtotal	1.19	0.08	0.13	0.39	0.06	0.40	0.14	0.20	0.14	3.62	0.28
	Planned Outage											
	Generators	α	α	0.00	α	α	α	0.00	0.00	0.00	α	
	HV Lines	α	0.02	0.01	0.04	0.07	0.01	0.07	0.08	0.00	0.02	
	LV Lines	α	α	α	0.02	0.02	0.01	0.02	0.06	0.00	0.05	
	Subtotal	α	0.02	0.01	0.06	0.09	0.01	0.09	0.14	0.00	0.07	0.03
	Total Outage											
	Generators	1.09	α	0.05	0.04	α	0.05	0.02	0.01	0.02	0.22	
	HV Lines	0.10	0.09	0.09	0.39	0.13	0.35	0.19	0.26	0.11	3.41	
	LV Lines	α	α	0.01	0.03	0.02	0.01	0.02	0.06	α	0.06	
	Total	1.19	0.09	0.14	0.45	0.15	0.41	0.23	0.34	0.14	3.69	0.31
SAIDI [Minute]	Forced Outage											
	Generators	2,127	α	1	3	α	5	5	8	8	11	
	HV Lines	27	6	17	344	8	378	18	23	95	1,236	
	LV Lines	α	1	1	1	1	13	0	1	1	22	
	Subtotal	2,154	7	19	348	9	396	24	32	104	1,269	221
	Planned Outage											
	Generators	α	α	0	0	α	α	0	0	0	α	
	HV Lines	α	2	3	5	13	1	8	11	0	2	
	LV Lines	α	α	α	2	2	1	2	4	0	4	
	Subtotal	α	2	3	8	15	1	10	15	0	6	4
	Total Outage											
	Generators	2,127	α	1	3	α	5	5	8	8	11	
	HV Lines	27	8	20	349	21	379	25	34	95	1,238	
	LV Lines	α	1	1	4	3	13	2	5	1	26	
	Total	2,154	9	22	356	24	397	33	47	103	1,275	225

* The nationwide figures are calculated by weighing the figures from all regional service areas.

[14] Electric facilities such as generating plants, substations, transmission lines, or extra high voltage lines.

IV. Conclusion

Frequency

The criterion for maintained frequency is 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 frequency time-kept ratio within the target variance of the standard for frequency-synchronized regions for FY 2018 was achieved 100% except in the Hokkaido region. The fall of the ratio in Hokkaido EPCO area was temporary due to the Hokkaido Eastern Iburi Earthquake. The frequency fluctuation stabilized according to the increased supply capability in the area after the earthquake.

Voltage

The criteria of maintained 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 deviated points against the total number of measured points. No deviation from the voltage standard was observed nationwide in FY 2018.

Supply Disturbances and Interruption for LV Customers

The criteria of supply interruptions include the number of supply disturbances and the system average interruption indices, SAIFI and SAIDI. In FY 2018, the number of supply disturbances nationwide increased by about 10,000 cases compared with the average of the past 5-years. Eight of 10 areas, except the Hokkaido and Tohoku regions, indicated a higher number of supply disturbances than the 5-year average. For the breakdown by where interruptions originated, supply disturbances at HV overhead lines dominated the increase in the number of cases, which were likely to be caused by natural disasters, such as typhoons and heavy rainfall.

The 31 supply disturbances over a certain scale for FY 2018 was an increase by 16 from 15 supply disturbances recorded in FY 2017, which was the biggest in the past 5 years. Among these supply disturbances, the number due to rainstorms was 17, which was an increase of 14 from three for FY 2017. Considering the data from interruption for LV customers, the SAIFI data from four areas and SAIDI data from seven areas for FY 2018 registered the highest values during the past 5-year period, respectively. For the Hokkaido EPCO area, the increased SAIDI was mainly attributable to the blackout. For the Central and Western, and the Okinawa regions, those increases were mainly due to several very strong typhoons and heavy rainfall.

The Japanese government has recognized the importance of resilience in electricity infrastructures, and the necessity to review the ideal networks for highly resilient electricity systems and infrastructures based on the major disturbances due to a series of natural disasters after the summer of 2018. The government has launched the "Working Group on Electricity Resilience" to discuss challenges and countermeasures for the formation of resilient electricity infrastructures and systems. OCCTO continues to collect and publish information about the quality of electricity.

Alpha (α) is shown if the data are a fraction less than a unit.

<Reference> Comparison of System Average Interruptions in Japan with Various Countries and US States for 2014–2018.

Table 45 and Figure 33 show the SAIDI values, while Table 46 and Figure 34 show the SAIFI values for Japan and various countries and US states for the period 2014–2018. The data for EU countries were cited from the report[15] of the Council of European Energy Regulators (CEER), while those for major US states were from the report[16] of the Public Utilities Commission in each state. OCCTO aggregated and analyzed these data.[17]

The monitoring condition, such as the observed voltage, annual period of monitoring (starting from January or April),[18] or including/excluding natural disasters, vary in each country/state; therefore, the interruption data may not be adequately compared between Japan and various countries/states. Nevertheless, both SAIDI and SAIFI values were at lower levels than those of various countries/states. In addition, Japan observes only LV customers' data; however, few customers are supplied by networks other than LV; thus, the interruptions experienced by these customers were estimated to have a slight influence on the interruption data.

[15] Source: "CEER Benchmarking Report 6.1 on the Continuity of Electricity and Gas Supply Data update 2015/2016"
https://www.ceer.eu/documents/104400/-/-/963153e6-2f42-78eb-22a4-06f1552dd34c
This report is published roughly every 3 years using the updated data for the previous 3 years.

[16] Sources:
State of California: California Public Utilities Commission, "Electric System Reliability Annual Reports"
http://www.cpuc.ca.gov/General.aspx?id=4529
State of Texas: Public Utility Commission of Texas,
"Annual Service Quality Report pursuant to PUC Substantive Rule in S.25.81,"
http://www.puc.texas.gov/industry/electrici/reports/sqr/default.aspx
State of New York: Department of Public Service, "Electric Reliability Performance Reports."
http://www3.dps.ny.gov/W/PSCWeb.nsf/All/D82A200687D96D3985257687006F39CA?OpenDocument

[17] Values for states are calculated for California and Texas 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.)

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

Table 45 SAIDI of Japan and Various Countries/US States for FY 2014–2018 by Forced and Planned Outages
(Minutes/Year: Customer)

Country/State			Year 2014	2015	2016	2017	2018	Condition: Event of	Observed Voltage	Natural Disaster
JAPAN			20	21	25	16	225	except auto re-closing	LV	Include
		Forced	16	18	21	12	221			
		Planned	4	4	4	3	4			
U.S.A.	California		122	122	219	308	266	5 minutes and longer	All	Include
		Forced	115	115	124	244	201			
		Planned	7	7	95	64	65			
	Texas		214	277	214	522	175			
		Forced	207	268	205	509	158			
		Planned	7	10	9	13	17			
	New York		162	130	137	270	409			
		Forced	-	-	-	-	-			
		Planned	-	-	-	-	-			
EU	Germany		21	22	24	-	-	3 minutes and longer	All	Include
		Forced	14	15	13	-	-			
		Planned	8	7	10	-	-			
	Italy		153	196	144	-	-		All	Include
		Forced	94	129	65	-	-			
		Planned	60	67	79	-	-			
	France		67	74	71	-	-		All	Include
		Forced	52	58	53	-	-			
		Planned	16	16	18	-	-			
	Spain		63	69	66	-	-		All	Include
		Forced	53	56	54	-	-			
		Planned	11	13	12	-	-			
	UK		104	61	55	-	-		All	Exclude
		Forced	93	51	47	-	-			
		Planned	11	10	8	-	-			
	Sweden		102	135	94	-	-		All	Include
		Forced	84	118	76	-	-			
		Planned	18	17	19	-	-			
	Finland		80	169	81	-	-		except LV	Include
		Forced	67	158	68	-	-			
		Planned	13	12	13	-	-			
	Norway		161	173	129	-	-		All	Include
		Forced	118	129	88	-	-			
		Planned	43	44	41	-	-			

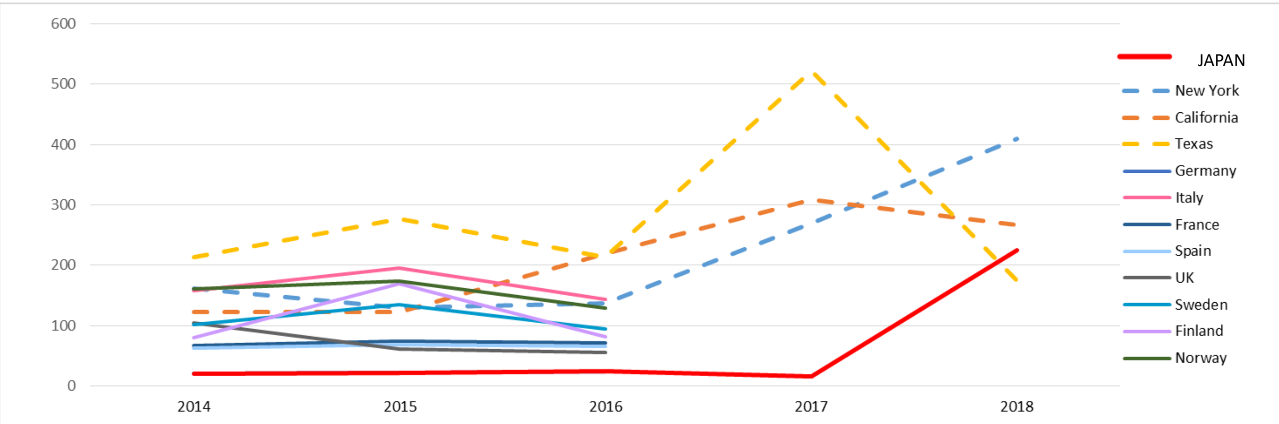


Figure 33 SAIDI of Japan and Various Countries/US States for FY 2014–2018 (Minutes/Year: Customer)

Table 46 SAIFI of Japan and Various Countries/US States for FY 2014–2018 by Forced and Planned Outages

(Number/Year: Customer)

Country/State			Year 2014	2015	2016	2017	2018	Condition: Event of	Observed Voltage	Natural Disaster
JAPAN			0.16	0.13	0.18	0.14	0.31	except auto re-closing	LV	Include
		Forced	0.13	0.10	0.14	0.11	0.28			
		Planned	0.04	0.03	0.03	0.03	0.03			
U.S.A.	California		1.00	0.94	1.31	1.46	1.45	5 minutes and longer	All	Include
		Forced	0.97	0.91	1.05	1.26	0.94			
		Planned	0.03	0.03	0.26	0.20	0.50			
	Texas		1.59	1.91	1.55	1.61	1.54			
		Forced	1.51	1.82	1.48	1.51	1.40			
		Planned	0.08	0.09	0.07	0.15	0.13			
	New York		0.68	0.67	0.79	0.85	1.01			
		Forced	-	-	-	-	-			
		Planned	-	-	-	-	-			
EU	Germany		0.45	0.91	0.59	-	-	3 minutes and longer	All	Include
		Forced	0.37	0.83	0.51	-	-			
		Planned	0.08	0.08	0.08	-	-			
	Italy		2.35	2.81	2.17	-	-		All	Include
		Forced	1.99	2.43	1.76	-	-			
		Planned	0.36	0.37	0.41	-	-			
	France		0.20	0.22	0.22	-	-		All	Include
		Forced	0.07	0.09	0.08	-	-			
		Planned	0.13	0.13	0.14	-	-			
	Spain		1.29	1.31	1.18	-	-		All	Include
		Forced	1.13	1.21	1.09	-	-			
		Planned	0.16	0.10	0.09	-	-			
	UK		0.76	0.60	0.57	-	-		All	Exclude
		Forced	0.72	0.56	0.53	-	-			
		Planned	0.04	0.04	0.04	-	-			
	Sweden		1.46	1.36	1.33	-	-		All	Include
		Forced	1.30	1.22	1.17	-	-			
		Planned	0.16	0.14	0.16	-	-			
	Finland		1.76	2.78	1.58	-	-		except LV	Include
		Forced	1.60	2.64	1.42	-	-			
		Planned	0.15	0.14	0.15	-	-			
	Norway		2.44	2.17	1.89	-	-		All	Include
		Forced	2.15	1.87	1.59	-	-			
		Planned	0.29	0.30	0.30	-	-			

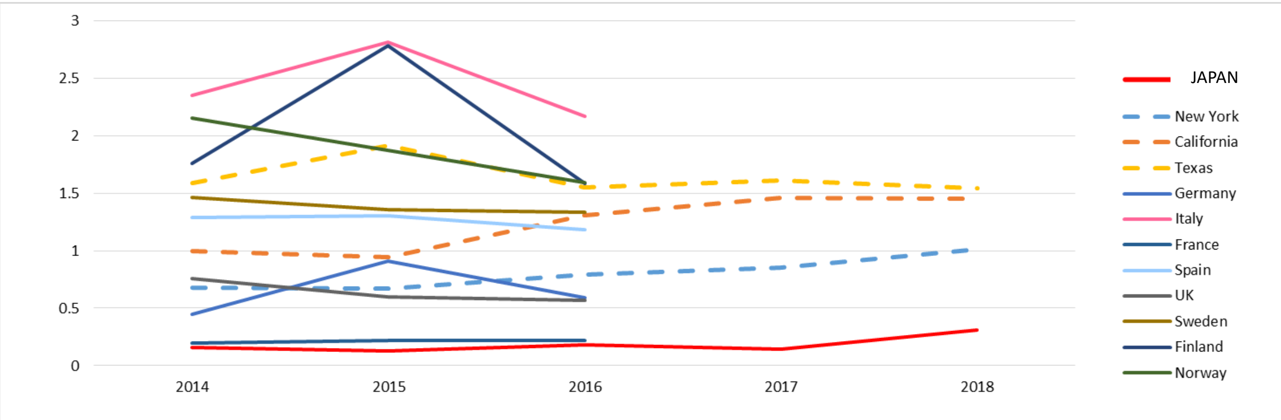


Figure 34 SAIFI of Japan and Various Countries/US States for FY 2014–2018 (Number/Year: Customer)

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

II. State of Electric Network

Outlook of Cross-regional Interconnection Lines

- Actual Data for FY 2018 -

September 2019

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 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 completion of actual data collection up to fiscal year 2018 (FY 2018).

SUMMARY

This report is presented to review the outlook of electricity supply–demand and cross-regional interconnection lines in FY 2018, based on Article 181 of the Operational Rules of the Organization.

The report consists of two parts: the situation of electricity supply and demand, and interconnection lines.

Regarding actual utilization of interconnection lines, the total volume of the utilization of interconnection lines was 110,762 GWh, −21,633 GWh over FY 2017 owing to commercial operation of the New Hokkaido Honshu HVDC Link.

The total number of congestion management hours was 42,113 h, −3,245 h over FY 2017 due to the introduction of the implicit auction scheme for utilizing cross-regional interconnection lines.

The numbers and days of maintenance of interconnection lines totaled 205 times and 446 days, respectively in FY 2018.

We hope this report provides useful information.

CONTENTS

Note:
The text of the Operational Rules was obtained from the amended version of April 1, 2019. 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.

(Errata)

20210825	P38	Table2-14 Actual Employment of the Transmission Margin	Date is corrected to Sep. 7 from Sep.6.

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 are transmission lines with 250 kV or more and AC/DC convertors that regularly connect the regional service areas of members that are GT&D companies. 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 secure the supply–demand balance in case of insufficient supply capacity for each regional service area. Figure 2-1 and Table 2-1 show the cross-regional interconnection lines in Japan.

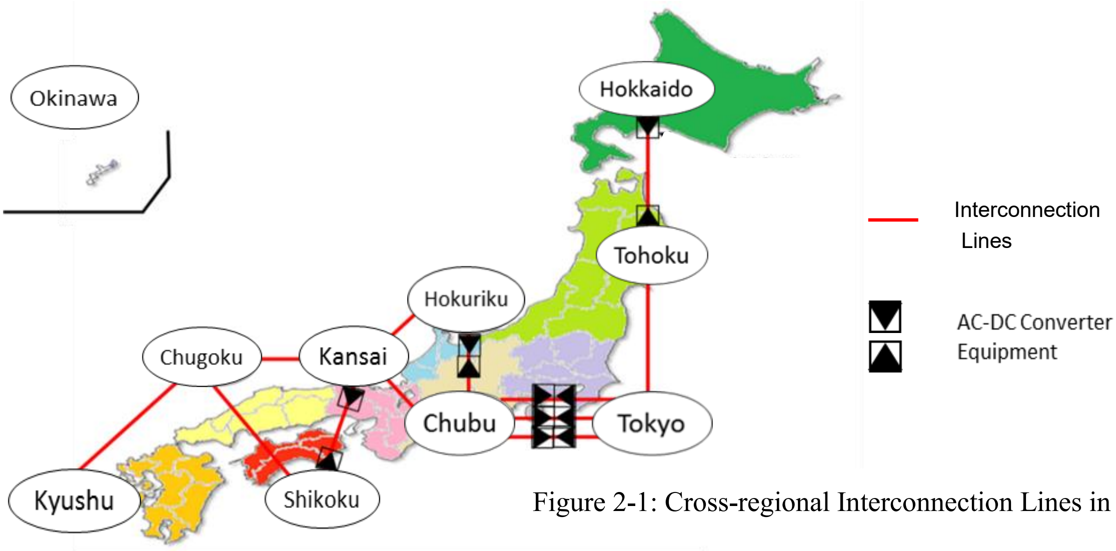


Figure 2-1: Cross-regional Interconnection Lines in Japan

Table 2-1: Summary of Cross-regional Interconnection Lines (at the end of FY 2018)

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	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 C.S.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 C.S.	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 Cross-regional Interconnection Lines

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

.

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

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

Thus, there are no capability allocation plans, and 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.

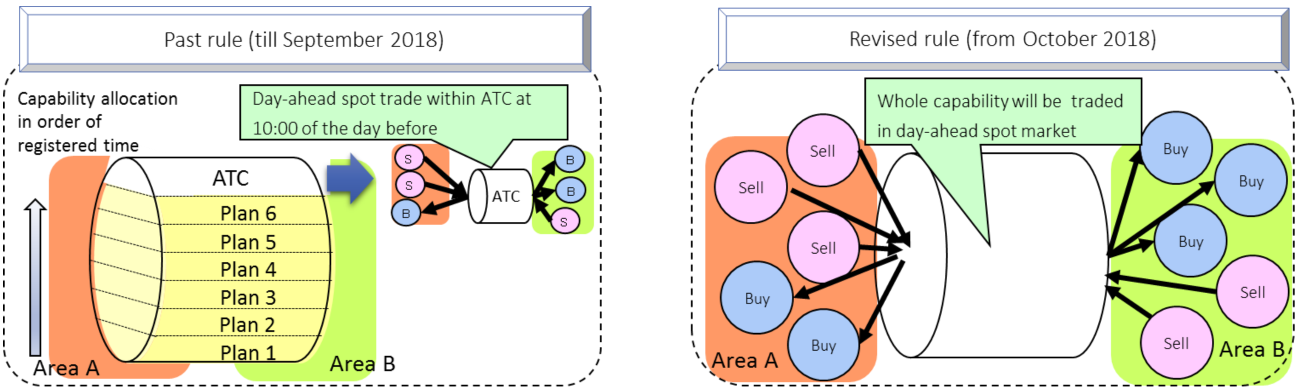


Figure 2-2: Management of Interconnection Lines

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 records 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 2018

Table 2-2 and Figure 2-3 show the monthly utilization of cross-regional interconnection lines for regional service areas in FY 2018.

Table 2-2: Monthly Utilization of Cross-regional Interconnection Lines for Regional Service Areas

[GWh]

		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	**Annual**
Hokkaido - Honshu	→Tohoku (Forward)	3	2	3	52	62	6	0	0	0	1	0	1	130
	→Hokkaido (Counter)	79	53	63	69	78	101	66	71	107	110	99	109	1,005
Tohoku-Tokyo	→Tokyo (Forward)	2,294	2,330	2,372	3,143	3,217	2,430	1,679	1,641	1,899	2,237	2,215	1,840	27,298
	→Tohoku (Counter)	428	384	371	583	627	692	8	8	17	8	6	7	3,139
Tokyo-Chubu	→Chubu (Forward)	266	204	258	366	352	155	46	42	8	13	1	0	1,711
	→Tokyo (Counter)	435	376	476	598	627	539	233	208	407	450	404	364	5,116
Chubu-Kansai	→Kansai (Forward)	735	534	444	662	670	474	42	44	21	18	15	15	3,675
	→Chubu (Counter)	663	713	861	1,159	1,131	1,282	786	786	809	667	591	533	9,980
Chubu-Hokuriku	→Hokuriku (Forward)	49	10	26	38	12	0	0	0	0	0	0	0	134
	→Chubu (Counter)	17	17	12	14	6	5	0	0	0	1	1	2	76
Hokuriku - Kanasai	→Kansai (Forward)	263	334	111	311	317	523	70	8	10	17	2	67	2,033
	→Hokuriku (Counter)	117	90	198	132	160	126	249	383	277	347	363	99	2,540
Kansai-Chugoku	→Chugoku (Forward)	1,222	1,014	549	557	815	447	25	11	27	21	23	22	4,734
	→Kansai (Counter)	1,206	1,202	1,182	1,532	1,670	1,393	1,155	1,129	807	876	554	683	13,388
Kansai-Shikoku	→Shikoku (Forward)	17	46	0	1	1	0	17	0	0	0	0	0	82
	→Kansai (Counter)	450	476	475	588	967	939	796	893	971	960	885	441	8,840
Chugoku-Shikoku	→Shikoku (Forward)	364	318	413	525	549	385	6	3	3	6	3	6	2,579
	→Chugoku (Counter)	252	290	324	429	523	601	302	308	300	257	292	146	4,023
Chugoku-Kyushu	→Kyushu (Forward)	565	451	223	180	231	305	3	4	8	15	4	10	1,998
	→Chugoku (Counter)	1,453	1,368	1,553	1,778	1,801	1,714	1,592	1,554	1,616	1,450	1,283	1,117	18,280

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

* The values in red are the annual maximum capability and the values in blue are the annual minimum capability for each line and direction, respectively.

Figure 2-3: Monthly Utilization of Cross-regional Interconnection Lines for Regional Service Areas

(2) Actual Utilization of Cross-regional Interconnection Lines for FY 2010–2018

Table 2-3 and Figure 2-4 show the annual utilization of cross-regional interconnection lines for regional service areas for FY 2010–2018.

Table 2-3 Annual Utilization of Cross-regional Interconnection Lines for Regional Service Areas (FY 2010–2018)

[GWh]

		FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	**FY 2018**
Hokkaido-Honshu	→Tohoku (Forward)	972	3,925	214	182	143	146	237	340	**130**
	→Hokkaido (Counter)	12	7	673	505	617	804	1,033	1,270	**1,005**
Tohoku-Tokyo	→Tokyo (Forward)	27,519	9,454	16,084	22,450	21,273	22,587	23,097	28,238	**27,298**
	→Tohoku (Counter)	12,219	5,674	4,520	3,891	4,029	3,714	4,660	7,071	**3,139**
Tokyo-Chubu	→Chubu (Forward)	188	1,151	1,579	2,829	2,702	693	2,729	3,954	**1,711**
	→Tokyo (Counter)	1,271	2,426	1,288	536	2,755	4,513	5,144	5,328	**5,116**
Chubu-Kansai	→Kansai (Forward)	943	3,734	7,487	7,049	7,131	3,412	5,538	8,106	**3,675**
	→Chubu (Counter)	10,721	8,403	5,726	4,928	6,342	7,577	6,544	9,889	**9,980**
Chubu-Hokuriku	→Hokuriku (Forward)	117	169	452	170	231	108	241	353	**134**
	→Chubu (Counter)	2,310	130	183	310	296	172	59	108	**76**
Hokuriku-Kanasai	→Kansai (Forward)	4,957	1,127	1,590	1,406	2,265	2,047	2,033	2,949	**2,033**
	→Hokuriku (Counter)	2,850	730	464	587	491	502	640	1,260	**2,540**
Kansai-Chugoku	→Chugoku (Forward)	1,423	1,483	2,836	2,326	2,252	948	716	4,493	**4,734**
	→Kansai (Counter)	7,916	10,520	6,788	5,468	5,994	9,138	13,179	16,727	**13,388**
Kansai-Shikoku	→Shikoku (Forward)	0	0	208	0	1	2	2	1	**82**
	→Kansai (Counter)	9,299	9,810	8,938	9,073	9,362	9,611	8,856	9,510	**8,840**
Chugoku-Shikoku	→Shikoku (Forward)	2,502	3,475	3,575	3,583	2,677	3,423	3,294	4,061	**2,579**
	→Chugoku (Counter)	7,496	6,727	3,564	3,694	3,912	4,631	7,638	7,540	**4,023**
Chugoku-Kyushu	→Kyushu (Forward)	903	2,582	4,210	3,838	3,596	2,174	1,935	3,014	**1,998**
	→Chugoku (Counter)	13,095	13,905	13,596	13,847	11,218	14,947	15,476	18,183	**18,280**

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

* The values in red are the annual maximum capability and the values in blue are the annual minimum capability in each line and direction for 2010–2018, respectively.

Figure 2-4: Annual Utilization of Cross-regional Interconnection Lines for Regional Service Areas (FY 2010–2018)

(3) Monthly Utilization of Cross-regional Interconnection Lines by Transaction in FY 2018

Table 2-4 shows the monthly utilization of cross-regional interconnection lines by transaction in FY 2018.

Table 2-4: Monthly Utilization of Cross-regional Interconnection Lines by Transaction

[GWh]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
Bilateral	8,273	7,952	8,283	10,412	11,604	9,961	38	11	-0	14	16	144	**56,710**
Day-ahead	2,374	2,040	1,425	1,948	1,818	1,819	6,737	6,761	7,087	7,278	6,618	5,215	**51,120**
1 Hour-ahead	232	219	205	357	394	337	298	321	198	161	105	103	**2,932**

* The values in red are the annual maximum capability and the values in blue are the annual minimum capability, respectively.
* The implicit auction scheme was introduced in October 2018.

(4) Annual Utilization of Cross-regional Interconnection Lines by Transaction for FY 2010–2018

Table 2-5 and Figures 2-5, 2-6, and 2-7 show the annual utilization of cross-regional interconnection lines by transaction for FY 2010–2018.

Table 2-5: Annual Utilization of Cross-regional Interconnection Lines by Transaction (FY 2010–2018)

[GWh]

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Bilateral	100,444	79,693	76,328	73,289	71,558	75,947	84,843	109,842	**56,710**
Day-ahead	6,251	5,718	7,155	11,632	14,174	13,152	14,817	18,350	**51,120**
1 Hour-ahead	2	22	493	1,750	1,554	2,050	3,392	4,203	**2,932**

* "Hour-ahead" means the transaction that is 4 hours ahead of the gate closure in FY 2015. From FY 2016, it refers to the transaction that is 1 hour ahead of the gate closure.

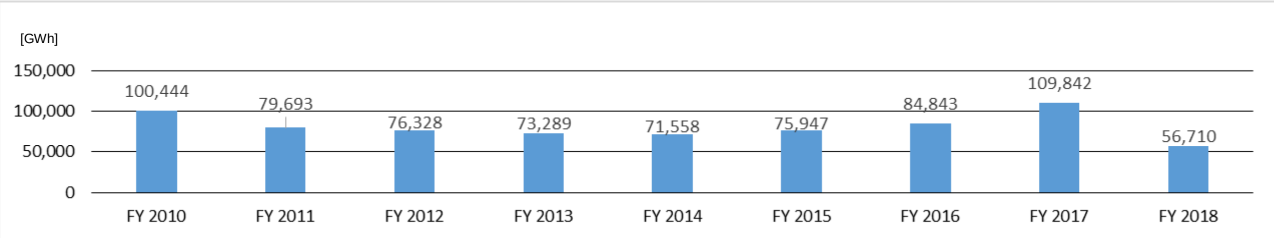


Figure 2-5: Annual Utilization of Cross-regional Interconnection Lines by Bilateral Transaction (FY 2010–2018)

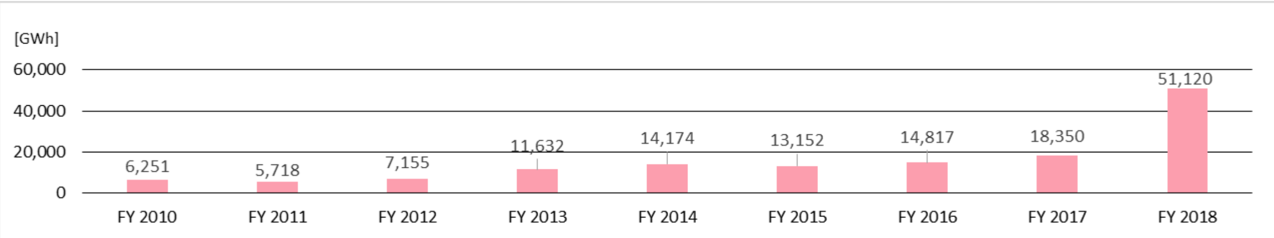


Figure 2-6: Annual Utilization of Cross-regional Interconnection Lines by Day-ahead Transaction (FY 2010–2018)

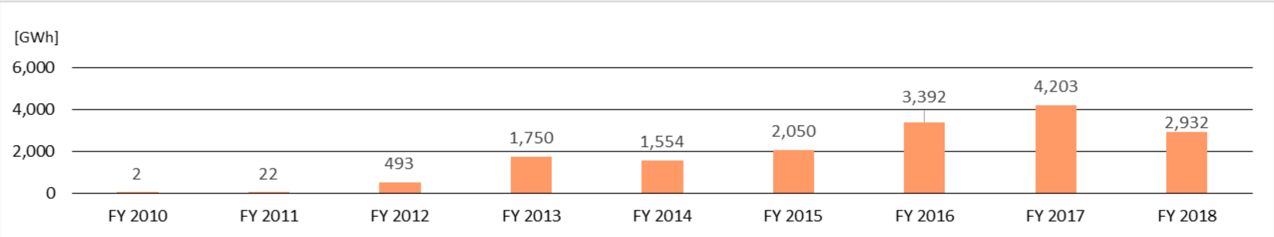


Figure 2-7: Annual Utilization of Cross-regional Interconnection Lines by Hour-ahead Transaction (FY 2010–2018)

3. Congestion Management and Constraints of Cross-regional Interconnection Lines

The following are the actual congestion management and constraints of cross-regional interconnection lines implemented according to the provisions of Article 143 of the Operational Rules.

(1) Monthly Congestion Management of Cross-regional Interconnection Lines by Weekly Plan Submission in FY 2018

Table 2-6 shows the monthly congestion management of cross-regional interconnection lines by weekly plan submissions in FY 2018.

Table 2-6: Monthly Congestion Management of Cross-regional Interconnection Lines by Weekly Plan Submissions

[h]

Interconnection	Weekly Plan Submission	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
Hokkaido-Honshu	Total	768	1,608	2,370	1,790	1,576	2,110	0	0	0	0	0	0	**10,222**
	Before Submission	0	864	1,146	942	1,054	622	0	0	0	0	0	0	**4,628**
	After Submission	768	744	1,224	848	522	1,488	0	0	0	0	0	0	**5,594**
Tohoku-Tokyo	Total	24	0	768	0	0	0	0	0	0	0	0	0	**792**
	Before Submission	24	0	130	0	0	0	0	0	0	0	0	0	**154**
	After Submission	0	0	638	0	0	0	0	0	0	0	0	0	**638**
Tokyo-Chubu	Total	3,053	4,099	3,362	3,446	4,441	3,549	0	0	0	0	0	0	**21,949**
	Before Submission	96	1,432	182	0	0	0	0	0	0	0	0	0	**1,710**
	After Submission	2,957	2,667	3,180	3,446	4,441	3,549	0	0	0	0	0	0	**20,239**
Chubu-Kansai	Total	1	0	63	84	1	0	0	0	0	0	0	0	**148**
	Before Submission	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	After Submission	1	0	63	84	1	0	0	0	0	0	0	0	**148**
Chubu-Hokuriku	Total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Before Submission	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	After Submission	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Hokuriku-Kansai	Total	293	0	0	0	0	0	0	0	0	0	0	0	**293**
	Before Submission	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	After Submission	293	0	0	0	0	0	0	0	0	0	0	0	**293**
Kansai-Chugoku	Total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Before Submission	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	After Submission	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Kansai-Shikoku	Total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Before Submission	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	After Submission	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chugoku-Shikoku	Total	105	82	0	0	0	0	0	0	0	0	0	0	**187**
	Before Submission	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	After Submission	105	82	0	0	0	0	0	0	0	0	0	0	**187**
Chugoku-Kyushu	Total	868	889	1,203	1,715	1,535	2,315	0	0	0	0	0	0	**8,524**
	Before Submission	852	748	712	1,054	1,334	2,130	0	0	0	0	0	0	**6,830**
	After Submission	16	141	491	661	201	185	0	0	0	0	0	0	**1,694**
Nationwide		5,111	6,677	7,765	7,035	7,553	7,973	0	0	0	0	0	0	**42,113**
	Before Submission	972	3,044	2,170	1,996	2,388	2,752	0	0	0	0	0	0	**13,322**
	After Submission	4,139	3,633	5,595	5,039	5,165	5,221	0	0	0	0	0	0	**28,791**

* The managed hours are collected as 30 minutes and rounded up to 1 hour.
* The total number of hours of allocation plans that managed to mitigate congestion.
* There were zero hours with congestion after the introduction of the implicit auction scheme in October 2018.

(2) Annual Congestion Management of Cross-regional Interconnection Lines by Weekly Plan Submission for FY 2010–2018

Table 2-7 and Figure 2-8 show the annual congestion management of cross-regional interconnection lines by weekly plan submissions for FY 2010–2018.

Table 2-7: Annual Congestion Management of Cross-regional Interconnection Lines by Weekly Plan Submissions (FY 2010–2018)

[h]

	Weekly Plan Submission	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
FY 2018	**Total**	5,111	6,677	7,765	7,035	7,553	7,973	0	0	0	0	0	0	**42,113**
	Before Submission	972	3,044	2,170	1,996	2,388	2,752	0	0	0	0	0	0	**13,322**
	After Submission	4,139	3,633	5,595	5,039	5,165	5,221	0	0	0	0	0	0	**28,791**
FY 2017	Total	2,210	3,758	2,789	2,985	2,682	2,851	3,024	4,433	5,188	5,263	4,519	5,659	**45,358**
	Before Submission	1,000	1,694	1,288	1,764	1,758	1,222	1,798	1,124	762	1,714	636	722	**15,482**
	After Submission	1,210	2,064	1,501	1,221	924	1,629	1,226	3,309	4,426	3,549	3,883	4,937	**29,876**
FY 2016	Total	533	1,006	123	221	136	422	703	467	499	508	12	541	**5,167**
	Before Submission	533	763	0	144	130	310	582	208	476	506	0	431	**4,083**
	After Submission	0	243	123	77	6	112	121	259	23	2	12	110	**1,085**
FY 2015	Total	1,175	3,858	1,293	761	791	996	1,396	854	946	774	723	1,275	**14,840**
	Before Submission	1,076	3,778	1,257	744	744	766	772	734	884	744	696	1,216	**13,410**
	After Submission	99	80	36	17	47	231	624	120	62	30	27	59	**1,430**
FY 2014	Total	1,132	1,820	411	18	48	250	101	21	49	76	108	44	**4,075**
	Before Submission	898	1,701	256	0	12	82	30	0	0	0	0	0	**2,978**
	After Submission	234	120	155	18	36	168	71	21	49	76	108	44	**1,097**
FY 2013	Total	1,106	1,189	134	3	19	94	873	0	10	474	205	16	**4,121**
	Before Submission	736	476	100	0	0	32	814	0	5	196	0	0	**2,359**
	After Submission	370	713	34	3	19	62	59	0	5	278	205	16	**1,762**
FY 2012	Total	458	1,237	502	620	727	1,025	299	1,039	795	1	667	469	**7,836**
	Before Submission	234	1,032	0	0	0	447	198	808	698	0	667	420	**4,503**
	After Submission	224	205	502	620	727	578	101	231	97	1	0	49	**3,333**
FY 2011	Total	142	771	994	604	1,236	757	657	296	524	444	2,071	1,622	**10,114**
	Before Submission	84	541	144	224	1,178	384	302	1	0	0	1,543	1,488	**5,889**
	After Submission	58	230	850	380	58	373	355	295	524	444	528	134	**4,226**
FY 2010	Total	553	13	277	52	144	2	5	1	4	551	0	120	**1,721**
	Before Submission	420	0	0	0	0	0	0	0	0	504	0	0	**924**
	After Submission	133	13	277	52	144	2	5	1	4	48	0	120	**798**

* The values in red are the annual maximum capability.
* The managed hours are collected as 30 minutes and rounded up to 1 hour.
* The total number of hours of utilization plans that managed to mitigate congestion.
* In-service dates of function for capability allocation plan revision of the Cross-regional Operation System are as below.
  1. The function for revision of the weekly capability allocation plan and its congestion management: September 2016.
  2. The function for revision of the monthly capability allocation plan and its congestion management: February 2017.
  3. Introduction of the implicit auction scheme: October 2018.

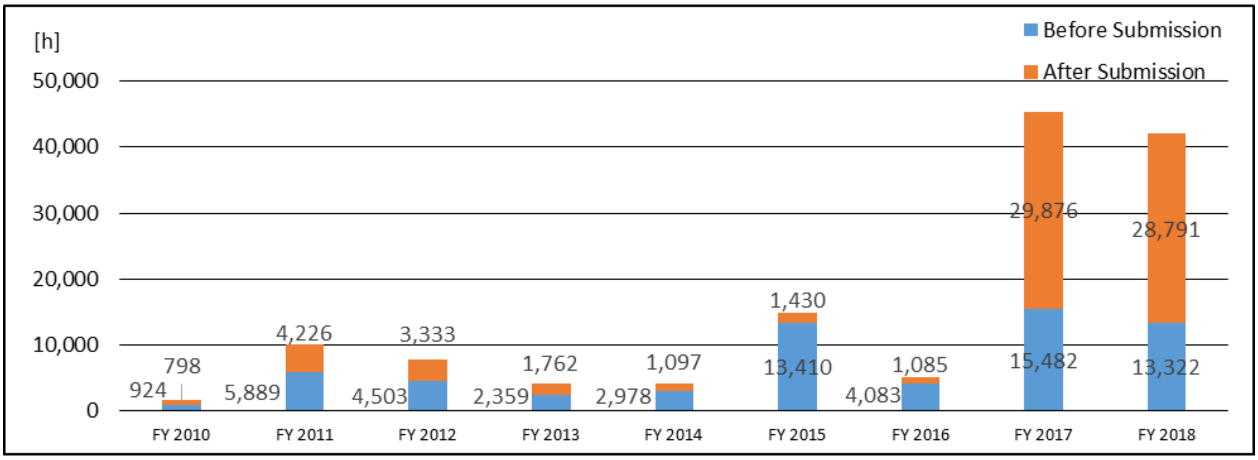


Figure 2-8: Annual Congestion Management of Cross-regional Interconnection Lines by Weekly Plan Submissions (FY 2010–2018)

(3) Monthly Congestion Management of Cross-regional Interconnection Lines by Constraints in FY 2018

Table 2-8 shows the monthly congestion management of cross-regional interconnection lines by constraints in FY 2018.

Table 2-8: Monthly Congestion Management of Cross-regional Interconnection Lines by Constraints

[h]

Interconnection	Constraints	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	**Annual**
Hokkaido-Honshu	Total	768	1,608	2,370	1,790	1,576	2,110	0	0	0	0	0	0	**10,222**
	Over Capability	768	1,608	2,370	1,790	1,576	2,110	0	0	0	0	0	0	**10,222**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Tohoku-Tokyo	Total	24	0	768	0	0	0	0	0	0	0	0	0	**792**
	Over Capability	24	0	768	0	0	0	0	0	0	0	0	0	**792**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Tokyo-Chubu	Total	3,053	4,099	3,362	3,446	4,441	3,549	0	0	0	0	0	0	**21,949**
	Over Capability	3,053	4,099	3,362	3,446	4,441	3,549	0	0	0	0	0	0	**21,949**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chubu-Kansai	Total	1	0	63	84	1	0	0	0	0	0	0	0	**148**
	Over Capability	1	0	63	84	1	0	0	0	0	0	0	0	**148**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chubu-Hokuriku	Total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Over Capability	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Hokuriku-Kansai	Total	293	0	0	0	0	0	0	0	0	0	0	0	**293**
	Over Capability	293	0	0	0	0	0	0	0	0	0	0	0	**293**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Kansai-Chugoku	Total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Over Capability	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Kansai-Shikoku	Total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Over Capability	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chugoku-Shikoku	Total	105	82	0	0	0	0	0	0	0	0	0	0	**187**
	Over Capability	105	82	0	0	0	0	0	0	0	0	0	0	**187**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chugoku-Kyushu	Total	868	889	1,203	1,715	1,535	2,315	0	0	0	0	0	0	**8,524**
	Over Capability	868	889	1,203	1,715	1,535	2,315	0	0	0	0	0	0	**8,524**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Nationwide		5,111	6,677	7,765	7,035	7,553	7,973	0	0	0	0	0	0	**42,113**
	Over Capability	5,111	6,677	7,765	7,035	7,553	7,973	0	0	0	0	0	0	**42,113**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**

* The managed hours are collected as 30 minutes and rounded up to 1 hour.
* The total number of hours of capability allocation plans that managed to mitigate congestion.
* "Congestion management for over capability" means the management implemented when the scheduled power flow reaches the maximum of available transfer capability of the interconnection line.
* "Congestion management for minimum flow" means the management implemented when the scheduled power flow goes below the minimum setting value of commutating facilities at the interconnection line.

(4) Annual Congestion Management of Cross-regional Interconnection Lines by Constraints for FY 2010–2018

Table 2-9 and Figure 2-9 show the annual congestion management of cross-regional interconnection lines by constraints for FY 2010–2018.

Table 2-9 Annual Congestion Management of Cross-regional Interconnection Lines by Constraints (FY 2010–2018)

[h]

FY	Constraints	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
FY 2018	**Total**	5,111	6,677	7,765	7,035	7,553	7,973	0	0	0	0	0	0	**42,113**
	Over Capability	5,111	6,677	7,765	7,035	7,553	7,973	0	0	0	0	0	0	**42,113**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
FY 2017	Total	2,210	3,758	2,789	2,985	2,682	2,851	3,024	4,433	5,188	5,263	4,519	5,659	**45,358**
	Over Capability	2,210	3,758	2,789	2,985	2,682	2,851	3,024	4,433	5,188	5,263	4,519	5,659	**45,358**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
FY 2016	Total	533	1,006	123	221	136	422	703	467	499	508	12	541	**5,167**
	Over Capability	533	1,006	123	221	136	422	703	467	499	508	12	541	**5,167**
	Minimum Flow	0	0	0	0	0	0	0	0	0	0	0	0	**0**
FY 2015	Total	1,175	3,858	1,293	761	791	996	1,396	854	946	774	723	1,275	**14,840**
	Over Capability	1,175	2,437	1,293	761	791	863	1,233	854	946	774	723	1,275	**13,123**
	Minimum Flow	0	1,421	0	0	0	133	163	0	0	0	0	0	**1,717**
FY 2014	Total	1,132	1,820	411	18	48	250	101	21	49	76	108	44	**4,075**
	Over Capability	990	1,661	411	18	48	192	73	21	49	76	108	44	**3,688**
	Minimum Flow	142	160	0	0	0	58	28	0	0	0	0	0	**387**
FY 2013	Total	1,106	1,189	134	3	19	94	873	0	10	474	205	16	**4,121**
	Over Capability	928	853	134	3	19	94	324	0	10	474	205	16	**3,058**
	Minimum Flow	178	336	0	0	1	0	549	0	0	0	0	0	**1,063**
FY 2012	Total	458	1,237	502	620	727	1,025	299	1,039	795	1	667	469	**7,836**
	Over Capability	457	1,160	496	324	511	928	0	325	675	0	667	469	**6,010**
	Minimum Flow	1	77	6	296	217	97	299	715	120	1	0	0	**1,826**
FY 2011	Total	142	771	994	604	1,236	757	657	296	524	444	2,071	1,622	**10,114**
	Over Capability	114	613	144	9	10	143	124	36	496	434	2,069	1,621	**5,810**
	Minimum Flow	29	158	850	595	1,226	614	534	260	28	10	2	1	**4,304**
FY 2010	Total	553	13	277	52	144	2	5	1	4	551	0	120	**1,721**
	Over Capability	500	4	2	49	0	2	5	1	2	19	0	97	**680**
	Minimum Flow	53	9	276	3	144	0	0	0	2	532	0	24	**1,042**

* The values in red are the annual maximum capability.
* The managed hours are collected as 30 minutes and rounded up to 1 hour.
* The total number of hours of capability allocation plans that managed to mitigate congestion.
* In-service dates of function for capability allocation plan revision of the Cross-regional Operation System are as below.
  1. The function for revision of the weekly capability allocation plan and its congestion management: September 2016.
  2. The function for revision of the monthly capability allocation plan and its congestion management: February 2017.
  3. Introduction of the implicit auction scheme: October 2018.

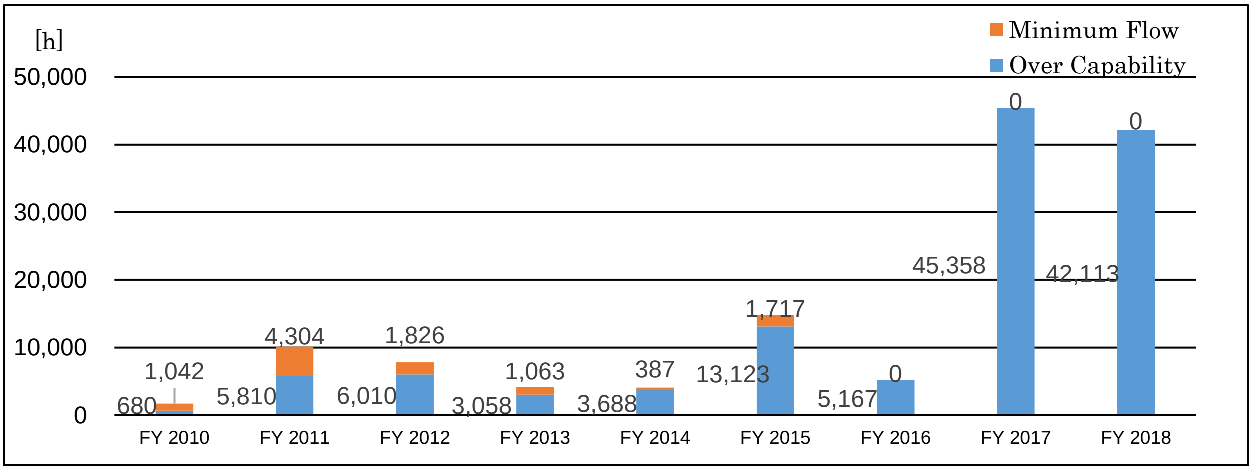


Figure 2-9: Annual Congestion Management of Cross-regional Interconnection Lines by Constraints (FY 2010–2018)

4. Status of Maintenance Work on Cross-regional Interconnection Lines

The following are details of the actual maintenance work on cross-regional interconnection lines as reported by the GT&D companies according to the provisions of Article 167 of the Operational Rules.

(1) Actual Monthly Maintenance Work on Cross-regional Interconnection Lines in FY 2018

Table 2-10 shows the monthly maintenance work on cross-regional interconnection lines in FY 2018, and Figure 2-10 shows the nationwide monthly planned outage rate in FY 2018.

Table 2-10: Monthly Maintenance Work 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			12	8							2	3			1	2			3	2					18	15
Tohoku-Tokyo	Soma-Futaba bulk line, Iwaki bulk line					15	11																	4	7	19	18
Tokyo-Chubu	Sakuma FC C.S.	4	4	2	2									2	12	5	30	2	5							15	53
	Shin Shinano FC C.S.	2	2	2	10	3	8			1	3			4	13	1	2	2	2							15	40
	Higashi Shimizu FC C.S.	1	1																					8	12	9	13
Chubu-Kansai	Mie-Higashi Omi line					1	1																	2	1	3	2
Chubu-Hokuriku	Minami Fukumitsu HVDC BTB C.S., Minami Fukumitsu Substation											8	19													8	19
Hokuriku-Kansai	Echizen-Reinan line	6	13	7	26	1	4									1	1									15	44
Kansai-Chugoku	Seiban-Higashi Okayama line, Yamazaki-Chizu line			13	30	6	25					13	25	7	23	1	1	1	1							41	105
Kansai-Shikoku	Kihoku and Anan AC/DC C.S.	9	18			3	3	1	2			1	1	6	11									4	16	24	51
Chugoku-Shikoku	Honshi interconnection line	5	12	5	29									2	2									5	14	17	57
Chugoku-Kyushu	Kanmon interconnection line													5	10	13	17			2	1	1	1			21	29
Nationwide (Cumulative works for the same facilities deducted)		27	50	41	105	29	52	1	2	1	3	24	48	26	71	22	53	5	8	5	3	1	1	23	50	205	446

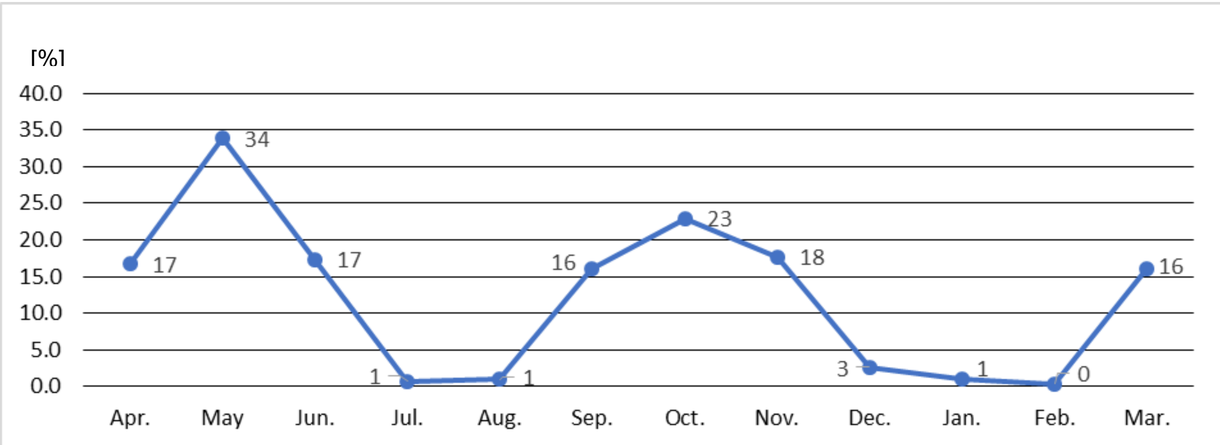


Figure 2-10: Nationwide Monthly Planned Outage Rate

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

(2) Annual Maintenance Work on Cross-regional Interconnection Lines for FY 2010–2018

Table 2-11 shows the annual maintenance work on cross-regional interconnection lines for FY 2010–2018.

Table 2-11: Annual Maintenance Work on Cross-regional Interconnection Lines (FY 2010–2018)

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	Total	9-years Average
Number	64	56	58	38	63	91	218	267	205	1,060	118

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

5. Unplanned Outage of Cross-regional Interconnection Lines

(1) Unplanned Outage of Cross-regional Interconnection Lines in FY 2018

Table 2-12 shows the unplanned outage of cross-regional interconnection lines in FY 2018.

Table 2-12: Unplanned Outage of Cross-regional Interconnection Lines

Date	Facility	Background
Aug. 27	Shin Shinano FC unit No.2	Malfunction of thyristor valve
Sep. 4	Kihoku and Anan AC/DC C.S.	Unknown
Sep. 6	Hokkaido-Honshu HVDC Link	Secondary accident of network due to Hokkaido Eastern Iburi Earthquake
Sep. 10	Shin Shinano FC unit No.2	Secondary accident of network
Sep. 30	Sakuma FC	Fallen tree
Oct. 1	Shin Shinano FC unit No.2	Secondary accident of network

* The unplanned outage affecting TTC is described.

(2) Annual Unplanned Outage of Cross-regional Interconnection Lines for FY 2010–2018

Table 2-13 shows the annual unplanned outage of cross-regional interconnection lines for FY 2010–2018.

Table 2-13: Annual Unplanned Outage of Cross-regional Interconnection Lines (FY 2010–2018)

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	Total	9-years Average
Number	9	5	6	9	1	3	3	3	6	45	5

6. Actual Utilization of the Transmission Margin

The “utilization of the transmission margin” describes the supply of electricity by GT&D companies utilizing part of their transmission margin when there is no ATC on the interconnection lines that applicants for capability allocation wish to use. There was no actual utilization of the transmission margin in FY 2018 according to the provisions of Article 151 of the Operational Rules.
From the next report, the actual utilization of transmission margin will not be reported due to the introduction of the implicit auction scheme; there are no allocation plans for bilateral contracts that may cause congestions.

7. Actual Employment of the Transmission Margin

The “employment of the transmission margin” describes the supply of electricity by GT&D companies utilizing their transmission margin to interconnection lines where the supply–demand balance is restricted or insufficient to reduce power supply, or other such possibilities. Table 2-14 shows the actual employment of the transmission margin for FY 2018 according to the provisions of Article 152 of the Operational Rules.

Table 2-14: Actual Employment of the Transmission Margin

Date	Facility	Background
From Sep. 7 to 21	Hokkaido-Honshu HVDC Link (Flow from Honshu to Hokkaido)	To fulfill instructed amount of power exchange with the need of increasing supply capacity by cross-regional power transfer against decreasing supply capacity in Hokkaido EPCO area due to Hokkaido Eastern Iburi Earthquake.

8. Actual Available Transfer Capabilities of Each Cross-regional Interconnection Line

The actual ATC values calculated and published are shown in Figures 2-13 to 2-22. Figures 2-11 and 2-12 detail how to interpret the ATC graph.

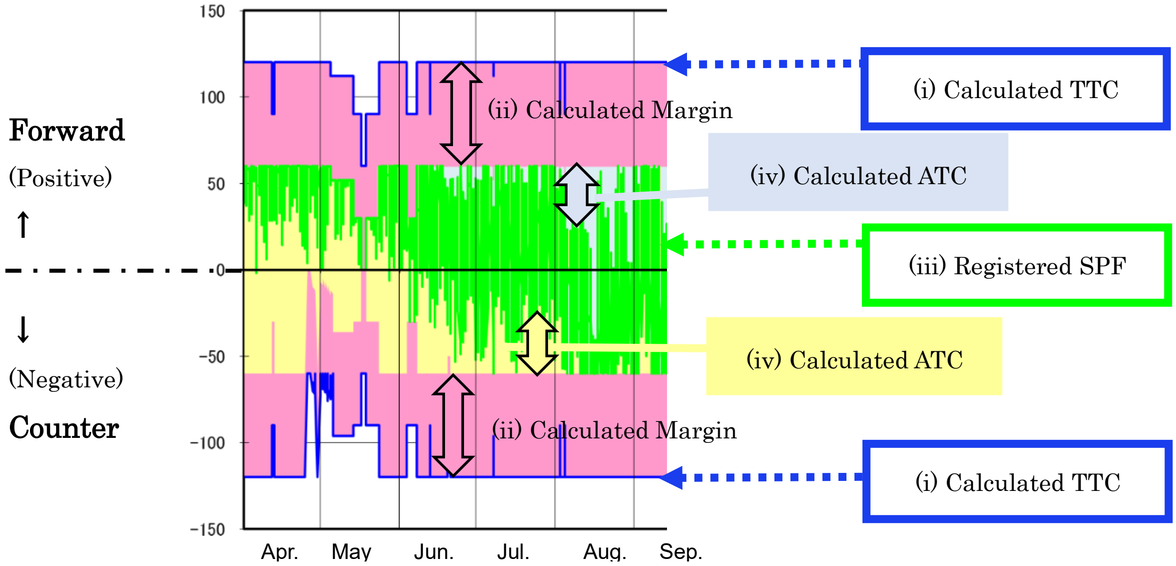


Figure 2-11: How to Interpret the ATC graphs

	By the end of September, 20118	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

Figure 2-12: Explanations of ATC graphs components

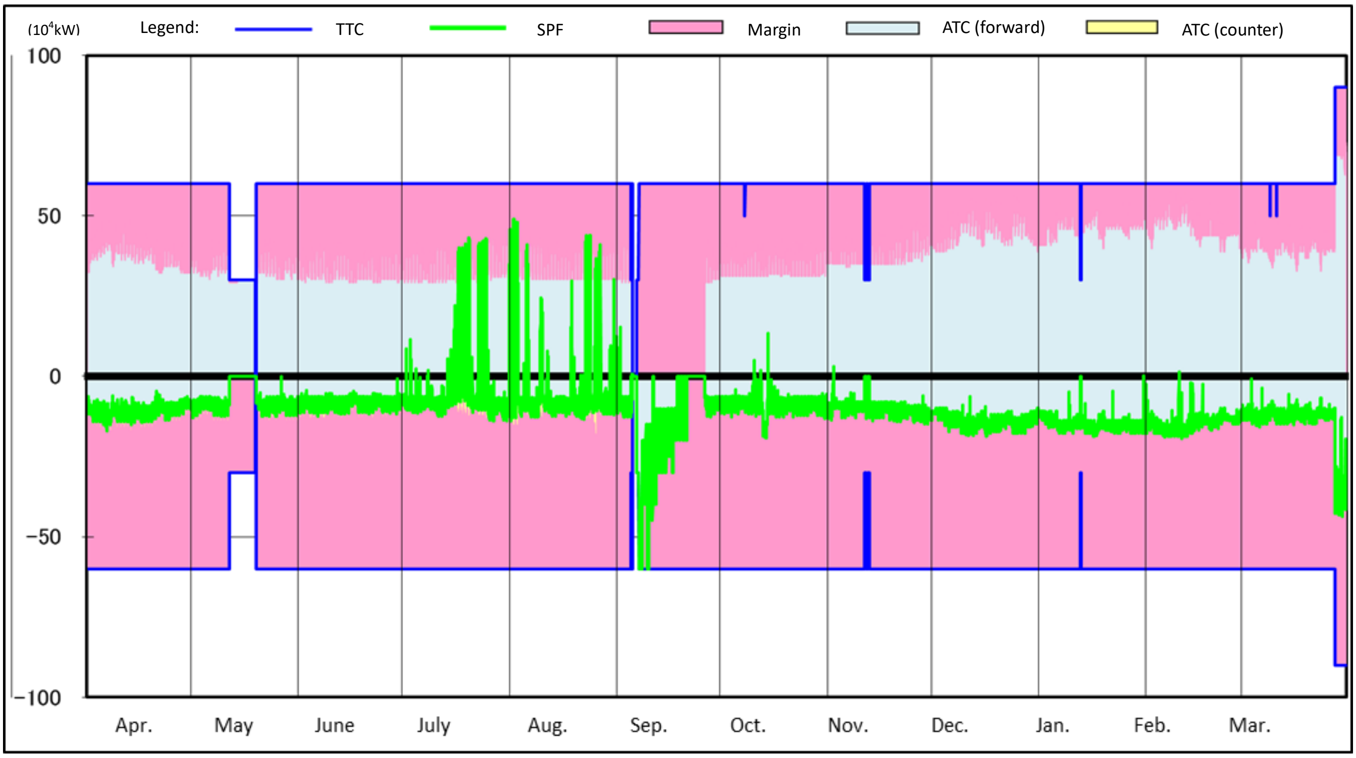
The actual flows on the transmission lines are offset in each direction. Therefore, the scheduled power flow is the offset figure between forward and counter flows, not the simple addition of each direction. In addition, offset figures on the graphs are observed as SPF, not observing the capacity of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

(Reference) Publishing actual ATC

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

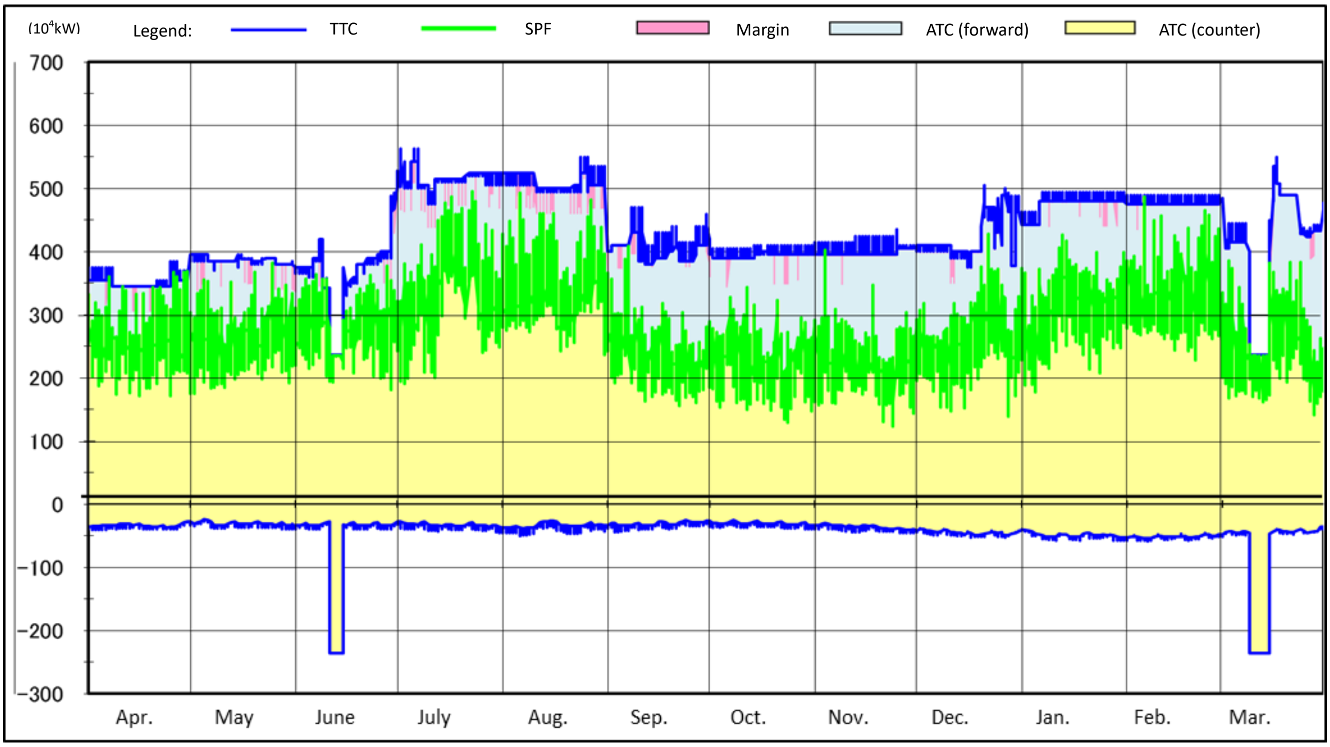
URL http://occtonet.occto.or.jp/public/dfw/RP11/OCCTO/SD/LOGIN_login#

Figure 2-13: Actual ATC of Interconnection Facilities between Hokkaido and Honshu
(Hokkaido–Honshu HVDC Link, and the New Hokkaido–Honshu HVDC Link)



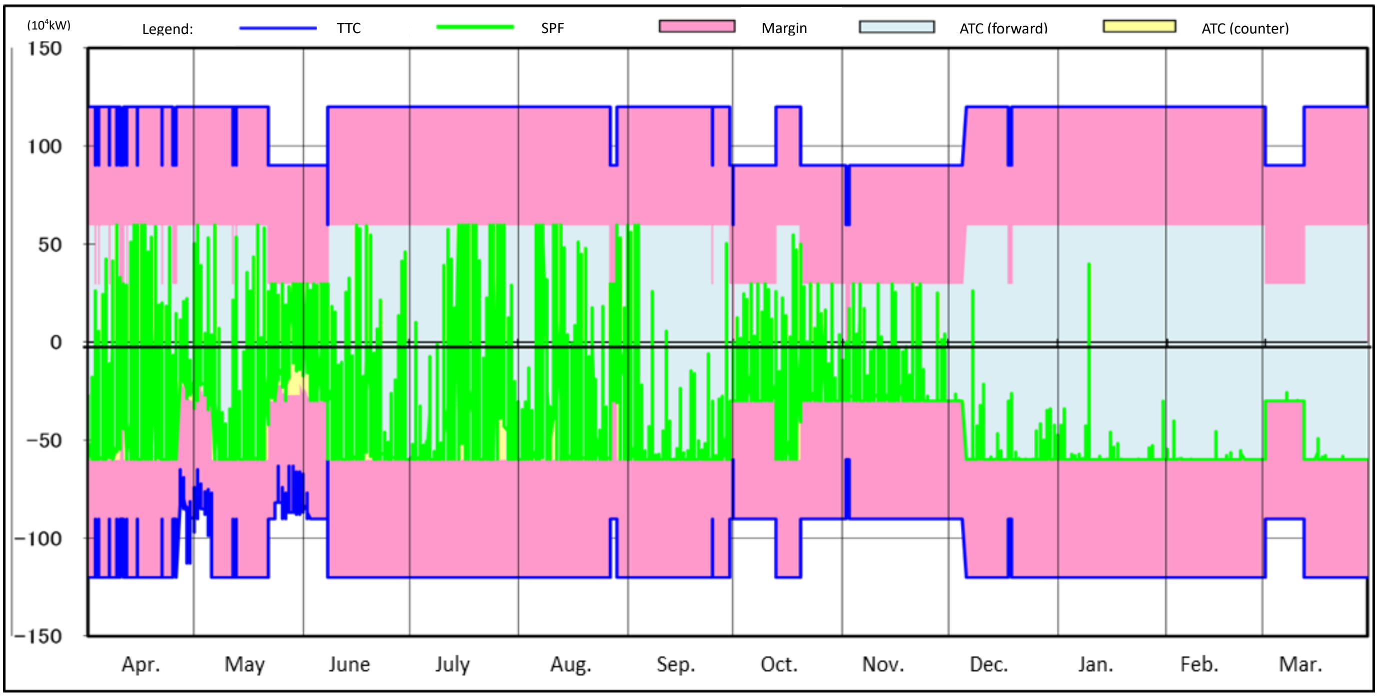
Note: Hokkaido to Tohoku as forward (positive) flow, Tohoku to Hokkaido as counter (negative) flow.

Figure 2-14: Actual ATC of Interconnection Lines between Tohoku and Tokyo
(Soma-Futaba Bulk Line and Iwaki Bulk Line)



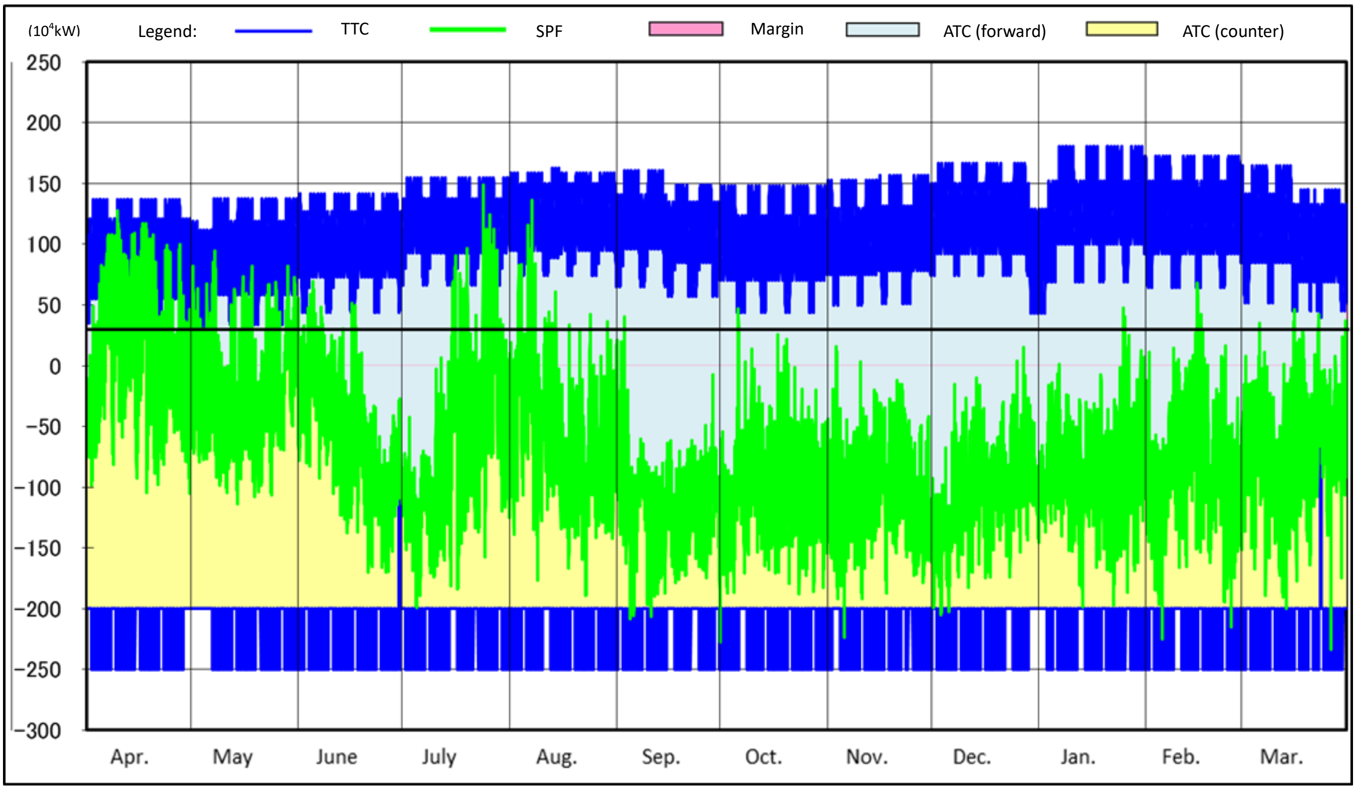
Note: Tohoku to Tokyo as forward (positive) flow, Tokyo to Tohoku as counter (negative) flow.

Figure 2-15: Actual ATC of Interconnection Facilities between Tokyo and Chubu (Sakuma, Shin-Shinano and Higashi Shimizu F.C.)



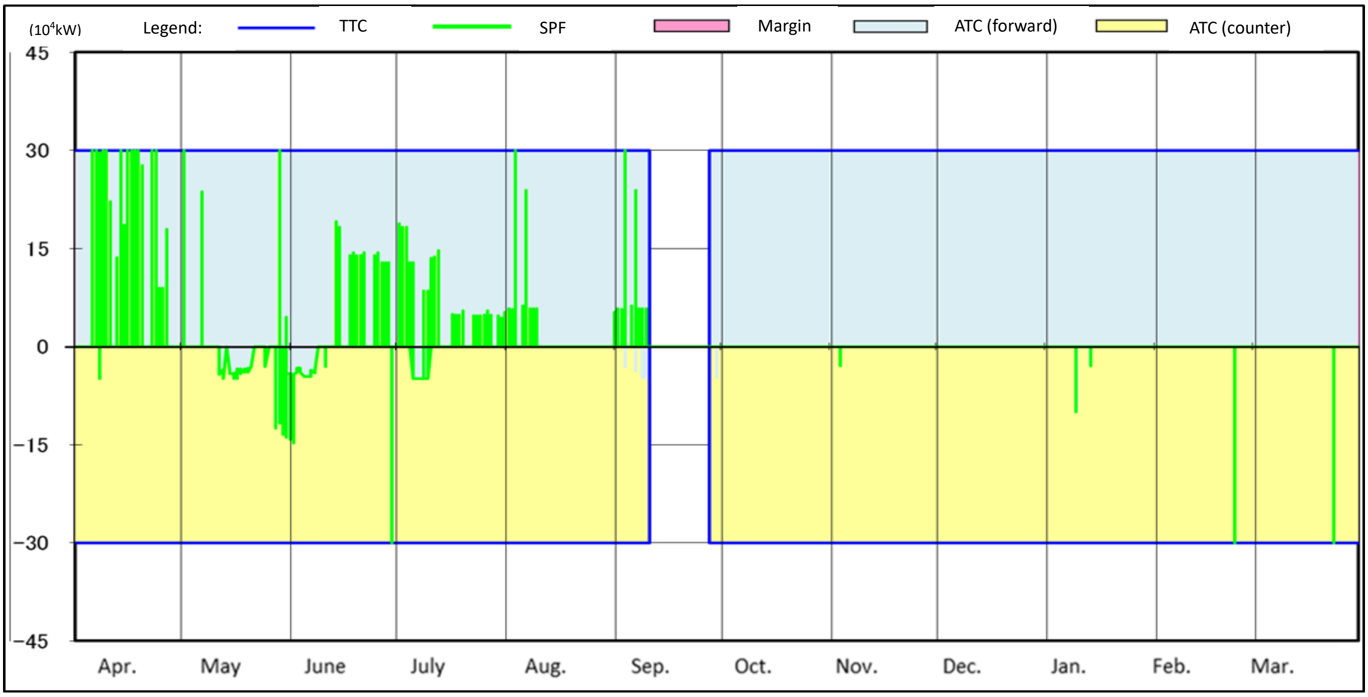
Note: Tokyo to Chubu as forward (positive) flow, Chubu to Tokyo as counter (negative) flow.

Figure 2-16: Actual ATC of the Interconnection Line between Chubu and Kansai (Mie-Higashi Omi Line)



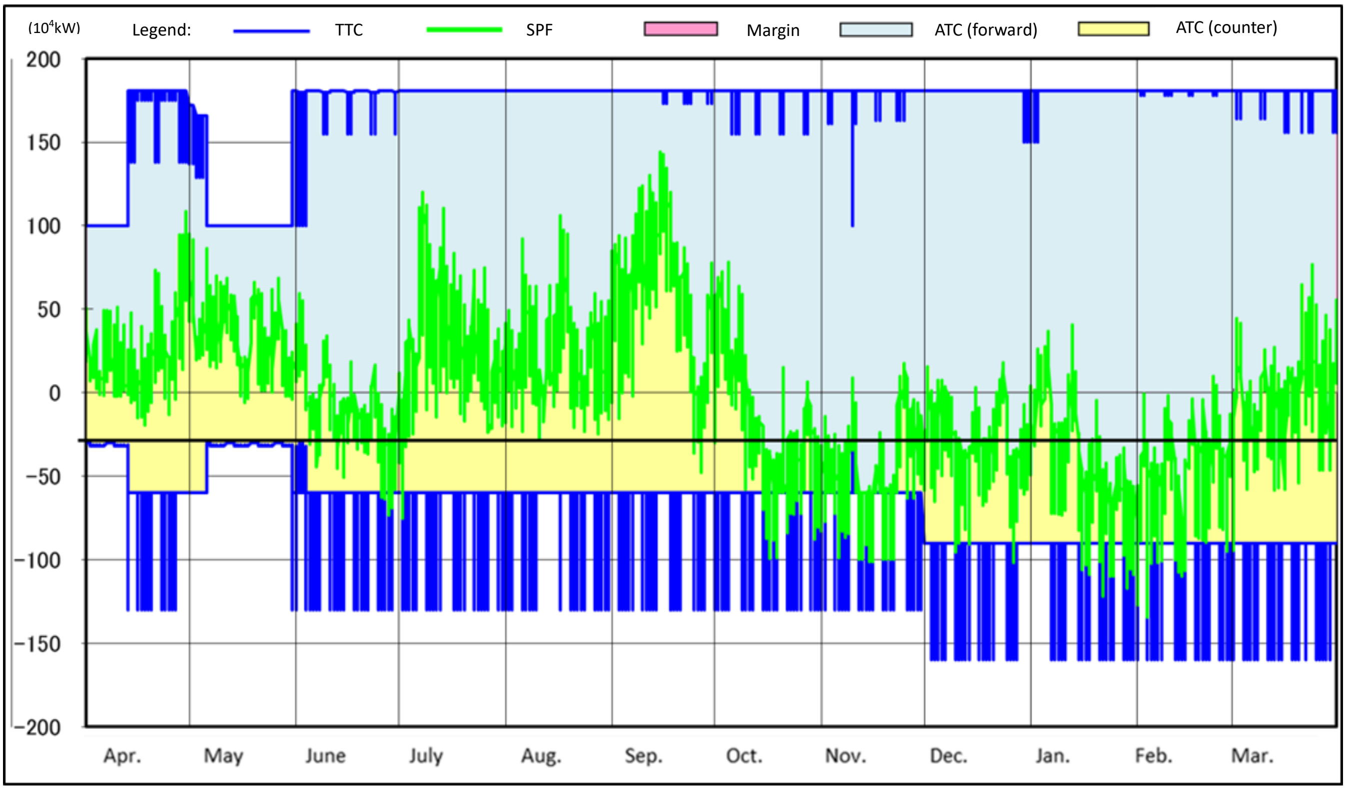
Note: Chubu to Kansai as forward (positive) flow, Kansai to Chubu as counter (negative) flow.

Figure 2-17: Actual ATC of Interconnection Facilities between Chubu and Hokuriku
(Minami Fukumitsu HVDC BTB C.S. and Minami Fukumitsu Substation)



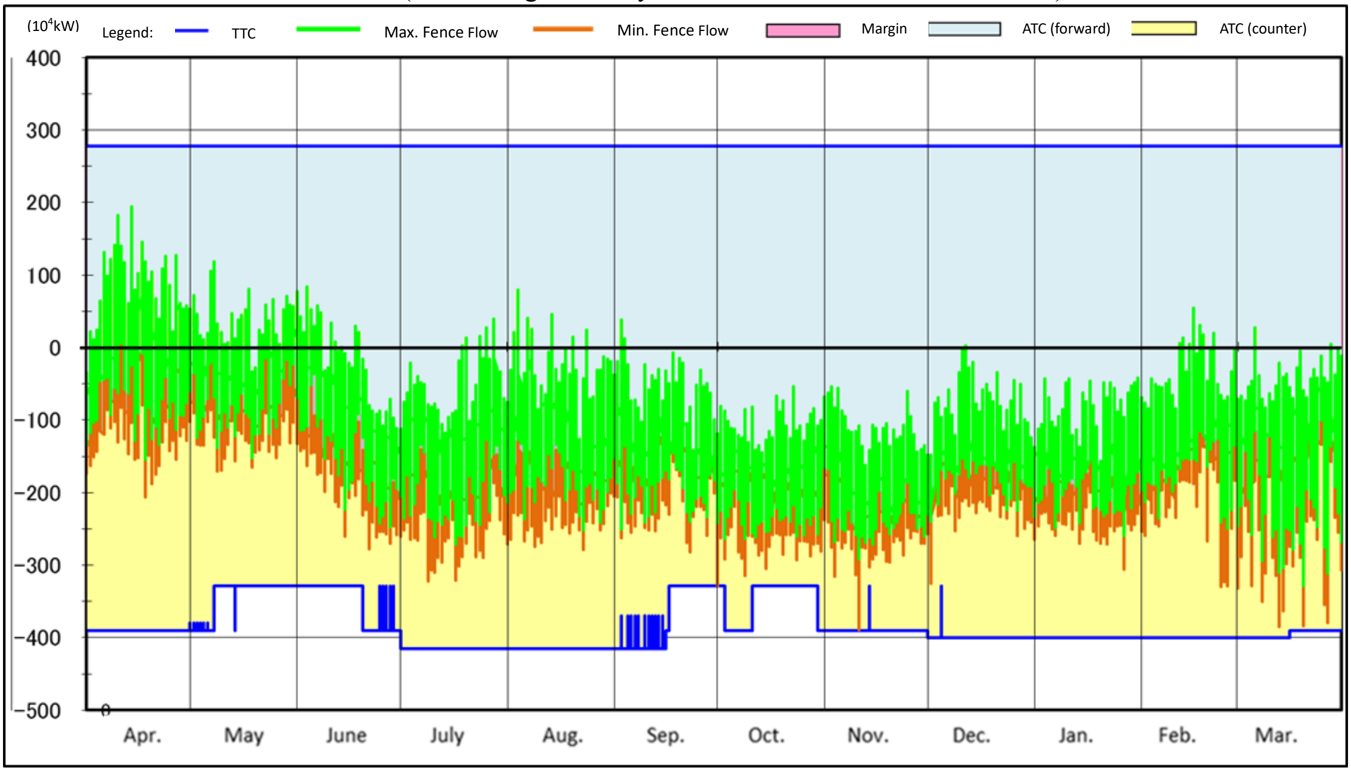
Note: Chubu to Hokuriku as forward (positive) flow, Hokuriku to Chubu as counter (negative) flow.

Figure 2-18: Actual ATC of the Interconnection Line between Hokuriku and Kansai (Echizen-Reinan Line)



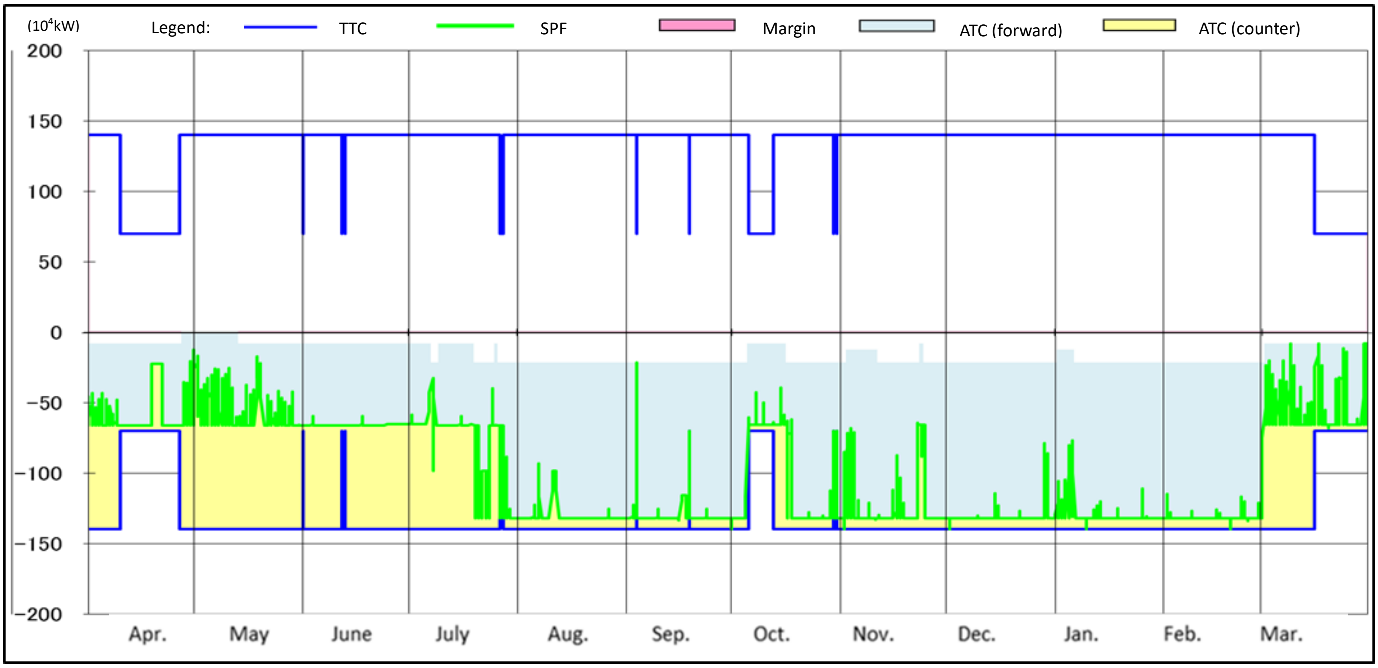
Note: Hokuriku to Kansai as forward (positive) flow, Kansai to Hokuriku as counter (negative) flow.

Figure 2-19: Actual ATC of Interconnection Lines between Kansai and Chugoku
(Seiban-Higashi Okayama Line and Yamazaki-Chizu Line)



Note: Kansai to Chugoku as forward (positive) flow, Chugoku to Kansai as counter (negative) flow.

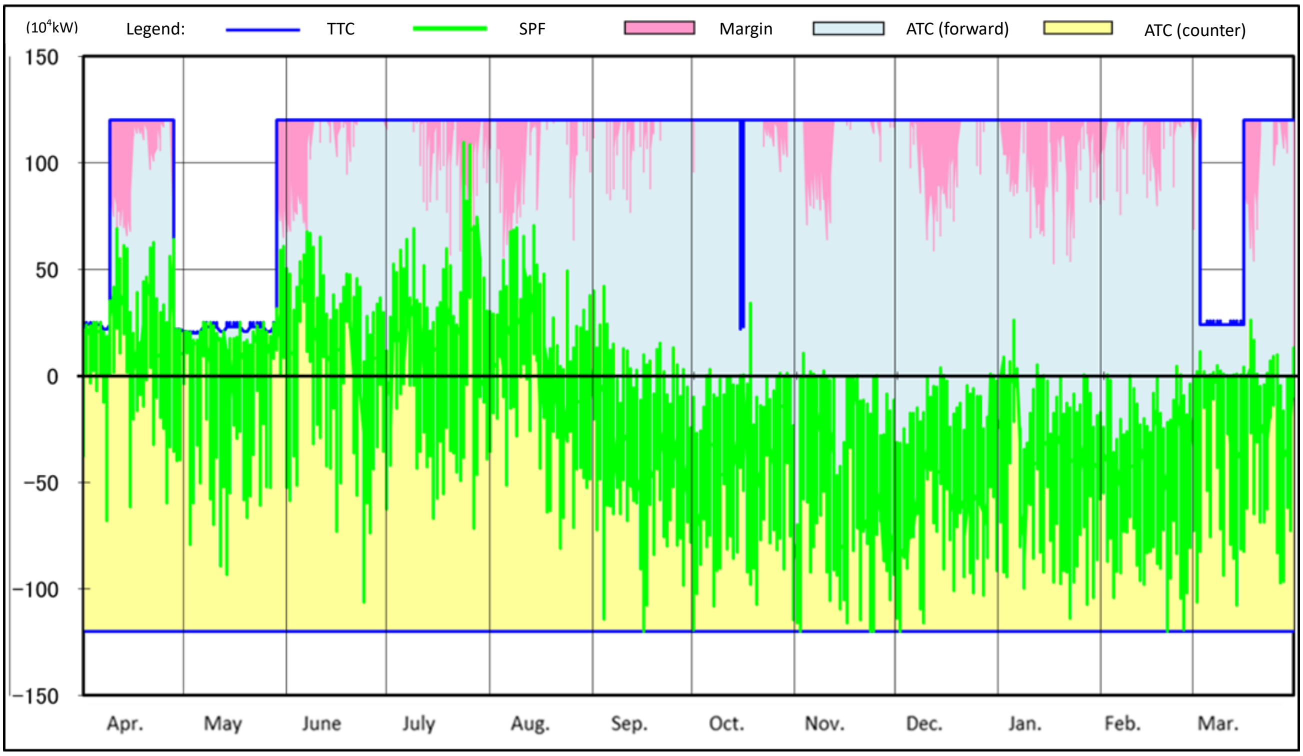
Figure 2-20: Actual ATC of Interconnection Facilities between Kansai and Shikoku
(Interconnection facilities between Kihoku and Anan AC/DC C.S.)



Note: Kansai to Shikoku as forward (positive) flow, Shikoku to Kansai as counter (negative) flow.

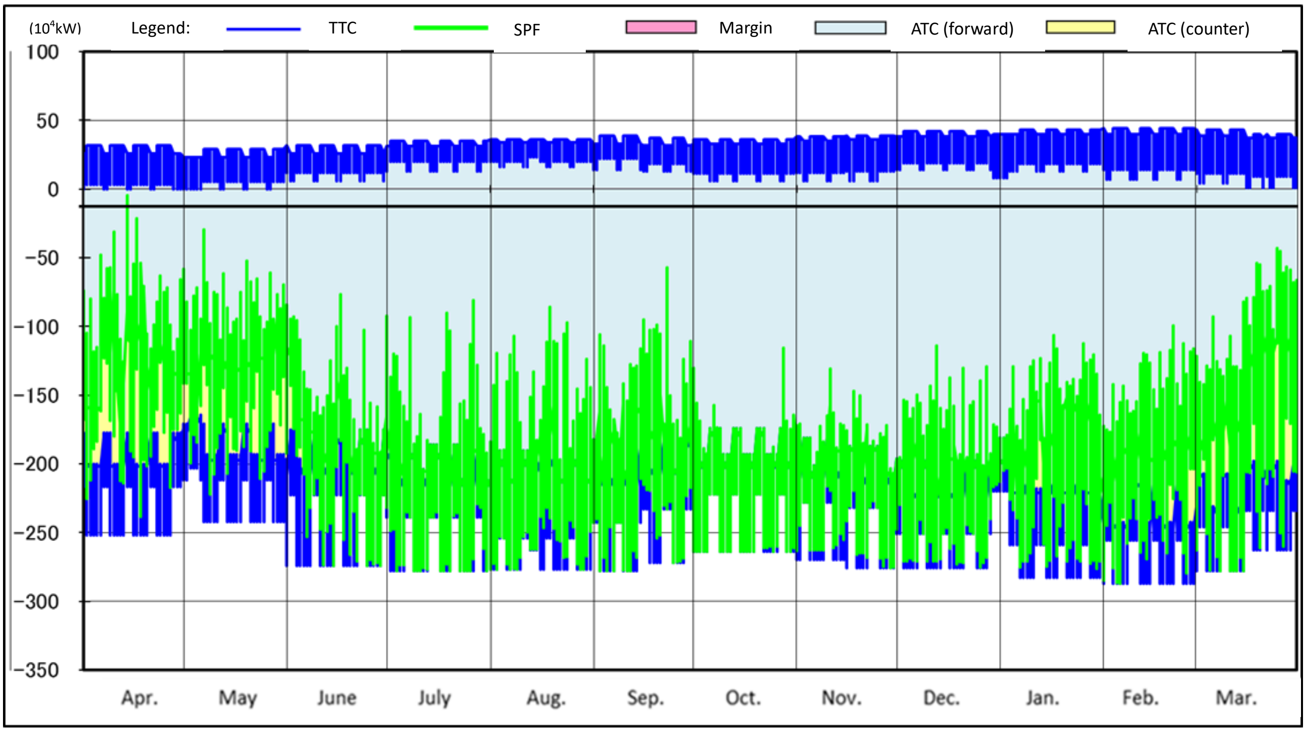
* ATC on forward flow is calculated and chosen from the smaller value from the following.
・TTC－transfer margin－SPF.
・TTC of Minami Awa Bulk Line－(Supply Capacity of Tachibanawan Thermal Power Station－SPF of Anan-Kihoku DC Bulk Line).

Figure 2-21: Actual ATC of the Interconnection Line between Chugoku and Shikoku (Honshi Interconnection Line)



Note: Chugoku to Shikoku as forward (positive) flow, Shikoku to Chugoku as counter (negative) flow.

Figure 2-22: Actual ATC of the Interconnection Line between Chugoku and Kyushu (Kanmon Interconnection Line)



Note: Chugoku to Kyushu as forward (positive) flow, Kyushu to Chugoku as counter (negative) flow.

9. Actual Constraints on Cross-regional Interconnection Lines Nationwide

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

CONCLUSION

Actual Utilization of Cross-regional Interconnection Lines

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

---

* Constraints maps are published on the websites below (in Japanese only).
Hokkaido Electric Power Company : http://www.hepco.co.jp/corporate/con_service/bid_info.html
Tohoku Electric Power Company : http://www.tohoku-epco.co.jp/jiyuka/04.htm
Tokyo Electric Power Company : http://www.tepco.co.jp/pg/consignment/system/index-j.html
Chubu Electric Power Company : http://www.chuden.co.jp/corporate/study/free/rule/map/index.html
Hokuriku Electric Power Company : http://www.rikuden.co.jp/rule/U_154seiyaku.html
The Kansai Electric Power Company : http://www.kepco.co.jp/corporate/takusou/disclosure/ryutusetsubi.html
The Chugoku Electric Power Company : http://www.energia.co.jp/retailer/keitou/access.html
Shikoku Electric Power Company : http://www.yonden.co.jp/business/jiyuuka/tender/index.html
Kyushu Electric Power Company : http://www.kyuden.co.jp/wheeling_disclosure
The Okinawa Electric Power Company : http://www.okiden.co.jp/business-support/service/rule/plan/index.html

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 2018

[only in Japanese]

http://www.occto.or.jp/houkokusho/2019/files/190530_accessjisseki.pdf

May 2019

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 2019

http://www.occto.or.jp/en/information_disclosure/supply_plan/files/supplyplan_2019.pdf

May 2019

Organization for Cross-regional Coordination of Transmission Operators, Japan

Aggregation of Electricity Supply Plans
Fiscal Year 2019

May 2019

Organization for Cross-regional Coordination of Transmission Operators, Japan

＜INTRODUCTION＞

The Organization for Cross-regional Coordination of Transmission Operators, Japan (hereafter, the Organization) has aggregated the electricity supply plans for fiscal year (FY) 2019 according to Articles 29 and 181 of the Operational Rules of the Organization and Paragraph 1, Article 29 of the Electricity Business Act, which require the plans to be submitted by electric power companies (EPCOs), and publish their results.
The Organization has aggregated the plans for FY 2019 according to Article 29 of the Act and Article 28 of the Operational Rules, which were submitted to the Ministry of Economy, Trade and Industry (METI) under the same article of the Act.
The electricity supply plans are submitted by the EPCOs according to the Network Code of the Organization, aggregated by the Organization, and sent to METI annually by the end of March.
In total, 1,299 electricity supply plans for FY 2019 were aggregated, including 1,296 plans submitted by companies that became EPCOs by the end of November 2018 and three plans submitted by companies that became EPCOs by March 1, 2019.

Number of Electric Power Companies Subject to the Aggregation in FY 2019

Business License	Number
Generation Companies	725
Retail Companies	535
Specified Transmission, Distribution and Retail Companies	22
Specified Transmission and Distribution Companies	5
Transmission Companies	2
General Transmission and Distribution Companies	10
Total	1,299

CONTENTS

I. Electricity Demand Forecast

1. Actual and Preliminary Data for FY 2018 and Forecast for FY 2019 (Short-Term)

a. Peak Demand (average value of the three highest daily loads[1]) in August

Table 1-1 shows the actual data for the aggregated peak demand for each regional service area[2] submitted by the 10 general transmission and distribution (GT&D) companies for FY 2018 and the forecast[3] value for FY 2019.

Peak demand (average value of the three highest daily loads) for FY 2019 was forecast at 159,070 MW, which represents a 0.4% decrease over 159,700 MW, that is, the temperature-adjusted[4] value for FY 2018.

Table 1-1 Peak Demand (average value of the three highest daily loads) in August
(nationwide, 10^4 kW at the sending end)

FY 2018 Actual (temperature adjusted)	FY 2019 Forecast
15,970	15,907 (-0.4%)*

* % change compared with actual data for the previous year

b. Forecast for FY 2019

Table 1-2 shows the monthly average value of the three highest daily loads in FY 2019 from the aggregated peak demand for each regional service area submitted by the 10 GT&D companies. The monthly average value of the three highest daily loads in summer (August) is greater than that in winter (January) by about 10 GW; therefore, nationwide peak demand occurs in summer.

Table 1-2 Monthly Peak Demand (average value of the three highest daily loads) in FY 2019
(nationwide, 10^4 kW at the sending end)

	Apr.	May	Jun.	Jul.	Aug.	Sep.
Peak Demand	11,641	11,446	12,748	15,872	15,907	13,899
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Peak Demand	11,887	12,552	14,285	14,892	14,870	13,536

[1] Peak demand (average value of the three highest daily loads) corresponds to the average value of the three highest daily loads (hourly average) in each month.

[2] 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 transmission and distribution network of the GT&D companies. The Organization publishes these average values according to the provisions of paragraph 5, Article 23 of the Operational Rules.

[3] Demand forecast beyond FY 2019 is based on normal weather. Thus, weather conditions for forecast assumption may vary in contrast to the actual data or estimated value in FY 2018.

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

c. Annual Electric Energy Requirements

Table 1-3 shows the preliminary data[5] for FY 2018 and the forecast value for FY 2019 from the aggregated electric energy requirements of each regional service area submitted by the 10 GT&D companies. The electric energy requirements for FY 2019 are forecast at 890.5 TWh, a 0.4% increase over the 886.9 TWh in the preliminary data for FY 2018.

Table 1-3 Annual Electric Energy Requirements
(nationwide, TWh at the sending end)

FY 2018 Preliminary (temperature-adjusted)	FY 2019 Forecast
886.9	890.5 (+0.4%)*

* % changes over the preliminary value for the previous year.

5 Preliminary data for annual electric energy requirements are an aggregation of the actual data from April to November 2018 with the preliminary data from December 2018 to March 2019.

2. 10-Year Demand Forecast (Long-Term)

Table 1-4 shows the major economic indicators developed and published on November 28, 2018 by the Organization, which are assumptions for the GT&D companies to forecast the peak demand in their regional service areas.

The real gross domestic product (GDP)[6] is estimated at ¥538.3 trillion in FY 2018 and ¥572.5 trillion in FY 2028 with an annual average growth rates (AAGR) of 0.6%. The index of industrial production (IIP)[7] is projected at 104.3 in FY 2018 and 108.5 in FY 2028 with an AAGR of 0.4%.

Table 1-4 Major Economic Indicators Assumed for Demand Forecast

	FY 2018	FY 2028
Gross Domestic Product(GDP)	¥ 538.3 trillion	¥ 572.5 trillion [+0.6%]*
Index of Industrial Product(IIP)	104.3	108.5 [+0.4%]*

* Average annual growth rate for the forecast value of FY 2018

a. Peak Demand (average value of the three highest daily loads) in August

Table 1-5 shows the peak demand forecast for FY 2019, FY 2023, and FY 2028 as the aggregation of peak demand for each regional service area submitted by the 10 GT&D companies. In addition, Figure 1-1 shows the actual data and the forecast of peak demand from FY 2006 to 2028. The peak demand nationwide is forecast at 158,140 MW in FY 2023 and 157,350 MW in FY 2028, with an AAGR of minus 0.1% from FY 2018 to FY 2028.

The peak demand forecast over 10 years shows a slightly decreasing trend, which is largely due to negative factors, such as efforts to reduce electricity use, wider utilization of energy-saving electric appliances, a shrinking population, and load-leveling measures, and despite positive factors such as the expansion of economic scale and greater dissemination of electric appliances.

In addition, the AAGR forecast is lower than that of the previous year, mainly due to a declining level of economic activity and a decreasing trend in actual electricity demand because of progress in energy conservation.

Table 1-5 Peak Demand Forecast (average value of the three highest daily loads) for August (nationwide, 10^4 kW at the sending end)

FY 2019 [aforementioned]	FY 2023	FY 2028
15,907	15,814 [-0.2%]*	15,735 [-0.1%]*

* Average Annual Growth Rate for the forecast value of FY 2018

[6] GDP expressed as the chained price for CY 2011.
[7] Index value in CY 2015 = 100

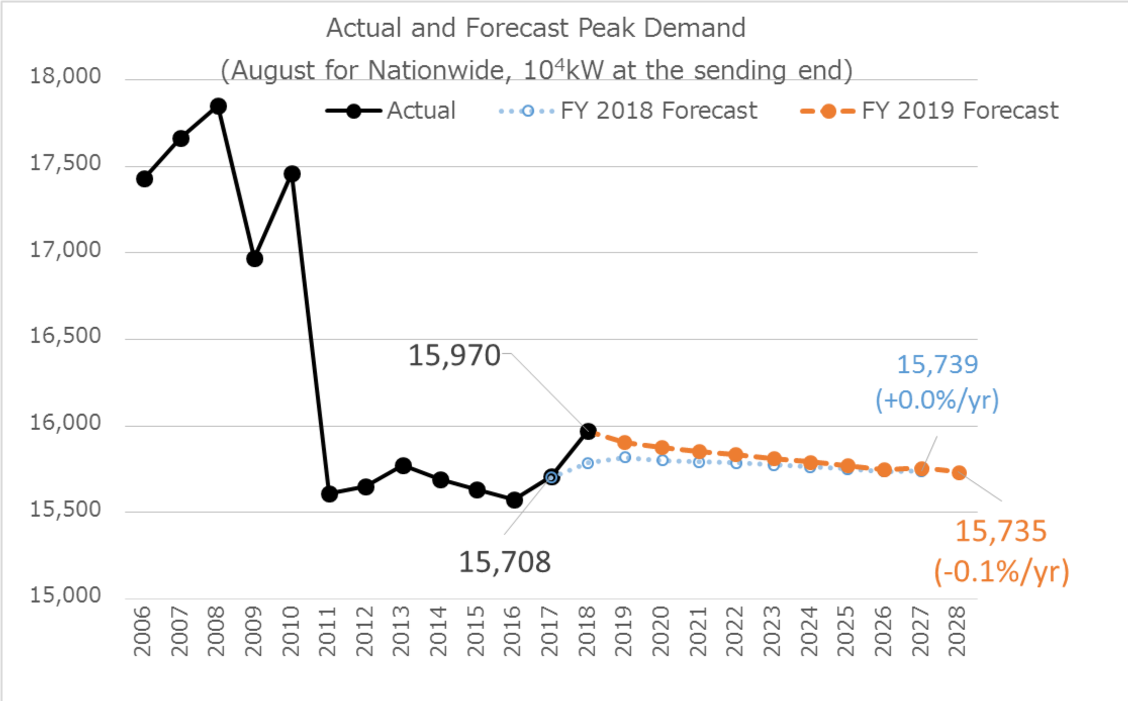


Figure 1-1 Actual and Forecast Peak Demand (August for Nationwide, 10^4 kW at the sending end)

b. Annual Electric Energy Requirement

Table 1-6 shows the forecast for annual electric energy requirements in FY 2019, FY 2023, and FY 2028 as the aggregation of the electric energy requirements for each regional service area submitted by the 10 GT&D companies. The nationwide annual electric energy requirement is forecast at 884.6 TWh in FY 2023 and 882.1 TWh in FY 2028, with an AAGR of minus 0.1% from FY 2018 to FY 2028.

The annual electric energy requirement forecast over 10 years shows a slightly decreasing trend, which is largely due to negative factors, such as efforts to reduce electricity use, wider utilization of energy-saving electric appliances, and a shrinking population, and despite positive factors such as the expansion of economic scale and greater dissemination of electric appliances.

Table 1-6 Annual Electric Energy Requirement Forecast
(nationwide, TWh at the sending end)

FY 2019 [aforementioned]	FY 2023	FY 2028
890.5	884.6 [-0.1%]*	882.1 [-0.1%]*

* AAGR for the forecast value of FY 2018.

II. Electricity Supply and Demand

1. Supply–Demand Balance Evaluation Method

The Organization will evaluate the supply–demand balance for each regional service area as well as nationwide using the supply capacity[8] and peak demand data for the regional service areas. Based on the discussion at the 37th meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (March 20, 2019), the Organization will implement its evaluation using the criterion of whether the reserve margin (%)[9] for each regional service area is secured over 8% or not, and when the least reserve margin emerges at the time other than the average value of the three highest daily loads, the least reserve margin also is secured over 8%.

In the Okinawa EPCO regional service area, the criterion is to secure power supply capacity over peak demand against an interruption of its largest generating unit and balancing capacity with frequency control function in its regional service area.

Figure 2-1 summarizes the supply–demand balance evaluation. Supply capacity includes the generating capacity requirements secured by retail and GT&D companies for their regional service areas and the production of surplus power[10] of generation companies. The supply capacity currently secured by retail companies includes power procured[11] from other regional service areas through cross-regional interconnection lines. Thus, the surplus power of generation companies or reserve capacity of retail companies might provide supply capacity for other regional service areas in the future.

Under the circumstances in which the operation of a nuclear power plant has become uncertain, the supply capacity of the corresponding unit or plant is recorded as zero where the corresponding supply capacity is reported as "uncertain" according to Procedures for Electricity Supply Plans of FY 2019 (published in December 2018 by the Agency for Natural Resources and Energy). In the electricity supply plans for FY 2019, supply capacity was reported as "uncertain" by all nuclear power plants except for those that had resumed operation by the time of the submission of the electricity supply plans (March 1, 2019).

---

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

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

10 Surplus power is the surplus power generation capacity of generation companies in a regional service area without sales destination.

11 In case of congestion in cross-regional interconnection lines, the rebated figure to each area calculated by the Organization is added.

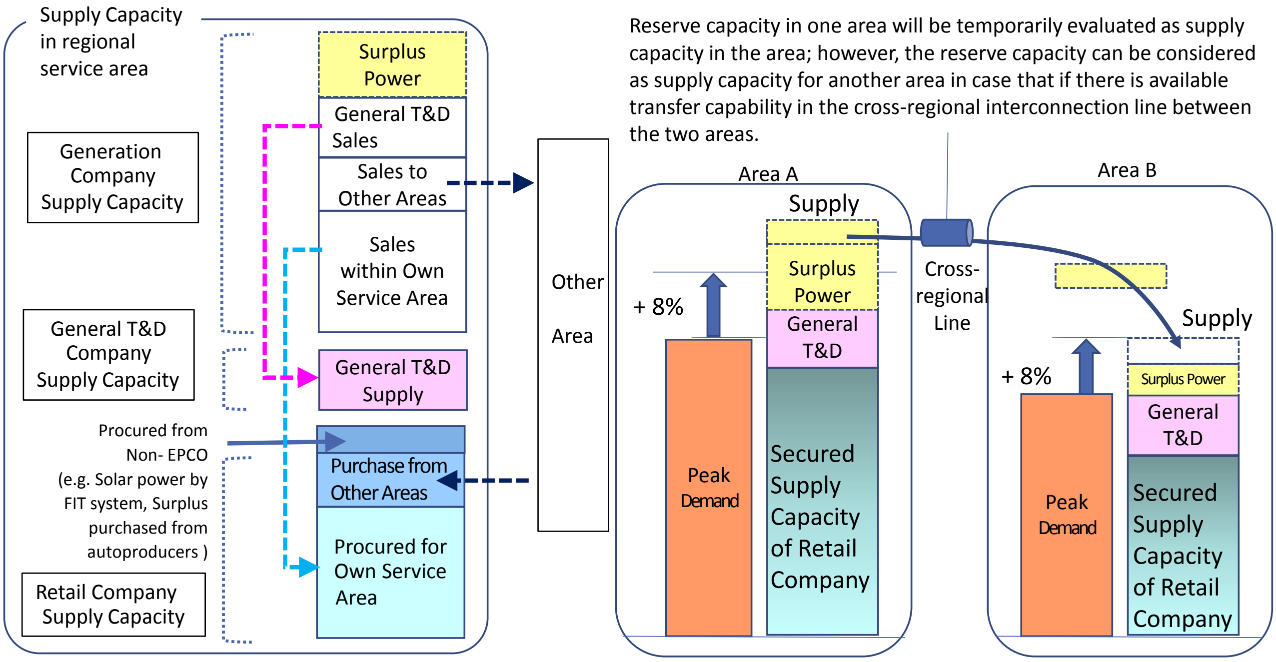


Figure 2-1 Summary of Supply–Demand Balance Evaluation

2. Actual Data for FY 2018 and Projection for FY 2019 (Short-Term)

a. Actual Data for FY 2018

Table 2-1 shows the actual supply–demand balance in August 2018 based on the nationwide supply capacity and peak demand data.

A reserve margin of 8%, which is the criterion for stable supply, was secured in all regional service areas supplied by GT&D companies.

Table 2-1 Actual Supply–Demand Balance in August 2018
(nationwide, 10^4 kW at the sending end)

Peak Demand (temperature adjusted) [aforementioned]	Supply Capacity (nationwide)	Reserve Capacity	Reserve Margin
15,970	17,891	1,921	10.7%

Table 2-2 shows the actual supply–demand balance in each regional service area in August 2018. A reserve margin of 8% could not be secured in the Tokyo area; a reserve margin of 3%, which is the criterion for stable daily operation, was secured.

Table 2-2 Actual Supply–Demand Balance in August 2018
(each regional service area, 10^4 kW at the sending end)

	Hokkaido	Tohoku	Tokyo	Chubu	Hokuriku	Kansai	Chugoku	Shikoku	Kyushu	Okinawa
Peak Demand	419	1,297	5,377	2,473	504	2,639	1,028	504	1,552	150
Supply Capacity	550	1,603	5,697	2,736	582	2,886	1,222	551	1,877	187
Reserve Margin	31.4%	23.6%	6.0%	10.6%	15.4%	9.4%	19.0%	9.2%	20.9%	24.7%

b. Projection of Supply–Demand Balance in FY 2019

Table 2-3 and Figure 2-2 show the projection of a monthly supply–demand balance (at the time of the least reserve margin) for FY 2019. A reserve margin of 8% is secured for each month nationwide.

Table 2-3 Projection of the Monthly Supply–Demand Balance for FY 2019
(at the time of the least reserve margin; nationwide, 10^4 kW at the sending end)

	Apr.	May	Jun.	Jul.	Aug.	Sep.
Peak Demand	11,623	11,389	12,640	15,661	15,680	13,826
Supply Capacity	14,679	14,535	15,016	17,253	17,141	16,303
Reserve Margin	26.3%	27.6%	18.8%	10.2%	9.3%	17.9%
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Peak Demand	11,861	12,552	14,285	14,892	14,870	13,536
Supply Capacity	14,218	14,668	16,130	16,893	16,836	16,228
Reserve Margin	19.9%	16.9%	12.9%	13.4%	13.2%	19.9%

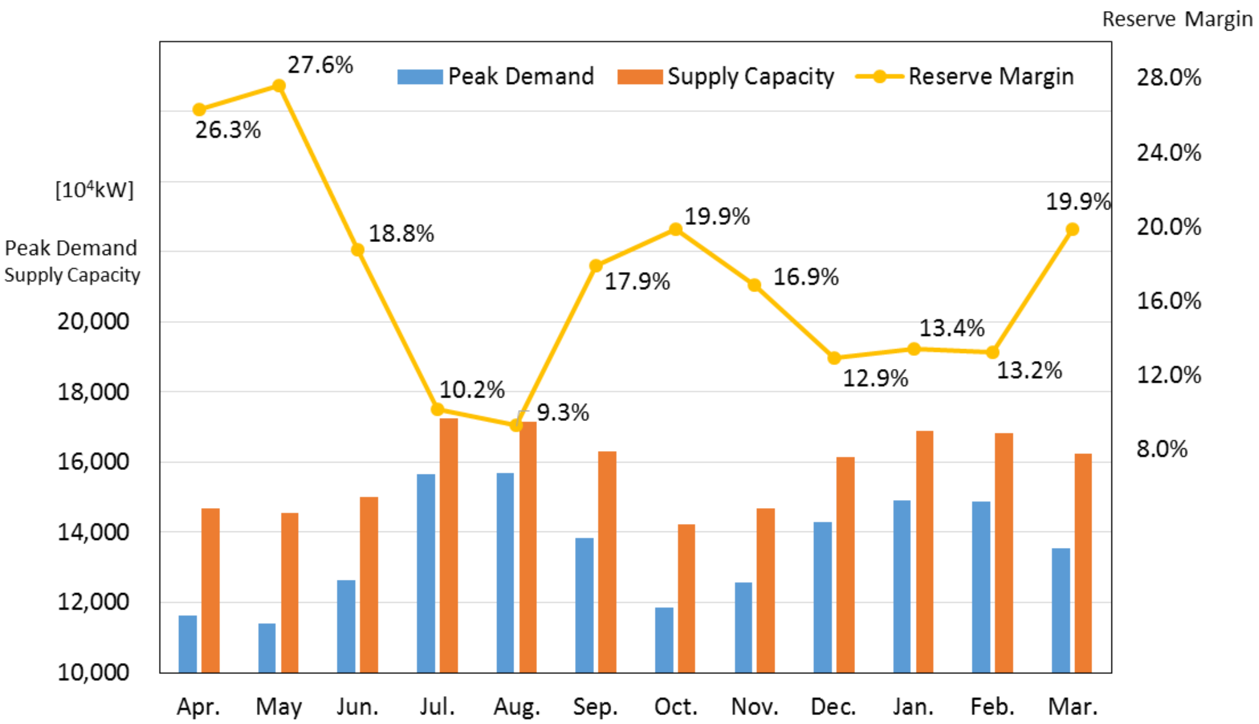


Figure 2-2 Projection of the Monthly Supply–Demand Balance for FY 2019
(at the time of the least reserve margin; nationwide, at the sending end)

Table 2-4 shows the monthly projection of the least reserve margin for each regional service area. In addition, Table 2-5 shows the monthly projection of the least reserve margin[12] for each regional service area recalculated using power exchanges to areas below the 8% reserve margin from areas of over 8% reserve margin based on the available transfer capability (ATC)[13].

The least reserve margin for each regional service area almost secures the criterion of a stable supply, with a reserve margin of 8%, except for some areas and months. However, a nationwide reserve margin of 8% (the criterion of stable supply) is secured by using cross-regional interconnection lines to share power from other areas with sufficient supply capacity.

Table 2-4 Monthly Projection of the Least Reserve Margins Nationwide and for Each Regional Service Area
(resources within own service area only, at the sending end)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	36.2%	47.4%	57.0%	21.1%	22.2%	24.9%	19.7%	19.5%	25.0%	19.6%	21.5%	23.8%
Tohoku	19.8%	26.8%	16.9%	14.3%	11.5%	13.1%	9.8%	12.0%	11.3%	10.9%	12.0%	12.4%
Tokyo	20.2%	30.8%	18.7%	8.5%	8.7%	22.6%	23.8%	16.5%	20.0%	18.4%	16.7%	23.8%
50 Hz area Total	21.3%	31.2%	20.9%	10.3%	10.0%	20.9%	20.6%	15.8%	18.6%	16.9%	16.1%	21.4%
Chubu	26.9%	21.1%	19.7%	8.4%	10.1%	17.8%	19.0%	17.2%	8.7%	10.1%	11.8%	17.6%
Hokuriku	28.1%	24.0%	15.0%	16.1%	11.0%	15.6%	13.3%	8.1%	13.7%	9.4%	9.3%	16.2%
Kansai	30.6%	25.3%	14.0%	6.5%	5.5%	16.0%	19.9%	19.9%	8.7%	11.8%	10.4%	17.3%
Chugoku	24.1%	21.9%	16.8%	12.6%	11.2%	14.8%	19.3%	12.6%	0.6%	8.4%	9.8%	16.6%
Shikoku	42.9%	39.9%	30.1%	20.2%	16.1%	14.9%	23.8%	26.0%	15.8%	4.2%	5.3%	2.4%
Kyushu	35.5%	26.0%	12.7%	9.6%	4.8%	9.3%	16.3%	15.9%	5.4%	9.6%	9.1%	25.7%
60 Hz area Total	30.1%	24.5%	16.8%	9.7%	8.3%	15.1%	18.8%	17.1%	7.8%	9.9%	10.1%	17.8%
Interconnected	26.0%	27.5%	18.6%	9.9%	9.1%	17.7%	19.6%	16.5%	12.5%	13.0%	12.8%	19.4%
Okinawa	55.3%	41.9%	35.7%	33.1%	33.5%	38.1%	46.9%	53.9%	73.8%	70.3%	78.0%	84.3%
Nationwide	26.3%	27.6%	18.8%	10.2%	9.3%	17.9%	19.9%	16.9%	12.9%	13.4%	13.2%	19.9%

Below 8% Criteria

Table 2-5 Monthly Projection of the Least Reserve Margins Nationwide and for Each Regional Service Area
(with power exchanges through cross-regional interconnection lines, at the sending end)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	21.3%	29.8%	45.2%	11.3%	12.4%	19.2%	19.6%	16.0%	16.9%	15.4%	14.6%	22.3%
Tohoku	21.3%	28.9%	17.8%	11.3%	9.0%	19.2%	19.6%	16.0%	16.9%	15.4%	14.6%	19.3%
Tokyo	21.3%	28.9%	17.8%	9.8%	9.0%	19.2%	19.6%	16.0%	16.9%	15.4%	14.6%	19.3%
Chubu	30.1%	26.3%	17.8%	9.8%	9.0%	16.8%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Hokuriku	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Kansai	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Chugoku	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Shikoku	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Kyushu	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.5%
Interconnected	26.0%	27.5%	18.6%	9.9%	9.1%	17.7%	19.6%	16.5%	12.5%	13.0%	12.8%	19.4%
Okinawa	55.3%	41.9%	35.7%	33.1%	33.5%	38.1%	46.9%	53.9%	73.8%	70.3%	78.0%	84.3%
Nationwide	26.3%	27.6%	18.8%	10.2%	9.3%	17.9%	19.9%	16.9%	12.9%	13.4%	13.2%	19.9%

Improved to over 8%

[12] This evaluation is implemented based on the following. The evaluation of timing of utilization of interconnection lines varies in the regional service areas; power exchange availability is calculated based on the least reserve margin, and the calculated results are lower than those based on the reserve margin at a given time. Therefore, this evaluation covers a more severe condition, which is better for a stable supply.

[13] The projection of the reserve margin is based on the ATC of transactions among areas indicated in the electricity supply plan.

In the Okinawa EPCO regional service area,[14] which is a small and isolated island system unable to receive power through interconnection lines, the criterion of stable supply is to secure supply capacity over peak demand by deducting the capacity of the largest generating unit and balancing capacity with frequency control ('Generator I', total of 301 MW), without applying the criteria of other interconnected areas. Table 2-6 shows the monthly reserve margin against the deduction of the capacity of Generator I, which indicates the stable supply was secured in each month.

Table 2-6 Monthly Reserve Margin against the Deduction of the Capacity of Generator I (at the sending end)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Okinawa	26.4%	17.1%	14.0%	12.7%	13.1%	17.1%	24.2%	27.0%	43.4%	41.3%	48.8%	53.4%

[14] In the Okinawa EPCO regional service area, the evaluation excludes the reserve margins of several isolated islands.

3. Projection of Supply–Demand Balance for 10 years (Long-Term)

a. Supply–Demand Balance

Table 2-7 and Figure 2-3 show the annual supply–demand balance projection for a 10-year period. A reserve margin of 8% is secured each year nationwide.

Table 2-7 Annual Supply–Demand Balance Projection from FY 2019 to 2028
(nationwide at 17:00 in August, 10^4 kW at the sending end)

	2019	2020	2021	2022	2023
Peak Demand	15,556	15,526	15,504	15,483	15,463
Supply Capacity	17,088	17,575	17,113	16,980	17,303
Reserve Margin	9.8%	13.2%	10.4%	9.7%	11.9%
	2024	2025	2026	2027	2028
Peak Demand	15,441	15,421	15,399	15,406	15,385
Supply Capacity	17,365	17,480	17,476	17,530	17,537
Reserve Margin	12.5%	13.4%	13.5%	13.8%	14.0%

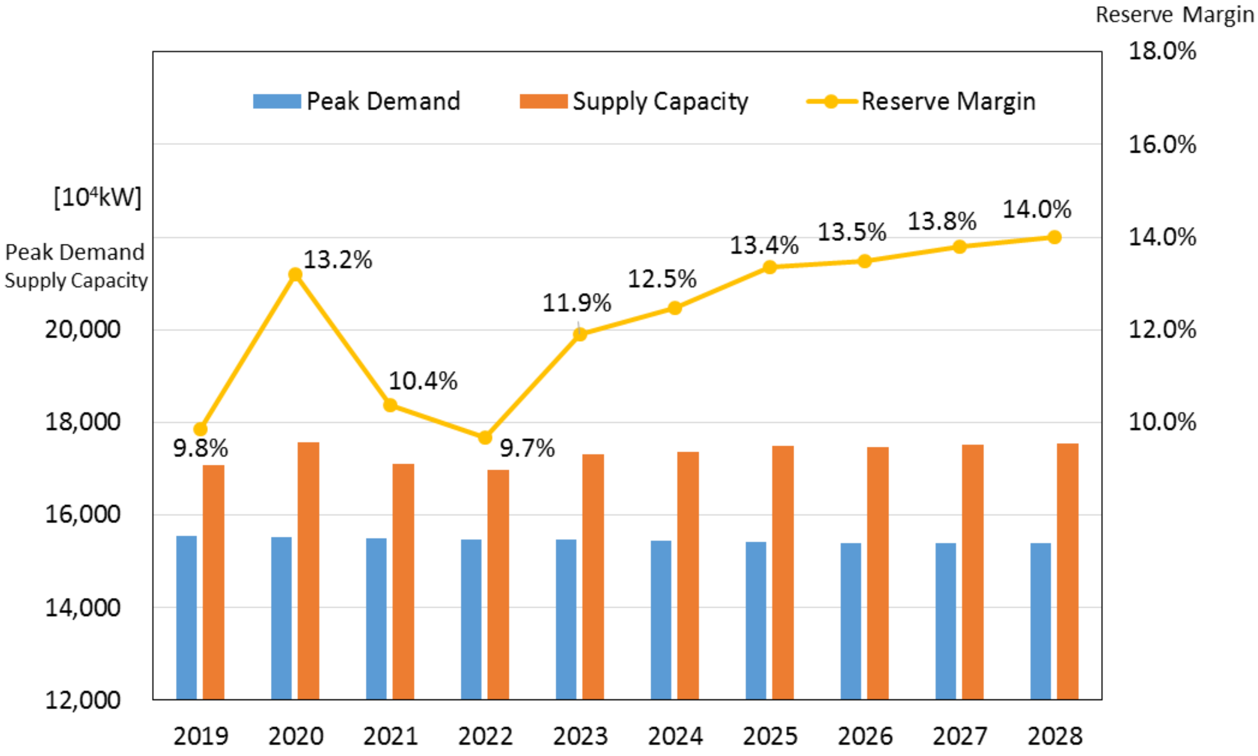


Figure 2-3 Mid-to-Long-Term Annual Supply–Demand Balance Projection
(nationwide at 17:00 in August, at the sending end)

The hours with the least reserve margins vary; for example, 15:00 in the areas of Tokyo, and Shikoku[15], 17:00 in the areas of Hokkaido, Tohoku, Chubu, Hokuriku, Kansai, and Chugoku, 19:00 in the Kyushu area, and 20:00 in Okinawa. Reserve margins at each time calculation include some areas and years that cannot achieve the criterion of a stable supply, i.e., a reserve margin of 8%. However, the criterion of a stable supply is projected to be secured in all areas and years by sharing power from other areas with sufficient supply capacity through cross-regional interconnection lines (see Referential Review A).

Table 2-8 shows the annual projection of reserve margins at 17:00 in August judged as the most severe supply–demand balance for each regional service area from FY 2019 to 2028. Table 2-9 shows these projections recalculated by adding power exchanges for the years and areas of below 8% reserve margin even with additional generated surplus from areas of over 8% reserve margin based on the ATC.

The evaluation shows that the reserve margin will fall below 8% as follows: in the Tokyo EPCO regional service area in FY 2022; in the Chubu EPCO area in FY 2021–2028; and in the Kansai EPCO area in FY 2019, and 2021–2028. However, all areas will be projected to secure 8% reserve margin required for a stable supply by sharing power from other areas with sufficient supply capacity through cross-regional interconnection lines during the projected period.

Table 2-8 Annual Projection of Reserve Margins for Each Regional Service Area
(at 17:00 in August, resources within own service area only, at the sending end)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	22.2%	21.3%	36.8%	37.4%	38.5%	39.0%	39.3%	38.7%	50.0%	50.1%
Tohoku	11.5%	8.7%	18.5%	20.0%	20.3%	21.3%	21.8%	24.6%	25.1%	25.7%
Tokyo	9.0%	12.4%	9.8%	6.6%	9.9%	12.1%	16.5%	15.8%	15.5%	15.5%
50 Hz area Total	10.3%	12.3%	13.1%	11.0%	13.6%	15.4%	18.9%	18.8%	19.3%	19.5%
Chubu	10.1%	9.2%	1.0%	4.2%	4.8%	5.4%	5.6%	6.3%	6.2%	6.7%
Hokuriku	11.0%	11.7%	10.2%	9.9%	9.9%	9.8%	8.8%	8.6%	8.4%	8.3%
Kansai	5.5%	11.5%	3.3%	4.6%	7.1%	7.5%	3.4%	4.3%	4.7%	4.9%
Chugoku	11.2%	16.2%	19.3%	11.0%	14.6%	15.0%	15.6%	16.0%	15.8%	16.1%
Shikoku	16.1%	30.2%	13.6%	11.5%	21.2%	21.2%	21.7%	22.1%	22.5%	22.8%
Kyushu	9.1%	16.7%	15.5%	16.5%	17.3%	12.1%	12.1%	10.9%	11.0%	11.0%
60 Hz area Total	9.1%	13.4%	7.8%	8.1%	10.2%	9.6%	8.4%	8.7%	8.8%	9.1%
Interconnected	9.6%	12.9%	10.1%	9.4%	11.7%	12.2%	13.1%	13.2%	13.5%	13.7%
Okinawa	35.7%	42.1%	36.1%	38.5%	33.9%	41.1%	40.7%	40.0%	39.5%	39.0%
Nationwide	9.8%	13.2%	10.4%	9.7%	11.9%	12.5%	13.4%	13.5%	13.8%	14.0%

Below 8% Criteria

[15] At 17:00 beyond the third year of the projection.

Table 2-9 Annual Projection of Reserve Margins for Each Regional Service Area
(at 17:00 in August, with power exchanges through cross-regional interconnection lines, at the sending end)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	12.4%	12.3%	27.6%	27.2%	28.3%	28.8%	29.0%	29.0%	40.4%	40.4%
Tohoku	9.5%	12.3%	9.6%	8.7%	11.2%	11.7%	14.6%	14.8%	14.6%	13.2%
Tokyo	9.5%	12.3%	9.6%	8.7%	11.2%	11.7%	14.6%	14.8%	14.6%	13.2%
Chubu	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Hokuriku	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Kansai	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Chugoku	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Shikoku	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Kyushu	9.5%	13.4%	9.9%	10.5%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Interconnected	9.6%	12.9%	10.1%	9.4%	11.7%	12.2%	13.1%	13.2%	13.5%	13.7%
Okinawa	35.7%	42.1%	36.1%	38.5%	33.9%	41.1%	40.7%	40.0%	39.5%	39.0%
Nationwide	9.8%	13.2%	10.4%	9.7%	11.9%	12.5%	13.4%	13.5%	13.8%	14.0%

Improved above Criteria

The Organization did not count newly developing facilities at EPCOs that are not obliged to submit development plans or at EPCOs that are obliged to submit plans, but that have not reported such plans. Therefore, the Organization has investigated generating facilities that are not included in the electricity supply plans, although they were already applied to generator connection to GT&D companies and submitted construction plans according to the provisions of Article 48 of the Act in cooperation with the Government.
As a result, there are 1,300 MW of such generating facilities nationwide; thus, the Organization includes those facilities to supply capacity and recalculates reserve margins as outlined in Table 2-10.

Table 2-10 Annual Projection of Reserve Margins for Each Regional Service Area
(at 17:00 in August, with power exchanges through cross-regional interconnection lines and generating facilities not included in the electricity supply plans, at the sending end)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	12.4%	13.8%	30.1%	29.7%	30.7%	31.3%	31.5%	31.5%	42.9%	42.9%
Tohoku	9.6%	13.7%	13.2%	14.5%	14.8%	15.5%	16.2%	16.8%	17.3%	14.8%
Tokyo	9.6%	13.7%	10.2%	9.0%	11.8%	12.2%	16.2%	16.2%	15.8%	14.8%
Chubu	9.6%	13.7%	10.2%	9.0%	11.8%	12.2%	11.4%	11.5%	11.6%	13.0%
Hokuriku	9.6%	13.7%	10.2%	9.0%	11.8%	12.2%	11.4%	11.5%	11.6%	13.0%
Kansai	9.6%	13.7%	10.2%	9.0%	11.8%	12.2%	11.4%	11.5%	11.6%	13.0%
Chugoku	9.6%	13.7%	10.2%	9.0%	11.8%	12.2%	11.4%	11.5%	11.6%	13.0%
Shikoku	9.6%	13.7%	10.2%	9.0%	11.8%	12.2%	11.4%	11.5%	11.6%	13.0%
Kyushu	9.6%	13.7%	10.3%	11.0%	11.8%	12.2%	11.4%	11.5%	11.6%	13.0%
Interconnected	9.6%	13.7%	11.0%	10.2%	12.5%	13.0%	13.9%	14.1%	14.4%	14.6%
Okinawa	35.7%	42.1%	36.1%	38.5%	33.9%	41.1%	40.7%	40.0%	39.5%	39.0%
Nationwide	9.9%	14.0%	11.2%	10.5%	12.7%	13.3%	14.2%	14.3%	14.6%	14.8%

Table 2-11 shows the annual projection of reserve margins with the capacity of 301 MW equivalent to Generator I in the Okinawa EPCO area deducted, which indicates a stable supply is secured throughout the period.

Table 2-11 Annual Projection of a Reserve Margin with the Capacity Equivalent to Generator I in Okinawa Deducted (at 20:00 in August, at the sending end)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Okinawa	13.1%	19.6%	13.6%	16.0%	11.4%	18.7%	18.3%	17.6%	17.2%	16.7%

Table 2-12 shows the annual projection of reserve margins in January for winter peak demands in the Hokkaido and Tohoku EPCO areas. A stable supply is secured throughout the period.

Table 2-12 Annual Projection of Reserve Margins for Winter Peak Demand in the Hokkaido and Tohoku Areas (at 18:00 in January, at the sending end)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	19.6%	20.1%	14.7%	16.5%	16.8%	17.0%	17.1%	27.2%	27.2%	27.2%
Tohoku	10.9%	9.8%	11.2%	12.5%	12.8%	13.3%	13.7%	16.0%	16.5%	16.9%

b. Supply Capacity Secured by GT&D Companies

GT&D companies secure their supply capacity for the demand of isolated island areas throughout the projected period, and also secure a balancing capacity equivalent to 7%[16] over their peak demand in their regional service areas for FY 2019 by public solicitation. Table 2-13 shows the secured balancing capacity procured by GT&D companies.

Table 2-13 Secured Balancing Capacity[17] Procured by GT&D Companies (%, 10^4 kW in Okinawa)

	Hokkaido	Tohoku	Tokyo	Chubu	Hokuriku	Kansai	Chugoku	Shikoku	Kyushu	Okinawa
Balancing Capacity	7.0%	7.0%	7.2%	7.0%	7.0%	7.2%	6.9%	7.0%	7.0%	30.1

c. Conclusions Concerning Supply–Demand Balance Evaluation

Supply–Demand Balance Evaluation for FY 2019 (short-term): The criterion of stable supply (i.e., 8% of reserve margin) is secured throughout the areas and for the short-term period.

Supply–Demand Balance Evaluation for FY 2019–2028 (mid-to-long term): The criterion of stable supply is also secured throughout the areas and for the mid-to-long-term period.

The Organization continuously and carefully evaluates the supply–demand balance, with monitoring of the submission of altering supply plans and the accompanying supply–demand balance.

[16] Public solicitation of balancing capacity is implemented so as to secure a balancing capacity equivalent to 7% over their peak demand in their regional service areas, and its procurement is based on the peak demand of the second projected year of the previous electric supply plan. Therefore, the procured balancing capacity may be lower than the capacity equivalent to 7% over their peak demand of the current year.

[17] The capacity is the ratio of the balancing capacity to the peak demand in the regional service areas of GT&D companies. The ratios for the Hokkaido and Tohoku EPCO areas are in January, and in August for the other areas.

[Referential Review A]

[1] For reference, evaluations for the reserve margin for the short term are stated as below.

<Reference 1> Reserve Margin Projection for Each Month in FY 2019
(at the peak demand, the sending end, resources within own service area only)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	36.2%	47.4%	59.1%	21.1%	24.0%	24.9%	19.7%	19.5%	25.0%	19.6%	21.5%	23.8%
Tohoku	19.8%	28.5%	19.4%	17.5%	14.7%	14.9%	9.8%	12.0%	11.3%	10.9%	12.0%	12.4%
Tokyo	20.2%	30.8%	18.7%	8.5%	8.7%	22.6%	23.8%	16.5%	20.0%	18.4%	16.7%	23.8%
50 Hz area Total	21.3%	31.6%	21.5%	10.8%	10.7%	21.3%	20.6%	15.8%	18.6%	16.9%	16.1%	21.4%
Chubu	26.9%	21.1%	19.7%	9.4%	11.3%	17.8%	19.0%	17.2%	8.7%	10.1%	11.8%	17.6%
Hokuriku	28.3%	24.0%	15.0%	17.2%	12.3%	15.6%	15.9%	8.1%	13.7%	9.4%	9.3%	16.2%
Kansai	30.6%	25.3%	14.8%	9.2%	8.2%	16.9%	19.9%	19.9%	8.7%	11.8%	10.4%	17.3%
Chugoku	24.1%	21.9%	16.8%	14.6%	13.2%	14.8%	19.3%	12.6%	0.6%	8.4%	9.8%	16.6%
Shikoku	42.9%	39.9%	30.1%	20.2%	16.1%	14.9%	23.8%	26.0%	15.8%	4.2%	5.3%	2.4%
Kyushu	35.5%	26.3%	13.4%	18.8%	14.5%	10.9%	16.3%	15.9%	5.4%	9.6%	9.1%	25.7%
60 Hz area Total	30.1%	24.5%	17.1%	12.7%	11.5%	15.6%	18.9%	17.1%	7.8%	9.9%	10.1%	17.8%
Interconnected	26.0%	27.6%	19.0%	11.9%	11.1%	18.1%	19.7%	16.5%	12.5%	13.0%	12.8%	19.4%
Okinawa	55.3%	42.7%	38.7%	37.1%	38.0%	41.5%	46.9%	53.9%	73.8%	70.3%	78.0%	84.3%
Nationwide	26.3%	27.8%	19.3%	12.1%	11.4%	18.4%	20.0%	16.9%	12.9%	13.4%	13.2%	19.9%

Below 8% Criteria

<Reference 2> Reserve Margin Projection for Each Month in FY 2019
(at the peak demand, the sending end, with power exchanges through cross-regional interconnection lines)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	21.3%	29.8%	47.3%	13.7%	14.1%	19.6%	19.7%	16.0%	16.9%	15.4%	14.6%	22.3%
Tohoku	21.3%	29.3%	18.2%	13.7%	10.5%	19.6%	19.7%	16.0%	16.9%	15.4%	14.6%	19.3%
Tokyo	21.3%	29.3%	18.2%	10.0%	10.5%	19.6%	19.7%	16.0%	16.9%	15.4%	14.6%	19.3%
Chubu	30.1%	26.3%	18.2%	12.4%	11.5%	17.0%	19.7%	17.0%	9.1%	11.1%	11.3%	19.3%
Hokuriku	30.1%	26.3%	18.2%	12.4%	11.5%	17.0%	19.7%	17.0%	9.1%	11.1%	11.3%	19.3%
Kansai	30.1%	26.3%	18.2%	12.4%	11.5%	17.0%	19.7%	17.0%	9.1%	11.1%	11.3%	19.3%
Chugoku	30.1%	26.3%	18.2%	12.4%	11.5%	17.0%	19.7%	17.0%	9.1%	11.1%	11.3%	19.3%
Shikoku	30.1%	26.3%	18.2%	12.4%	11.5%	17.0%	19.7%	17.0%	9.1%	11.1%	11.3%	19.3%
Kyushu	30.1%	26.3%	18.2%	14.1%	11.5%	17.0%	19.7%	17.0%	9.1%	11.1%	11.3%	19.5%
Interconnected	26.0%	27.6%	19.0%	11.9%	11.1%	18.1%	19.7%	16.5%	12.5%	13.0%	12.8%	19.4%
Okinawa	55.3%	42.7%	38.7%	37.1%	38.0%	41.5%	46.9%	53.9%	73.8%	70.3%	78.0%	84.3%
Nationwide	26.3%	27.8%	19.3%	12.1%	11.4%	18.4%	20.0%	16.9%	12.9%	13.4%	13.2%	19.9%

Improved to over 8%

[2] For reference, annual evaluations of the supply–demand balance at 15:00 and 19:00 for the 10-year period FY 2019–2028 are presented below.

<Reference 3> Annual Reserve Margin Calculated at 15:00 in August (resources within own service area only, at the sending end)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	24.0%	23.4%	39.1%	39.7%	40.8%	41.3%	41.6%	41.1%	52.4%	52.5%
Tohoku	14.7%	12.9%	23.1%	25.0%	25.6%	26.9%	27.7%	30.8%	31.6%	32.5%
Tokyo	8.7%	12.0%	9.5%	6.4%	9.5%	11.7%	16.0%	15.2%	14.9%	15.0%
50 Hz area Total	10.7%	12.8%	13.8%	11.8%	14.3%	16.2%	19.6%	19.6%	20.2%	20.4%
Chubu	11.3%	10.7%	2.8%	6.0%	6.7%	7.3%	7.5%	8.2%	8.2%	8.7%
Hokuriku	12.3%	13.1%	12.0%	11.9%	12.1%	12.3%	11.5%	11.4%	11.4%	11.5%
Kansai	8.2%	14.3%	6.3%	7.8%	10.3%	10.8%	6.8%	7.9%	8.3%	8.6%
Chugoku	13.2%	16.9%	20.6%	14.6%	19.5%	20.0%	20.8%	21.3%	20.4%	20.7%
Shikoku	16.1%	30.2%	14.4%	16.3%	26.3%	26.6%	27.4%	28.1%	28.7%	29.3%
Kyushu	14.5%	26.6%	24.3%	25.5%	26.6%	21.0%	21.0%	19.7%	19.8%	19.9%
60 Hz area Total	11.5%	16.6%	11.1%	12.0%	14.3%	13.8%	12.7%	13.1%	13.2%	13.5%
Interconnected	11.1%	14.9%	12.3%	11.9%	14.3%	14.9%	15.8%	16.0%	16.3%	16.6%
Okinawa	38.0%	44.4%	38.6%	41.1%	36.5%	43.8%	43.4%	42.8%	42.4%	42.0%
Nationwide	11.4%	15.2%	12.5%	12.2%	14.6%	15.1%	16.1%	16.3%	16.6%	16.9%

Below 8% Criteria

<Reference 4> Annual Reserve Margin Calculated at 15:00 in August (with power exchanges through cross-regional interconnection lines, at the sending end)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	14.1%	13.5%	29.9%	29.5%	30.6%	31.1%	31.4%	31.4%	42.7%	42.8%
Tohoku	10.5%	12.8%	11.0%	11.8%	12.9%	14.4%	15.4%	15.6%	16.1%	15.9%
Tokyo	10.5%	12.8%	11.0%	10.4%	12.9%	14.4%	15.4%	15.6%	15.5%	15.9%
Chubu	11.5%	15.3%	11.0%	10.4%	12.9%	14.4%	15.4%	15.6%	15.5%	15.9%
Hokuriku	11.5%	15.3%	11.0%	10.4%	13.6%	14.4%	15.4%	15.6%	15.5%	15.9%
Kansai	11.5%	15.3%	11.0%	10.4%	13.6%	14.4%	15.4%	15.6%	15.5%	15.9%
Chugoku	11.5%	15.3%	11.0%	10.4%	13.6%	14.4%	15.4%	15.6%	15.5%	15.9%
Shikoku	11.5%	15.3%	11.0%	10.4%	13.6%	14.4%	15.4%	15.6%	15.5%	15.9%
Kyushu	11.5%	22.7%	18.7%	19.6%	20.5%	14.9%	15.4%	15.6%	15.5%	15.9%
Interconnected	11.1%	14.9%	12.3%	11.9%	14.3%	14.9%	15.8%	16.0%	16.3%	16.6%
Okinawa	38.0%	44.4%	38.6%	41.1%	36.5%	43.8%	43.4%	42.8%	42.4%	42.0%
Nationwide	11.4%	15.2%	12.5%	12.2%	14.6%	15.1%	16.1%	16.3%	16.6%	16.9%

Improved to over 8%

<Reference 5> Annual Reserve Margin Calculated at 19:00 in August (resources within own service area only, at the sending end)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	24.6%	23.5%	39.3%	39.9%	41.0%	41.5%	41.8%	41.2%	52.9%	52.9%
Tohoku	18.3%	14.9%	25.1%	26.6%	26.7%	27.6%	28.0%	30.8%	31.2%	31.6%
Tokyo	9.6%	13.2%	10.5%	7.0%	10.5%	12.9%	17.6%	16.8%	16.5%	16.5%
50 Hz area Total	12.2%	14.2%	15.0%	12.7%	15.4%	17.4%	21.0%	20.9%	21.4%	21.6%
Chubu	12.8%	12.1%	3.2%	6.8%	7.6%	8.3%	8.5%	9.3%	9.3%	9.8%
Hokuriku	13.8%	13.1%	11.3%	17.0%	10.9%	16.6%	11.1%	15.2%	9.0%	14.8%
Kansai	10.2%	16.7%	8.0%	9.8%	12.5%	13.0%	8.5%	9.5%	9.8%	10.0%
Chugoku	13.6%	17.1%	20.7%	12.2%	15.9%	16.1%	16.6%	16.8%	16.5%	16.7%
Shikoku	16.1%	30.3%	14.4%	12.4%	22.3%	22.6%	23.0%	23.3%	23.6%	23.7%
Kyushu	4.8%	12.3%	10.6%	11.3%	11.4%	5.7%	5.6%	4.2%	4.1%	4.1%
60 Hz area Total	10.9%	15.2%	9.2%	10.1%	11.8%	11.5%	9.9%	10.4%	10.1%	10.7%
Interconnected	11.4%	14.8%	11.8%	11.3%	13.4%	14.1%	14.9%	15.1%	15.2%	15.6%
Okinawa	38.4%	44.9%	38.6%	41.0%	36.2%	43.6%	43.1%	42.3%	41.9%	41.3%
Nationwide	11.7%	15.1%	12.1%	11.6%	13.7%	14.4%	15.2%	15.4%	15.5%	15.8%

Below 8% Criteria

<Reference 6> Annual Reserve Margin Calculated at 19:00 in August (with power exchanges through cross-regional interconnection lines, at the sending end)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	14.5%	14.2%	29.9%	29.4%	30.6%	31.1%	31.4%	31.3%	43.0%	43.0%
Tohoku	11.4%	14.2%	11.3%	12.1%	12.9%	13.6%	16.5%	16.6%	16.3%	14.9%
Tokyo	11.4%	14.2%	11.3%	10.6%	12.9%	13.6%	16.5%	16.6%	16.3%	14.9%
Chubu	11.4%	15.2%	11.3%	10.6%	12.9%	13.6%	12.8%	13.2%	12.9%	14.7%
Hokuriku	11.4%	15.2%	11.3%	10.6%	12.9%	13.6%	12.8%	13.2%	12.9%	14.7%
Kansai	11.4%	15.2%	11.3%	10.6%	12.9%	13.6%	12.8%	13.2%	12.9%	14.7%
Chugoku	11.4%	15.2%	11.3%	10.6%	12.9%	13.6%	12.8%	13.2%	12.9%	14.7%
Shikoku	11.4%	15.2%	11.3%	10.6%	12.9%	13.6%	12.8%	13.2%	12.9%	14.7%
Kyushu	11.4%	15.2%	11.3%	10.6%	12.9%	13.6%	12.8%	13.2%	12.9%	14.7%
Interconnected	11.4%	14.8%	11.8%	11.3%	13.4%	14.1%	14.9%	15.1%	15.2%	15.6%
Okinawa	38.4%	44.9%	38.6%	41.0%	36.2%	43.6%	43.1%	42.3%	41.9%	41.3%
Nationwide	11.7%	15.1%	12.1%	11.6%	13.7%	14.4%	15.2%	15.4%	15.5%	15.8%

Improved to over 8%

[Referential Review B]

Adding Supply Capacity of Generating Facilities Not Included in the Electricity Supply Plans

Figure 2-4 shows mid-to-long-term projections of suspended thermal power plants, which indicates that suspended thermal power plants include generators available for rapid power generation that have the possibility of being counted on as additional supply capacity. Figure 2-5 shows the recalculated projection of mid-to-long-term supply–demand balance(with power exchanges through cross-regional interconnection lines and generating facilities not included in the electricity supply plans, at the sending end), which include the additional supply capacity such as the above stated generators and the generators with delayed planned outage by the maximum coordination of their work schedules.

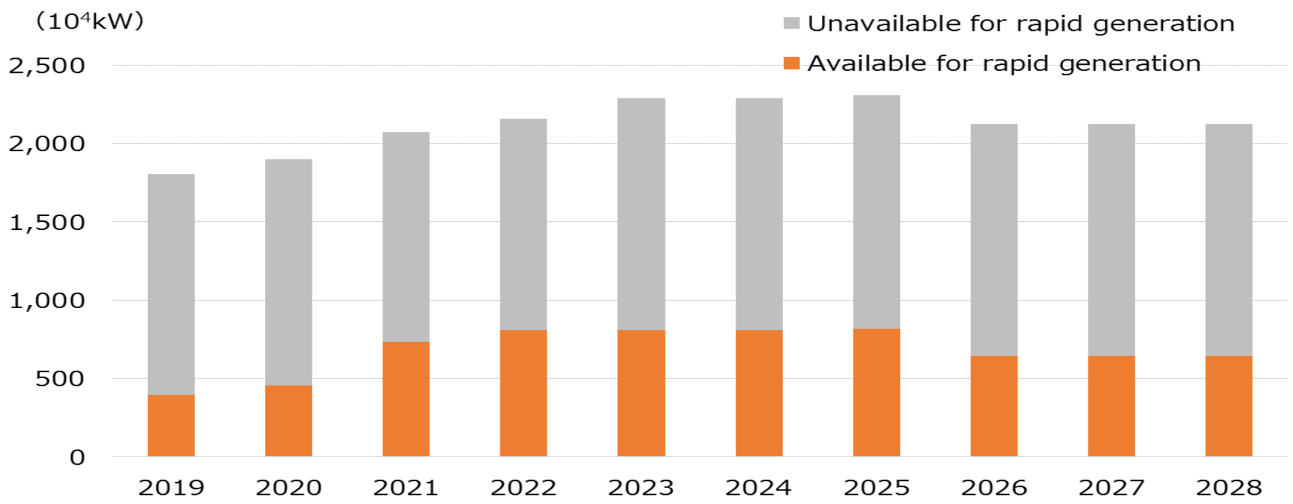


Figure 2-4 Mid-to-Long-Term Projections of Suspended Thermal Power Plants

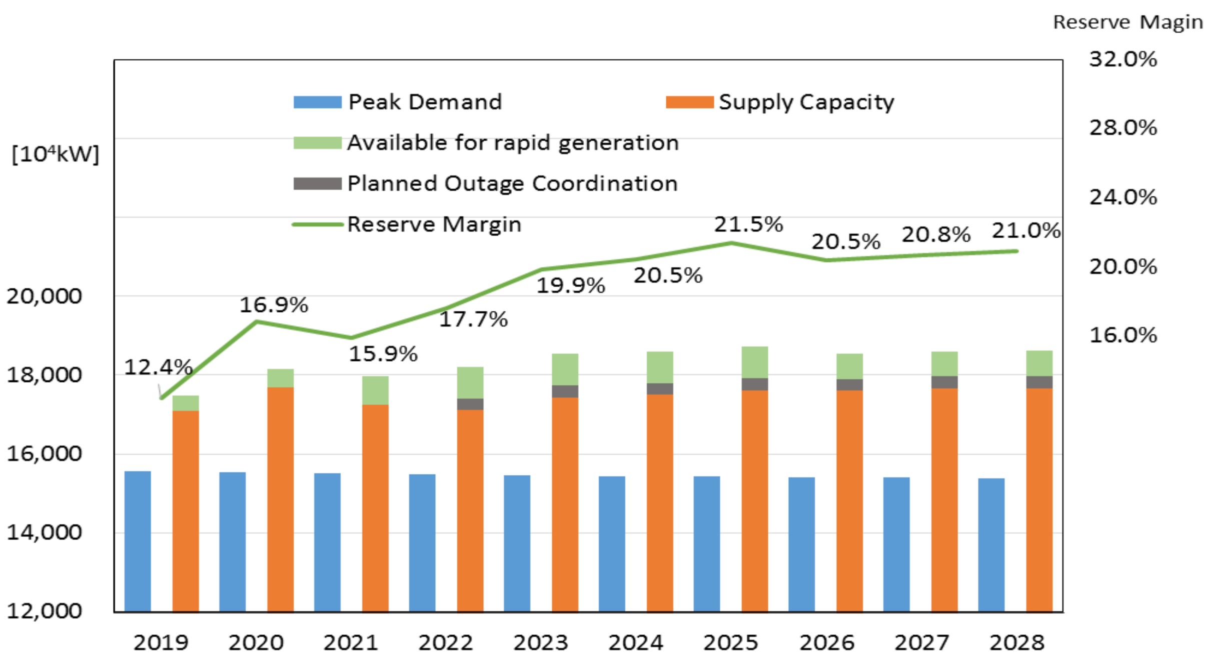


Figure 2-5 Annual Projection of Reserve Margins for Each Regional Service Area

(at 17:00 in August, with power exchanges through cross-regional interconnection lines and generating facilities not included in the electricity supply plans, at the sending end)

On the other hand, the reserve margins will decline by 2–5 % after review of the evaluation method of supply capacity (kW value) of renewable energy*.

* according to the calculation of the expected unavailable energy (EUE) evaluation of renewable energy generation based on the figures in August, page 37 of document 3 for the 3rd meeting of the Subcommittee on Electricity Resilience.

The original document [only in Japanese] is available at
http://www.occto.or.jp/iinkai/kouikikeitouseibi/resilience/2018/files/resilience_03_03_01.pdf

In addition, the necessary supply capacity in severe weather or rare occurrence risk is under review. It is possible that the minimum necessary supply capacity is secured if proper coordination of maintenance schedules of generators, or the utilization of suspended thermal generators is implemented at this moment.

Table 2-14 Supply Capacity of Renewable Energy (EUE Evaluation)

(10^4kW, %)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Solar [6,252]	135	650	764	838	1,119	630	407	29	104	172	83	70
	(2%)	(10%)	(12%)	(13%)	(18%)	(10%)	(7%)	(0%)	(2%)	(3%)	(1%)	(1%)
Wind [488]	105	89	64	59	55	63	98	111	145	136	147	121
	(22%)	(18%)	(13%)	(12%)	(11%)	(13%)	(20%)	(23%)	(30%)	(28%)	(30%)	(25%)
Hydro [1,828]	1,049	1,095	1,006	1,011	855	819	695	708	695	618	649	777
	(57%)	(60%)	(55%)	(55%)	(47%)	(45%)	(38%)	(39%)	(38%)	(34%)	(35%)	(42%)
Total [8,569]	1,289	1,834	1,833	1,908	2,029	1,512	1,200	847	944	927	878	968
	(15%)	(21%)	(21%)	(22%)	(24%)	(18%)	(14%)	(10%)	(11%)	(11%)	(10%)	(11%)

[ ]: Total installed capacity ( ): Ratio of the supply capacity to the total installed capacity

III. Analysis of the Transition of Power Generation Sources

1. Transition of Power Generation Sources (Capacity)

The installed power generation capacity is the aggregation of the capacity of electric power plants owned by EPCOs and those owned by companies other than EPCOs that are registered as the procured supply capacity of retail and GT&D companies.

Table 3-1 and Figure 3-1 show the transition of installed power generation capacity by power generation sources.

Solar power will notably increase its capacity. Coal- and LNG-fired capacities are also projected to increase, although they may temporarily decrease through replacement according to future power development plans for thermal generation. Oil-fired capacity is projected to decrease through retirement.

Table 3-1 Composition of the Transition of Installed Power Generation Capacities by Power Generation Sources[18]
(nationwide, 10^4 kW)

Power Generation Sources		FY 2018 (actual)	FY 2019	FY 2023	FY 2028
Hydro		4,905	4,911	4,922	4,928
	Conventional	2,158	2,164	2,175	2,181
	Pumped Storage	2,747	2,747	2,747	2,747
Thermal		16,064	15,858	16,630	16,754
	Coal	4,312	4,455	5,240	5,189
	LNG	8,201	8,307	8,310	8,485
	Oil and others[19]	3,551	3,096	3,081	3,081
Nuclear		3,804	3,804	3,804	3,804
Renewables		5,740	6,351	7,853	8,703
	Wind	380	442	811	1,039
	Solar	4,955	5,491	6,553	7,182
	Geothermal	49	53	53	53
	Biomass	267	287	367	361
	Waste	90	79	70	67
Miscellaneous		35	19	19	20
Total		30,548	30,944	33,228	34,209

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

[18] The installed power generation capacity is the sum of the values submitted by EPCOs.
[19] The category 'Oil and others' includes the total installed capacities from oil, LPG, and other gas and bituminous mixture fired capacities.

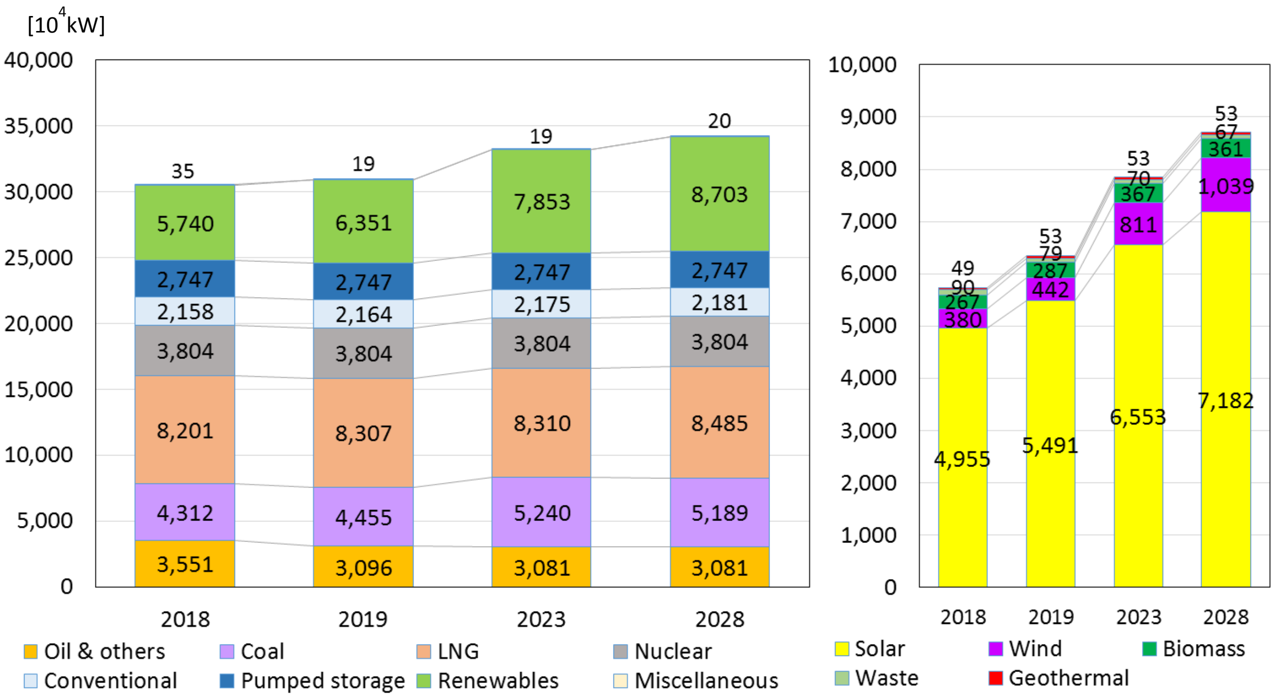


Figure 3-1 Transition of Installed Power Generation Capacities by Power Generation Sources (nationwide)

2. Transition of Gross Electric Energy Generation

Table 3-2 and Figure 3-2 show the transition of gross electric energy generation by power generation sources aggregated with the reported values submitted by generation companies and those procured by retail and GT&D companies from companies other than EPCOs.

For nuclear power plants, energy generation is calculated as zero for their capacity reported as "uncertain." However, the composition of gross electric energy generation may alter according to the operating conditions of nuclear power plants, change in generation sources, which is specified as "miscellaneous" in future trends, and regulating measures of generation efficiency by the Energy Conservation Act.

Table 3-2 Composition of the Transition of Gross Electric Energy Generation by Power Generation Sources[20]
(nationwide, 10^8 kWh at the generating end)

Power Generation Sources		FY 2018	FY 2019	FY 2023	FY 2028
Hydro		852	817	847	896
	Conventional	791	777	795	806
	Pumped Storage	61	40	52	90
Thermal		6,924	6,740	6,110	5,939
	Coal	2,764	2,857	3,067	3,160
	LNG	3,810	3,471	2,756	2,497
	Oil and others[19]	350	411	287	282
Nuclear		614	579	593	364
Renewables		846	938	1,234	1,354
	Wind	76	88	154	194
	Solar	566	627	778	851
	Geothermal	23	27	29	29
	Biomass	148	171	250	258
	Waste	33	25	23	23
Miscellaneous		84	47	65	36
Total		9,319	9,121	8,849	8,588

[20] The gross electric energy generation is the sum of the values submitted by EPCOs. For nuclear power plants, energy generation is calculated as zero for their capacity reported as zero.

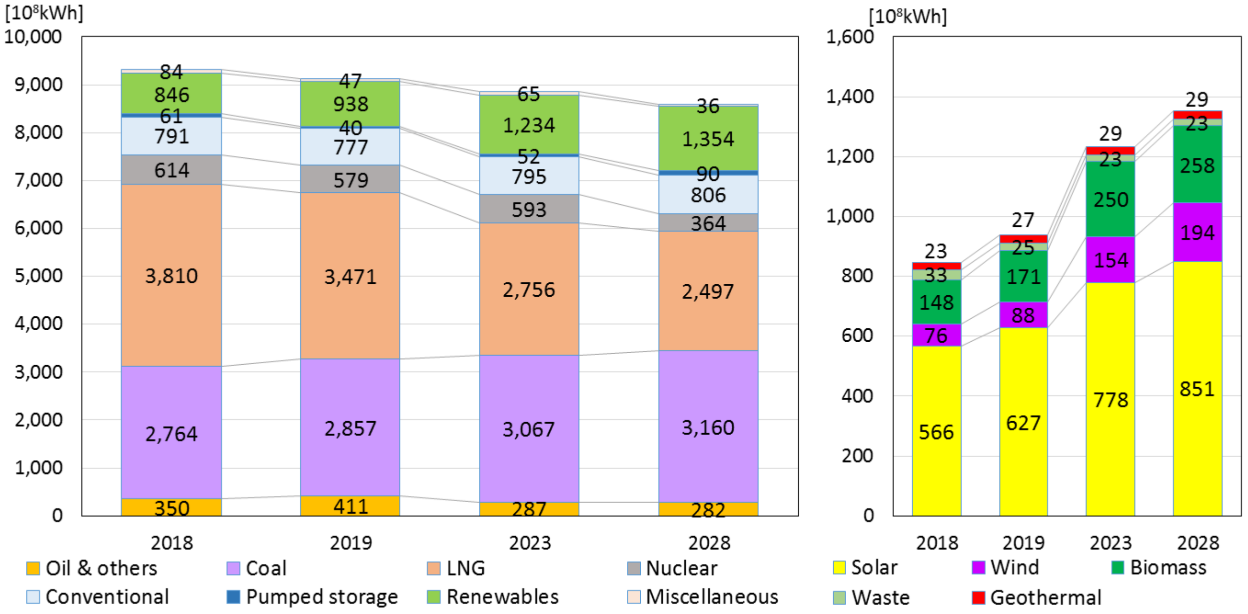


Figure 3-2 Transition of Electric Energy Generation by Power Generation Sources (nationwide)

3. Transition of Capacity Factor by Power Generation Sources

Table 3-3 and Figure 3-3 show the capacity factor by power generation sources. The projection of the capacity factor is calculated using the aforementioned power generation sources and gross electric energy generation data provided by the Organization.

According to future power development plans, the installed power generation capacity for thermal generation is projected to increase. However, this does not mean an increase in thermal generation, as the power supply from renewable energy is projected to increase; therefore, the capacity factor of thermal power plants is projected to decrease gradually.

For nuclear power generation, the installed power generation capacity contains that specified as "uncertain" and the capacity factor appears lower; therefore, this projection does not necessarily indicate the real capacity factor for nuclear power plants actually in operation.

Table 3-3 Capacity Factors by Power Generation Sources (nationwide)[21]

Power Generation Sources		FY 2018	FY 2019	FY 2023	FY 2028
Hydro		19.8%	18.9%	19.6%	20.8%
	Conventional	41.8%	40.9%	41.7%	42.2%
	Pumped Storage	2.5%	1.7%	2.2%	3.7%
Thermal		49.2%	48.4%	41.9%	40.5%
	Coal	73.2%	73.0%	66.8%	69.5%
	LNG	53.0%	47.6%	37.9%	33.6%
	Oil and others[19]	11.3%	15.1%	10.6%	10.4%
Nuclear		18.4%	17.3%	17.8%	10.9%
Renewables		16.8%	16.8%	17.9%	17.9%
	Wind[22]	22.7%	22.6%	21.7%	21.3%
	Solar[22]	13.0%	13.0%	13.6%	13.5%
	Geothermal	55.0%	57.3%	61.6%	61.6%
	Biomass	63.3%	68.0%	77.9%	81.6%
	Waste	41.8%	36.9%	37.9%	38.3%

[21] The capacity factor of nuclear power appears lower due to the calculation using the supply capacity reported as "uncertain" and does not indicate the real capacity factor for nuclear power plants.

[22] The capacity factors of wind and solar do not consider the decrease due to output shedding.

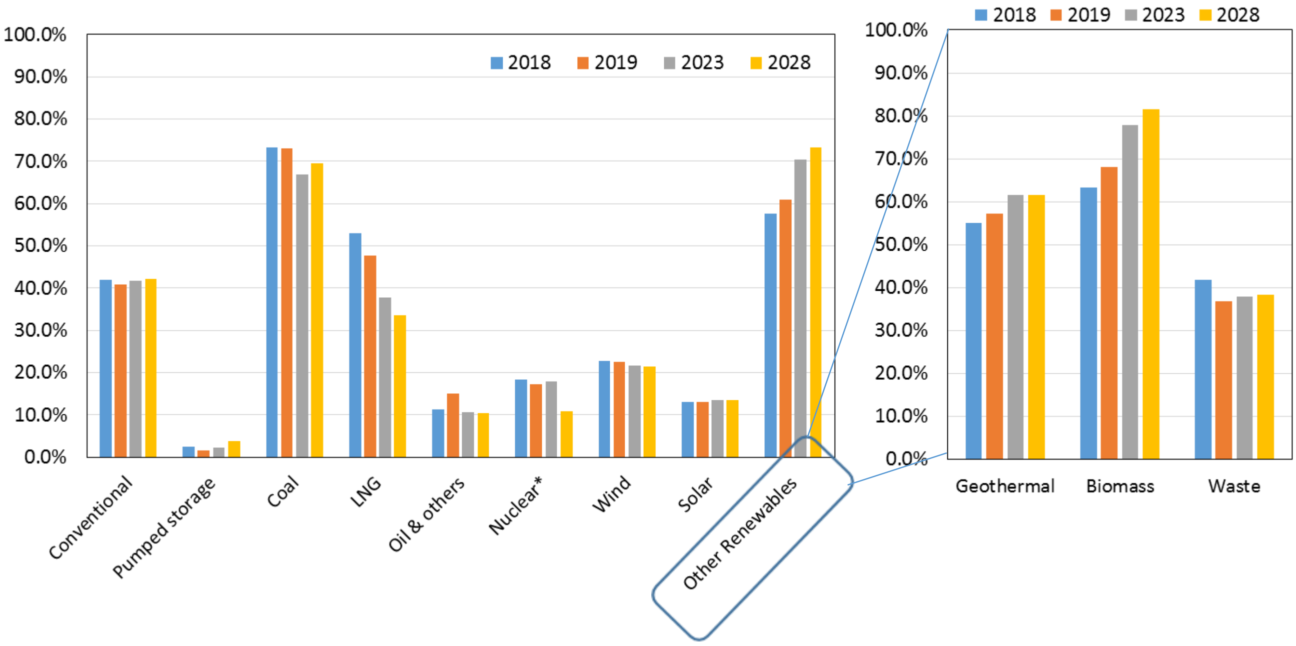


Figure 3-3 Capacity Factor by Power Generation Sources (Nationwide)[21]

4. Installed Power Generation Capacity and Gross Electric Energy Generation for Each Regional Service Area

Figure 3-4 shows the installed power generation capacity for each regional service area at the end of FY 2018. Figure 3-5 shows the gross electric energy generation for each regional service area in FY 2018.

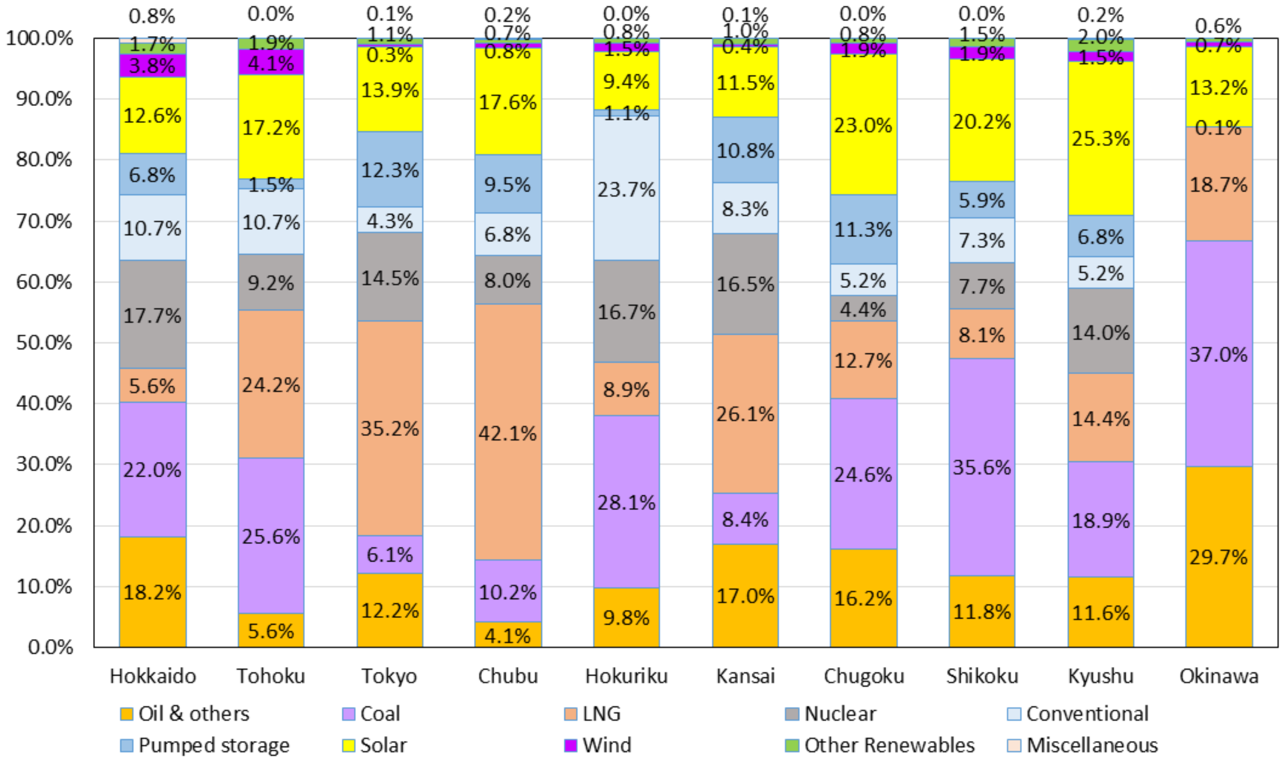


Figure 3-4 Composition of Installed Power Generation Capacity (kW) for Each Regional Service Area

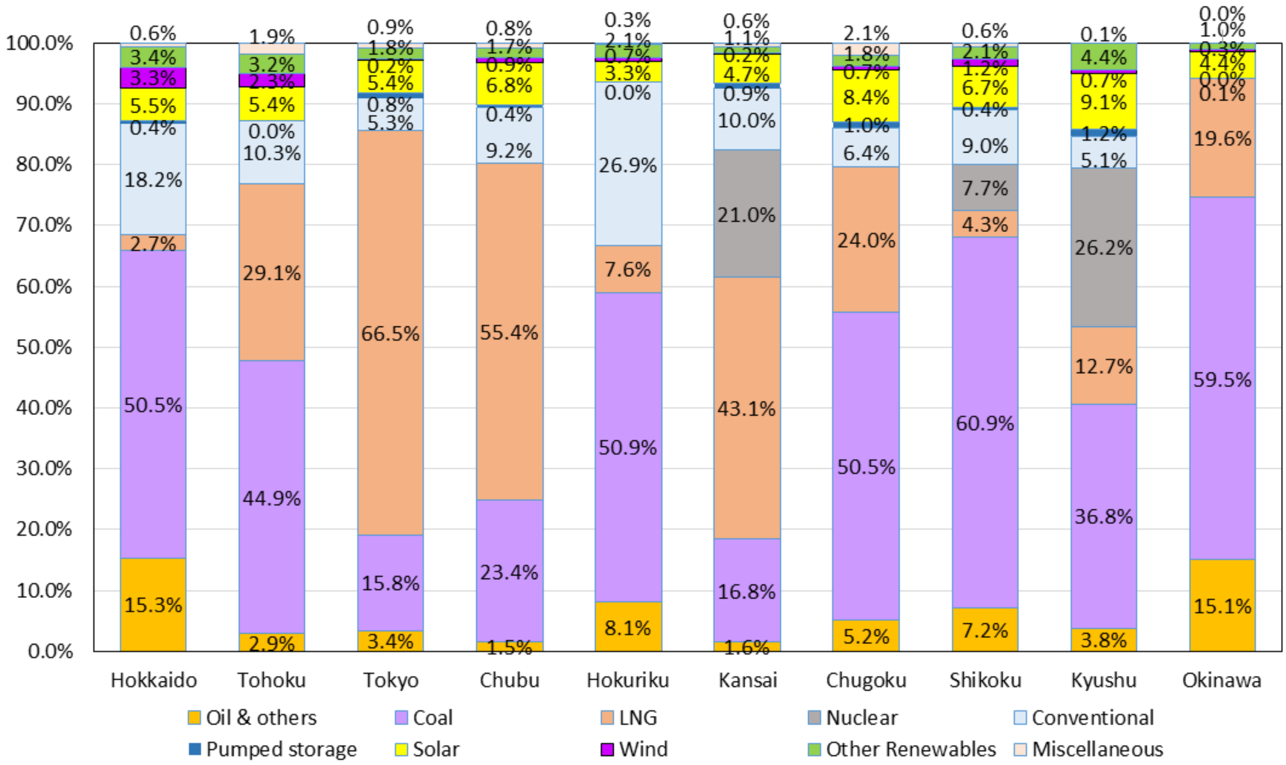


Figure 3-5 Composition of Gross Electric Energy Generation (kWh) for Each Regional Service Area

5. Development Plans by Power Generation Sources

Table 3-4 shows the development plans[23] up to FY 2028 submitted by generation companies, according to their new developments, uprated or derated installed facilities, and planned retirement of facilities in the projected period.

Table 3-4 Generation Development Plans up to FY 2028 by Stages (nationwide, 10^4 kW)

Power Generation Sources		New Installation		Uprating/Derating		Retirement	
		Capacity	Sites	Capacity	Sites	Capacity	Sites
Hydro		**32.6**	**41**	**5.2**	**47**	**▲ 20.0**	**26**
	Conventional	32.6	41	5.2	47	▲ 20.0	26
	Pumped Storage	-	-	-	-	-	-
Thermal		**1,611.8**	**41**	**▲ 24.0**	**1**	**▲ 1,009.6**	**45**
	Coal	824.1	13	-	-	▲ 75.6	3
	LNG	781.7	16	-	-	▲ 528.7	10
	Oil	6.0	12	▲ 24.0	1	▲ 405.3	32
	LPG	-	-	-	-	-	-
	Bituminous	-	-	-	-	-	-
	Other Gas	-	-	-	-	-	-
Nuclear		**1,018.0**	**7**	**15.2**	**1**	**▲ 55.9**	**1**
Renewables		**665.8**	**379**	**0.6**	**2**	**▲ 32.4**	**45**
	Wind	185.9	62	-	-	▲ 17.0	33
	Solar	378.0	285	-	-	▲ 0.2	1
	Geothermal	4.6	1	0.6	2	-	-
	Biomass	90.9	26	-	-	▲ 6.9	5
	Waste	6.4	5	-	-	▲ 8.3	6
Total		3,328.2	468	▲ 2.9	51	▲ 1,117.9	117

[23] Aggregated including facilities for which the date of commercial operation is "uncertain."

IV. Development Plans for Transmission and Distribution Facilities

The Organization has aggregated the development plans[24] for cross-regional transmission lines and substations (transformers and AC/DC converters) up to FY 2028 submitted by GT&D and transmission companies. Table 4-1 shows the development plans for cross-regional transmission lines and substations. Figure 4-1 shows the outlook for electric systems nationwide. (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

Increased Length of Transmission Lines*[25]*[26]		549 km
	Overhead Lines*	542 km
	Underground Lines	6 km
Uprated Capacities of Transformers		17,400 MVA
Uprated Capacities of AC/DC Converters[27]		1,800 MW
Decreased Length of Transmission Lines (Retirement)		▲ 108 km
Derated Capacities of Transformers (Retirement)		▲ 2,700 MVA

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

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

500kV Transmission Lines	・Cross-regional North Bulk Line(prov.): 81 km ・Cross-regional South Bulk Line(prov.): 62 km ・Soma-Futaba Bulk Line/ Connecting Point Change: 15 km ・Shinchi Thermal Power Line/ Cross-regional Switching Station(prov.) lead-in: 1 km ・Joban Bulk Line/ Cross-regional Switching Station(prov.) Dπ lead-in: 1 km
Switching Stations	500kV Switching Station(prov.): 10 circuits

[24] Development plans for transmission lines and substations are required to be submitted for voltages of more than 250 kV, or within two classes of the highest voltage available in the regional service areas. (For the Okinawa EPCO, only 132 kV or more is required.) The totals are not necessarily equal due to independent rounding.

[25] Development plans corresponding to changes in line category or circuit numbers that were not included in measuring the increased length of transmission lines were treated as no change in the length of transmission lines.

[26] Increased length does not include the item with * because of an undetermined in-service date.

[27] Installed capacity for the converter station on one side is included in the DC transmission system.

Interconnection Facility Enhancement Plan between Tokyo and Chubu
(120 MW→210 MW; in-service: March 2021)

AC/DC Converter Stations	・Shin Shinano AC/DC Converter Station： 900 MW ・Hida AC/DC Converter Station： 900 MW
DC Bulk Line 500kV Transmission Lines	・Hida-Shinano DC Bulk Line: 89 km ・Hida Branch Line: 0.4 km

Interconnection Facility Enhancement Plan between Tokyo and Chubu
(210 MW→300 MW; in-service: FY 2027)

Frequency Converter Stations	・Shin Sakuma FC station(prov.): 300 MW ・Higashi Shimizu FC station: 300 MW→900 MW
275 kV Transmission Lines	・Higashi Shimizu Line (prov.): 20 km ・Sakuma Higashi Bulk Line/ Shin Sakuma FC Branch Line (prov.): 3 km ・Sakuma Nishi Bulk Line/ Shin Sakuma FC Branch Line (prov.): 1 km ・Shin Toyone-Toei Line: 1 km ・Sakuma Nishi Bulk Line: 11 km , 2km ・Sakuma Higashi Bulk Line: 123 km
500 kV Transformers	・Shin Fuji Substation: 1,500MVA×1 ・Shizuoka Substation: 1,000MVA×1 ・Toei Substation: 800MVA×1 →1,500MVA×2

Interconnection Facility Enhancement Plan between Chubu and Kansai
(in-service: undetermined)

500 kV Transmission Lines	・Sekigahara Kita Oomi Line: 2 km ・Sangi Bulk Line/ Sekigahara Switching Station π lead-in: 1 km ・Kita Oomi Line/ Kita Oomi Switching Station π lead-in: 1 km
Switching Stations	・Sekigahara Switching Station: 6 circuits ・Kita Oomi Switching Station: 6 circuits

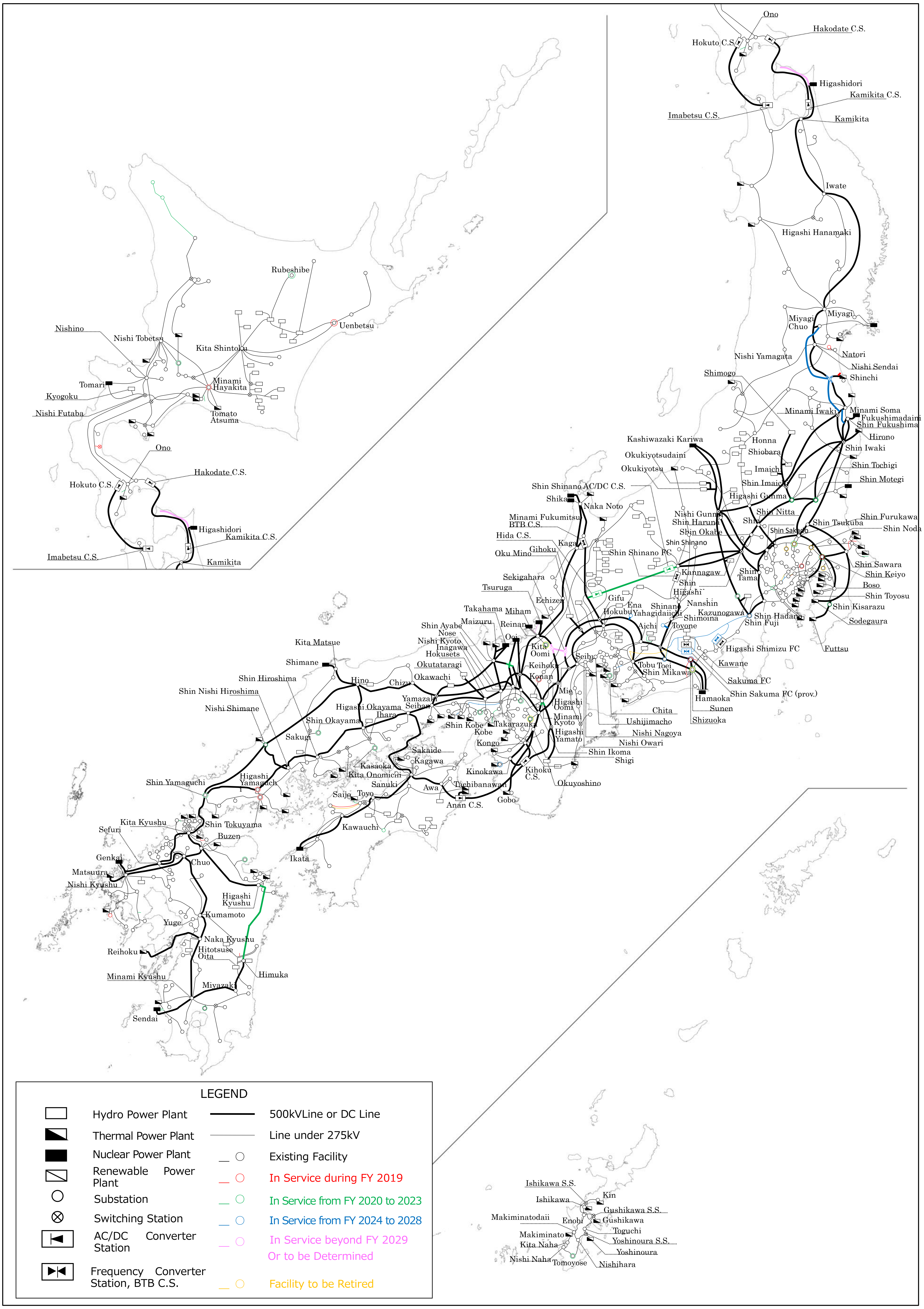


Figure 4 Power Grid Configuration in Japan

1. Development Plans for Major Transmission Lines

Table 4-2 Development Plans under Construction

Company	Line	Voltage	Length[28,29]	Circuit	In-construction	In-service	Purpose[30]
Hokkaido EPCO	Kami Yakumo Switching Station	187kV	-	2	Aug. 2018	Oct. 2019	Generator connection
	Kami Yakumo Branch Line	187kV	0.2km	1	Mar. 2019	Nov. 2019	Generator connection
Tohoku EPCO	1408G02 Branch Line	500kV	3km	2	Sep.2017	Jul. 2019	Generator connection
	Customer Line/ Natori Substation Dπ lead-in	275kV	0.4km	2	May 2018	Jun. 2019	Demand coverage
TEPCO Power Grid	G3060006 access line (prov.)	275kV	5.6km	2	Jan. 2017	Apr. 2019	Generator connection
	Shinano-Hida DC Bulk Line	DC± 200kV	89km	BP 1	Jul. 2017	Mar. 2021	Reliability upgrade*3
	Shinjuku-Jonan Line replacement	275kV	16.4km *1,*2	3	Nov. 2017	Jul. 2018(No.1) Apr. 2020(No.2) Apr. 2019(No.3)	Aging management
	Higashi Shinjuku Line replacement	275kV	23.4→ 5.0km (No.2) *1, *2 23.4→ 5.3km (No. 3) *1, *2	2	Jan. 2019	Nov. 2032(No.2) Nov. 2025(No.3)	Aging management
Chubu EPCO	Shizuoka Higashi Branch Line	275kV	2km	2	Jul.2001	Jun. 2019	Aging management Economic upgrade
	Shizuoka Nishi Branch Line	275kV	3km	2	Jul.2001	Jun. 2019	Aging management Economic upgrade
	Hida Branch Line	500kV	0.4km	2	Jun. 2018	Sep. 2020	Reliability upgrade*3
Kansai EPCO	Kobelco Power Kobe daini Thermal Power Line	275kV	4.4km*1	3	Apr. 2017	Feb. 2021(No.1) Feb. 2022(No.2)	Generator connection
Shikoku EPCO	Matsuyama Higashi Line	187kV	47.8km*2	1→2	Aug. 2018	Nov. 2019	Aging management Economic upgrade
Kyushu EPCO	Hyuga Bulk Line	500kV	124km	2	Nov. 2014	Jun. 2022	Reliability upgrade Economic upgrade
	Karita Thermal-Nissan line	220kV	4km*1*2	1	Oct. 2017	May 2019	Aging management
	GNE Togo Mega Solar branch line	220kV	0.3km	1	Oct. 2018	Oct. 2019	Generator connection
Electric Power Development Company (EPDC)	Ooma Bulk Line	500kV	61.2km	2	May 2006	Uncertain	Generator connection
Northern Hokkaido Wind Energy Transmission Company (NHWETC)	NHWETC Toyotomi-Nakagawa Bulk Line	187kV	51km	2	Sep. 2018	Sep. 2022	Generator connection

28 Length with *1 denotes "Underground," otherwise "Overhead."

29 Length with *2 denotes the change of line category or circuit numbers, not included in Table 4.

30 Purpose is stated below: *3 indicates the enforcement relating to cross-regional interconnection lines.

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

Table 4-3 Development Plans in the Planning Stages

Company	Line	Voltage	Length[28,29]	Circuit	In-construction	In-service	Purpose[30]
Hokkaido EPCO	Tomakomai Biomass (prov.) access line	187kV	0.2km	1	Apr. 2021	Oct. 2022	Generator connection
	Kaminokuni daini Wind Power (prov.) access line	187kV	0.1km	1	May 2021	Aug. 2021	Generator connection
	Kita Horonobe Line partly uprated	187kV	69km	2	Apr. 2021	Jul. 2022	Generator connection
Tohoku EPCO	Cross-regional North Bulk Line(prov.)	500kV	81km	2	Sep. 2022	Nov. 2027	Generator connection Reliability upgrade*3
	Cross-regional South Bulk Line(prov.)	500kV	62km	2	Sep. 2024	Nov. 2027	Generator connection Reliability upgrade*3
	Soma-Futaba Bulk Line/connecting point change	500kV	15km	2	Apr. 2022	Nov. 2025	Generator connection Reliability upgrade*3
	Shinchi Thermal Power access line / Cross-regional Switching Station (prov.) lead-in	500kV	1km	2	Jul. 2024	Jun. 2026	Generator connection Reliability upgrade*3
	Joban Bulk Line/Cross-regional Switching Station(prov.) Dπ lead-in	500kV	1km	2	May 2025	Jul. 2026	Generator connection Reliability upgrade*3
	Cross-regional Switching Station(prov.)	500kV	-	10	May 2023	Nov. 2027 (Jun. 2026)	Generator connection Reliability upgrade*3
TEPCO Power Grid	G7060005 access line(prov.)	275kV	1km*1	1	Sep. 2020	Apr. 2022	Generator connection
	MS18GHZ051500 access line (prov.)	275kV	0.1km	2	Mar. 2021	Sep. 2021	Generator connection
	Keihin Line No.1&2 /connecting point change	275kV	22.7→ 23.1km*2	2	May 2021	Apr. 2022	Generator connection
	Higashi Shimizu Line (prov.)	275kV	13km 7km	2	FY 2022	FY 2026	Reliability upgrade*3
	Nishi Gunma Bulk Line /Higashi Yamanashi Substation T lead-in	500kV	0.1km(No.1) 0.1km(No.2)	2→3	Nov. 2022	Oct. 2023	Demand coverage
	Shinjuku Line replacement	275kV	22.1→ 21.1km (No.1) *1, *2 19.9→ 21.1km (No.2,3) *1, *2	3	Sep. 2019	Aug. 2028(No.1) Nov. 2032(No.2) Nov. 2025(No.3)	Aging management
Chubu EPCO	Yahagi daiichi Branch Line	275kV	5km	1	Aug. 2019	Feb.2021	Aging management Economic upgrade
	Ena Branch Line(prov.)	500kV	1km	2	May 2020	Oct. 2024	Demand coverage
	Shimo Ina Branch Line(prov.)	500kV	1km	2	Mar. 2022	Oct. 2024	Demand coverage
	Higashi Nagoya -Tobu Line	275kV	8km*2	2	Apr. 2019	Jun. 2025	Aging management Economic upgrade
	Sekigahara-Kita Oomi Line	500kV	2km	2	Uncertain	Uncertain	Generator connection*3
	Sekigahara Switching Station	500kV	—	6	Uncertain	Uncertain	Generator connection*3
	Sangi Bulk Line/ Sekigahara Switching Station π lead-in	500kV	1km	2	Uncertain	Uncertain	Generator connection*3

Company	Line	Voltage	Length[28,29]	Circuit	In-construction	In-service	Purpose[30]
Kansai EPCO	Tsuruga Line/ North side improvement	275kV	9.8km→ 9.3km*2	2	Beyond FY 2020	Beyond FY 2023	Aging management
	Ooi Bulk Line/ Shin Ayabe Line route change	500kV	1.9km	2	Jun. 2019	Jan. 2020	Economic upgrade
	Kita Yamato Line/ Minami Kyoto Substation Lead-in change	500kV	0.1km	2	Aug. 2021	Dec. 2021	Economic upgrade
	Kita Oomi Switching Station	500kV	—	6	Uncertain	Uncertain	Generator connection*3
	Kita Oomi Line/ Kita Oomi Switching Station πlead-in	500kV	0.5km	2	Uncertain	Uncertain	Generator connection*3
	Shin Kobe Line/ reinforcement	275kV	20.2→ 21.5km*2	2	Apr. 2019	Jul. 2020	Generator connection Aging management
	Himeji LNG Thermal Power Line(prov.)	275kV	0.9km*1	1	Feb. 2021	Jun. 2024	Generator connection
	Shin Kakogawa Line/ reinforcement(prov.)	275kV	25.3→ 25.3km*2	2	Jul. 2021	Jun. 2025	Generator connection Aging management
Shikoku EPCO	Saijo Thermal Power access line	187kV	6.5km*2	2	Nov. 2019	May 2021	Generator connection
Kyushu EPCO	JR Shin Isahaya Branch Line	220kV	1km	2	Jul. 2019	Apr. 2021	Demand coverage
	Saibu Gas/ Hibiki Thermal Power Line	220kV	4km	2	Feb. 2021	Feb. 2023	Generator connection
	Shin Kagoshima Line/ Sendai Nuclear Power π lead-in	220kV	2→5km*2	1→2	Aug. 2020	Jul. 2023	Economic upgrade
EPDC	Sakuma Higashi Bulk Line/ Shin Sakuma FC Branch Line(prov.)	275kV	3km	2	FY 2022	FY 2026	Reliability upgrade*3
	Sakuma Nishi Bulk Line/ Shin Sakuma FC Branch Line (prov.)	275kV	1km	2	FY 2022	FY 2026	Reliability upgrade*3
	Shin Toyone-Toei Line	275kV	1km	1	FY 2022	FY 2026	Reliability upgrade*3
	Sakuma Nishi Bulk Line	275kV	10.6→ 11km*2	2	FY 2022	FY 2027	Reliability upgrade*3
	Sakuma Nishi Bulk Line	275kV	2km	2	FY 2022	FY 2026	Reliability upgrade*3
	Sakuma Higashi Bulk Line	275kV	123.7→ 123km*2	2	FY 2022	FY 2027	Reliability upgrade*3

Table 4-4 Retirement Plans

Company	Line	Voltage	Length	Circuit	Retirement	Purpose[30]
Shikoku EPCO	Kita Matsuyama Line	187kV	△47.5km	1	Nov. 2019	Aging management Economic upgrade
EPDC	Shin Toyone-Toei Line	275kV	△2.6km	1	FY 2026	Reliability upgrade*3
	Sakuma Nishi Bulk Line	275kV	△58.0km	2	FY 2026	Economic upgrade

2. Development Plans for Major Substations

Table 4-5 Development Plans under Construction

Company	Substation[31]	Voltage	Capacity	Number	In-construction	In-service	Purpose[30]
Hokkaido EPCO	Minami Hayakita	187/66kV	200MVA	1	Aug. 2018	Sep.2019	Generator connection
	Uenbetsu	187/66kV	75MVA→ 100MVA	1→1	Feb. 2019	Nov. 2019	Aging management
Tohoku EPCO	Natori*4	275/154kV	450MVA×2	2	Feb. 2017	Jun. 2019	Demand coverage
TEPCO Power Grid	Shin Keiyo	275/154kV	300MVA×2→ 450MVA×2	2→2	Jul. 2018	Sep. 2019(5B) Apr. 2021(6B)	Aging management
	Shin Shinano AC/DC Converter Station*4	—	—	-	Mar. 2016	Mar. 2021	Reliability upgrade*3
	Ueno	275/66kV	300MVA	1	Feb. 2019	Dec. 2019	Economic upgrade
Chubu EPCO	Shizuoka*4	500/275kV	1,000MVA	1	Aug.2001	Jun.2019	Aging management Economic upgrade
	Hida Converter Station*4	—	—	—	Aug. 2017	Mar. 2021	Reliability upgrade*3
	Shunen	275/154kV	450MVA×1→ 300MVA×1	1→1	Feb. 2019	May 2020	Aging management
Kansai EPCO	Konan	275/77kV	300MVA×1→ 200MVA×1	1→1	Dec. 2018	Oct. 2019	Aging management
Chugoku EPCO	Higashi Yamaguchi	500/220kV	1,000MVA	1	May 2017	Apr. 2019	Demand coverage Generator connection
	Shin Tokuyama	220/110kV	150MVA×1→ 300MVA×1	1→1	Jul. 2018	Apr. 2019	Aging management Generator connection
Okinawa EPCO	Tomoyose	132/66kV	125MVA×2→ 200MVA×2	2→2	Oct. 2017	Jun. 2020 Oct. 2023	Aging management
NHWETC	Kita Toyotomi*4	187/66kV	165MVA×3	3	Apr. 2019	Sep. 2022	Generator connection

Table 4-6 Development Plans in the Planning Stages

Company	Substation[31]	Voltage	Capacity	Number	In-construction	In-service	Purpose[30]
Hokkaido EPCO	Rubeshibe	187/66kV	60MVA×2→ 100MVA	2→1	Mar. 2021	Oct. 2021	Aging management
	Nishi Nakagawa(prov.)	187/100kV	100MVA×2	2	Jul. 2020	Jul. 2022	Generator connection
	Kita Ebetsu	187/66kV	100MVA×1→ 150MVA	1→1	Feb. 2022	Oct. 2022	Aging management
TEPCO Power Grid	Shin Motegi	500/275kV	1,500MVA	1	Nov.2019	Mar. 2021	Generator connection
	Shin Kisarazu	275/154kV	450MVA×2	2	Jun. 2020	Apr. 2022	Generator connection
	Higashi Yamanashi	500/154kV	750MVA	1	Apr. 2019	Dec. 2022	Demand coverage
	Shin Tochigi	500/154kV	750MVA	1	Apr. 2021	Jan. 2023	Generator connection
	Shin Fuji	500/275kV	1,500MVA	1	FY 2023	FY 2026	Reliability upgrade*3
	Kita Tokyo	275/66kV	300MVA	1	Sep. 2020	Jun. 2022	Economic upgrade
Chubu EPCO	Chita Thermal Power	275/154kV	300MVA×1→ 450MVA×1	1→1	Jul. 2019	Apr. 2021	Aging management
	Chita Thermal Power	275/154kV	450MVA×2	2	Jul. 2019	Nov. 2020(N1B) Aug. 2021(N2B)	Generator connection
	Ena(prov.)*4	500/154kV	200MVA×2	2	Dec. 2020	Oct. 2024	Demand coverage
	Shimo Ina(prov.)*4	500/154kV	300MVA×2	2	Dec. 2020	Oct. 2024	Demand coverage
	Toei	500/275kV	800MVA×1→ 1,500MVA×2	1→2	Nov. 2020	FY 2024(N2B) FY 2026(1B)	Reliability upgrade*3

.

[31] Substation with *4 denotes a substation or converter station newly installed, including an uprated electric facility.

Company	Substation[31]	Voltage	Capacity	Number	In-construction	In-service	Purpose [30]
Chubu EPCO	Shizuoka	500/275kV	1,000MVA	1	FY 2024	FY 2026	Reliability upgrade*3
	Higashi Shimizu	—	300MW→ 900MW	—	Feb. 2021	FY 2027	Reliability upgrade*3
Kansai EPCO	Higashi Osaka	275/77kV	300MVA→ 200MVA	1→1	Sep. 2019	Jun. 2020	Aging management
	Nishi Kobe	275/77kV	200MVA×2→ 300MVA	2→1	Nov. 2020	Jun. 2021	Aging management
	Koto	275/77kV	200MVA→ 300MVA	1→1	Oct. 2021	Oct. 2022	Aging management
	Yodogawa	275/77kV	300MVA×2→ 300MVA	2→1	Dec. 2020	Oct. 2021	Aging management
	Kainannko	275/77kV	300MVA×1, 200MVA×2→ 300MVA×2	3→2	Jun. 2021	Jun. 2024	Aging management
Chugoku EPCO	Sakugi	220/110kV	200MVA	1	Jun. 2019	Nov. 2020	Generator connection
	Shin Yamaguchi	220/110kV	400MVA	2	Apr. 2019	Jun. 2021	Economic upgrade
	Kasaoka	220/110kV	250MVA→ 300MVA	1→1	Aug. 2020	Jun. 2021	Aging management
	Nishi Shimane	500/220kV	1,000MVA	1	Apr. 2020	Mar. 2022	Generator connection
Shikoku EPCO	Kochi	187/66kV	200MVA→ 300MVA	1→1	Nov. 2021	Apr. 2022	Aging management Demand coverage
Kyushu EPCO	Hayami	220/66kV	250MVA	1	Apr. 2019	Jun. 2020	Generator connection
	Kirishima	220/66kV	300MVA	1	Nov. 2019	Sep. 2021	Generator connection
	Matsushima	220/66kV	150MVA	1	Apr. 2019	Mar. 2020	Economic upgrade
EPDC	Shin Sakuma FC (prov.)	—	—		FY 2021	FY 2027	Reliability upgrade*3

Table 4-7 Retirement Plans

Company	Substation	Voltage	Capacity	Number	Retirement	Purpose
TEPCO Power Grid	Shin Noda	275/154kV	∆300 MVA	∆1	Mar. 2020	Demand coverage
	Hanamigawa	275/66kV	∆300 MVA	∆1	Mar. 2021	Demand coverage
	Kita Tokyo	275/154kV	∆300 MVA	∆1	Oct. 2020	Economic upgrade
	Ageo	275/66kV	∆300 MVA	∆1	Feb. 2023	Economic upgrade
Chubu EPCO	Shunen	500/275kV	∆1,000 MVA	∆1	Jun. 2019	Aging management
Kansai EPCO	Higashi Osaka	275/154kV	∆300 MVA	∆1	Jan. 2021	Aging management
	Koto	275/77kV	∆100 MVA×2	∆2	Sep. 2022	Aging management

<u>Other development plans</u> (not subject to submission by the electric supply plan)

The development plan stated below is not required to be included in the electricity supply plan, but will be implemented as a functional improvement by Chubu EPCO and Hokuriku EPCO.

◇Minami Fukumitsu Interconnection Facility・Substation 500 kV AC Connecting Bus Line Addition (in service: October 2019).

3. Summary of Development Plans for Transmission Lines and Substations

Tables 4-8 to 4-11 show the summarized development or extension plans of major transmission lines and substations (transformers and converter stations) up to FY 2028 submitted by GT&D and transmission companies.

Table 4-8 Development Plans for Major Transmission Lines

Category	Voltage	Lines	Length[32]	Extended Length[33]	Total Length	Total Extended Length
Newly Installed or Extended	500kV	Overhead	291 km*[34]	583 km*	291 km*	583 km*
		Underground	0 km	0 km		
	275kV	Overhead	36 km	66 km	42 km	81 km
		Underground	6 km	15 km		
	220kV	Overhead	5 km	10 km	5 km	10 km
		Underground	0 km	0 km		
	187kV	Overhead	121 km	241 km	121 km	241 km
		Underground	0 km	0 km		
	132kV	Overhead	0 km	0 km	0 km	0 km
		Underground	0 km	0 km		
	DC	Overhead	89 km	89 km	89 km	89 km
		Underground	0 km	0 km		
	Total	Overhead	542 km	989 km	549 km	1,004 km
		Underground	6 km	15 km		
To be Retired	275kV	Overhead	△61km	△119km	△61km	△119km
		Underground	0km	0km		
	187kV	Overhead	△ 48 km	△ 48 km	△ 48 km	△ 48 km
		Underground	0 km	0 km		
	Total	Overhead	△108 km	△166 km	△ 108 km	△ 166 km
		Underground	0 km	0 km		

Table 4-9 Revised Plans for Line Category and the Numbers of Circuits[35]

Voltage	Length Extended	Total Extended Length
500kV	0 km	1 km
275kV	311 km	702 km
220kV	9 km	14 km
187kV	54 km	109 km
132kV	0 km	0 km
DC	0 km	0 km
Total	375 km	825 km

[32] Length denotes both the increased length due to newly installed or extended plans, and the decreased length due to retirement. Development plans corresponding to the change of line category or the 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 the length. The totals of lengths are not necessarily equal due to independent rounding.
In addition, the overall total length is not necessarily equal due to independent rounding.

[33] Total length denotes the aggregation of length multiplied by the number of circuits. Development plans corresponding to the change of line category or the number of circuits were not included in the increased length of transmission lines in Table 4-8 and are treated as no change in the length.

[34] See footnote 26.

[35] Table 4-9 aggregates the extended and total extended lengths corresponding to the revised plans for the line category and the number of circuits.

Table 4-10 Development Plans for Major Substations

Category[36]	Voltage[37]	Increased Numbers	Increased Capacity
Newly Installed or Extended	500kV	13 [5]	11,700 MVA [2,000MVA]
	275kV	5 [2]	3,000 MVA [900MVA]
	220kV	6 [0]	1,500 MVA [0MVA]
	187kV	5 [5]	1,050 MVA [695MVA]
	132kV	0 [0]	150 MVA [0MVA]
	Total	29 [12]	17,400 MVA [3,595MVA]
To be Retired	500kV	△ 1	△ 1,000 MVA
	275kV	△ 7	△1,700 MVA
	220kV	0	0 MVA
	187kV	0	0 MVA
	132kV	0	0 MVA
	Total	△ 8	△ 2,700 MVA

[ ] : The aforementioned increase in the number of transformers resulted from new substation installations.

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

Category	Company and Number of Sites		Capacity[38]
Newly Installed or Extended	TEPCO Power Grid	1	900MW
	Chubu EPCO	2	900MW 600MW
	Electric Power Development Company	1	300MW

36 Retirement plans with transformer installations are included in Newly Installed or Extended, and negative values are included in the increased numbers or the increased capacity.
37 Voltage class by upstream voltage.
38 Installed capacity of the converter stations on both sides of the DC lines is included.

V. Cross-Regional Operation

Retail companies will procure the supply capacity for their customers in their regional service areas. The scheduled procurement from the external service areas at 15:00 in August 2019 is illustrated in four figures. Figures 5-1 and 5-2 show the supply capacity and the ratio of the supply capacity, respectively, at 15:00 in August. Figures 5-3 and 5-4 show the energy supply and the ratio of the energy supply, respectively, in FY 2019.

Higher ratios for procurement from the external regional service areas are observed in Tokyo, Kansai and Chugoku EPCO areas; those to the external regional service areas are observed in Tohoku, Shikoku and Kyushu EPCO areas. Higher energy is transmitted from other areas to Tokyo, Kansai, Chugoku, and Shikoku EPCO areas by 10% and over.

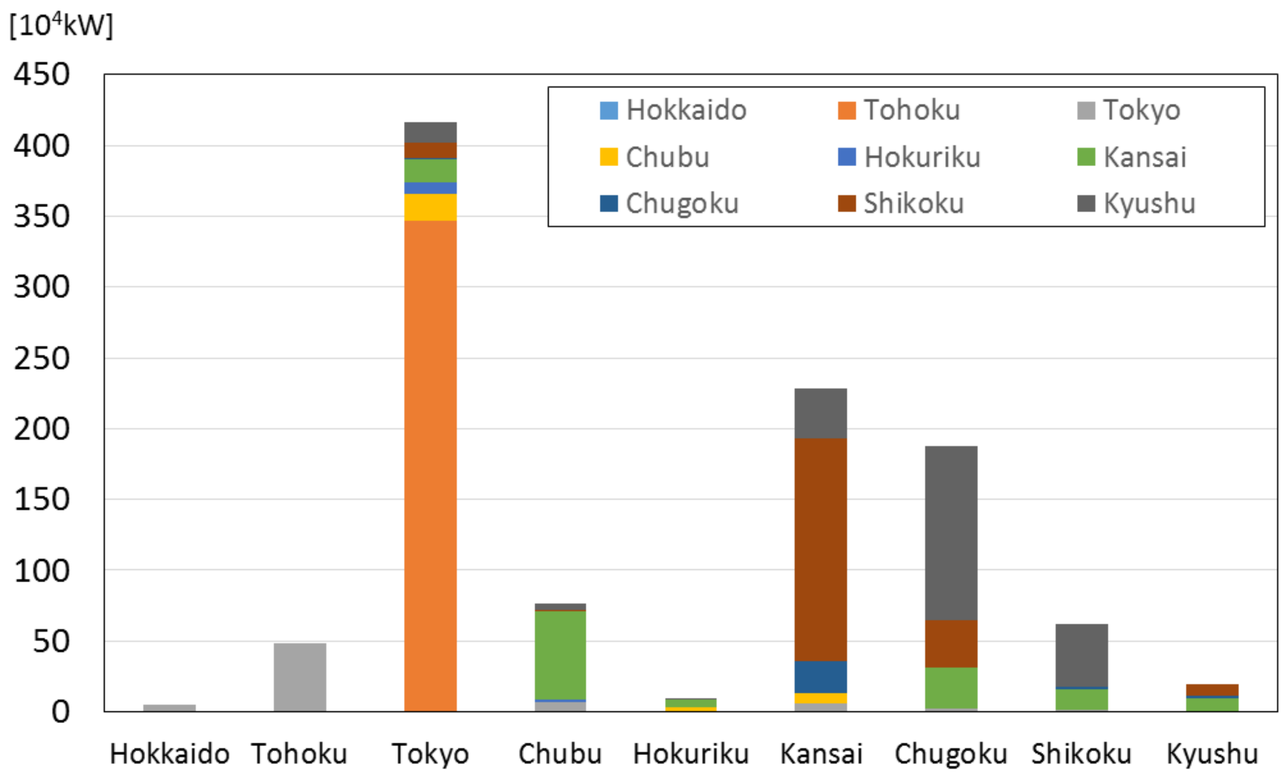


Figure 5-1 Scheduled Procurement of Supply Capacity from External Regional Service Areas

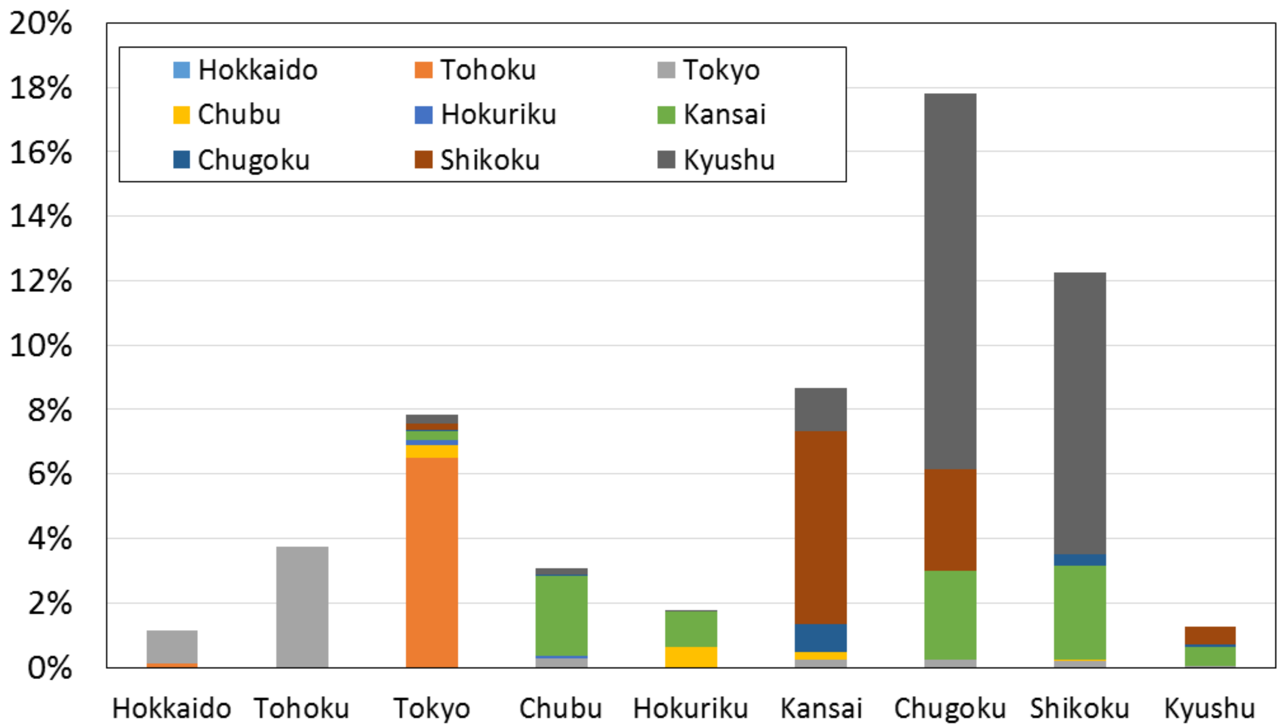


Figure 5-2 Ratio of Scheduled Procurement of Supply Capacity from External Regional Service Areas

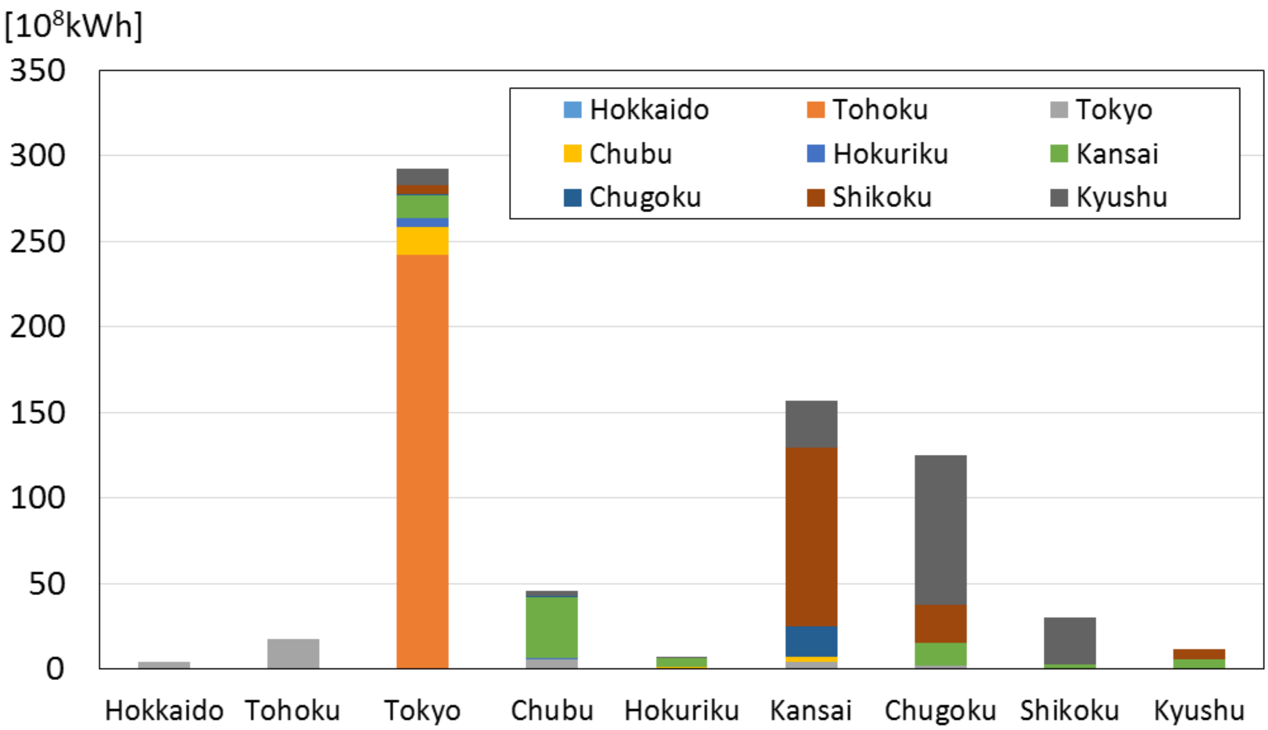


Figure 5-3 Scheduled Procurement of Energy Supply from External Regional Service Areas

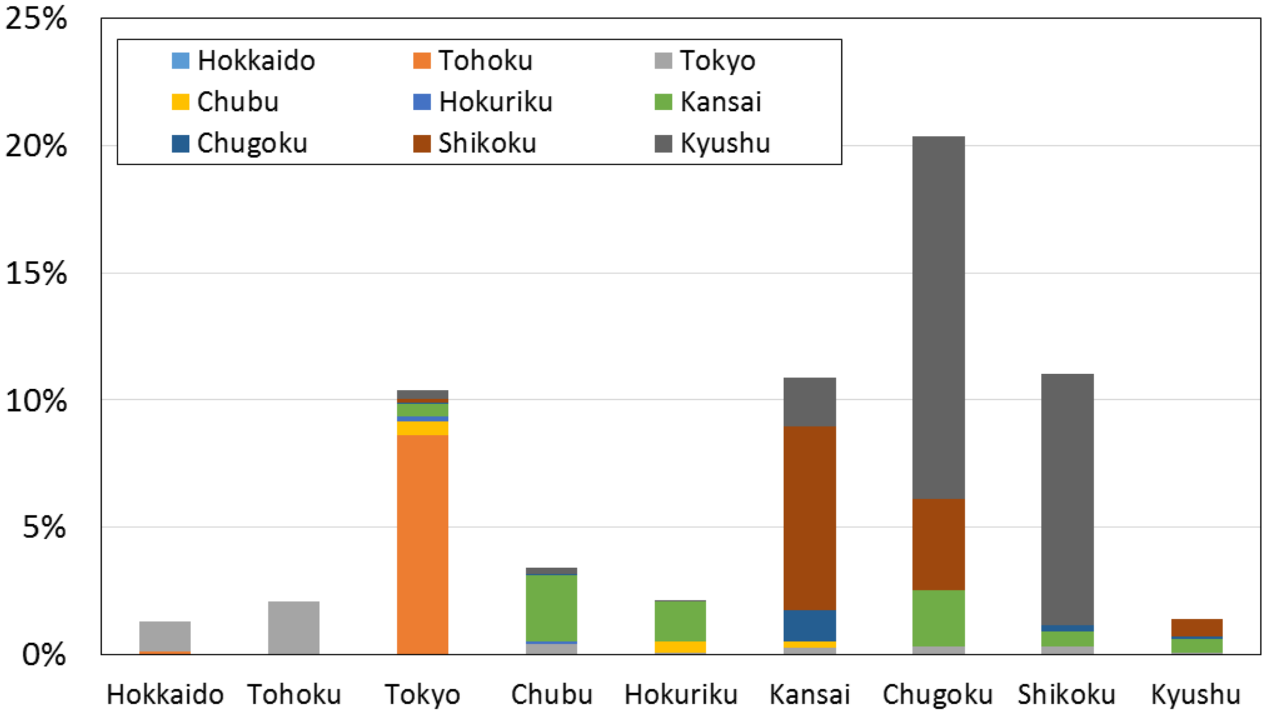


Figure 5-4 Ratio of Scheduled Procurement of Energy Supply from External Regional Service Areas

VI. Analysis of Characteristics of Electric Power Companies

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

In total, 535 retail companies submitted their electricity supply plans, and these are classified by the business scale of the retail demand forecast by the corresponding companies. Figures 6-1 and 6-2 show the distributions of the business scale of retail demand and the accumulated retail demand forecast by the corresponding companies, respectively. Notably, small-to-medium-sized retail companies (business scale of under 1 GW) plan to expand business.

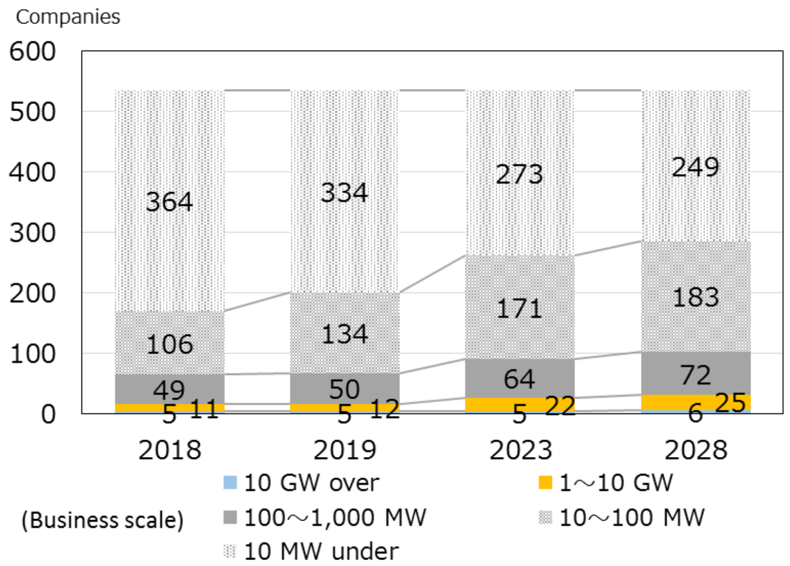


Figure 6-1 Distribution by Business Scale of the Retail Demand by Retail Companies

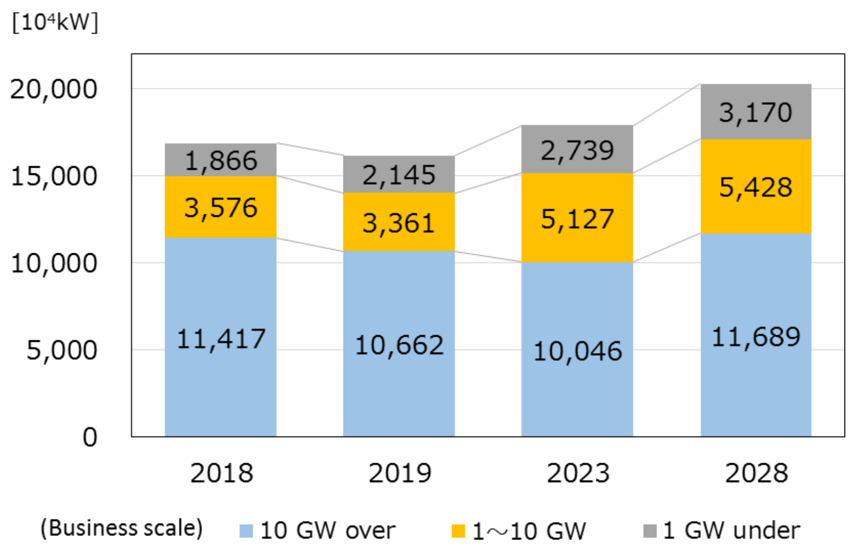


Figure 6-2 Distribution by Accumulated Retail Demand by Retail Companies

Similarly, retail companies are classified by the business scale of the retail energy sales forecast by the corresponding companies. Figures 6-3 and 6-4 show the distributions of the business scale of retail company energy sales and their accumulated energy sales forecast, respectively. Similarly, small and medium-sized retail companies (business scale of under 1 GW) plan to expand business.

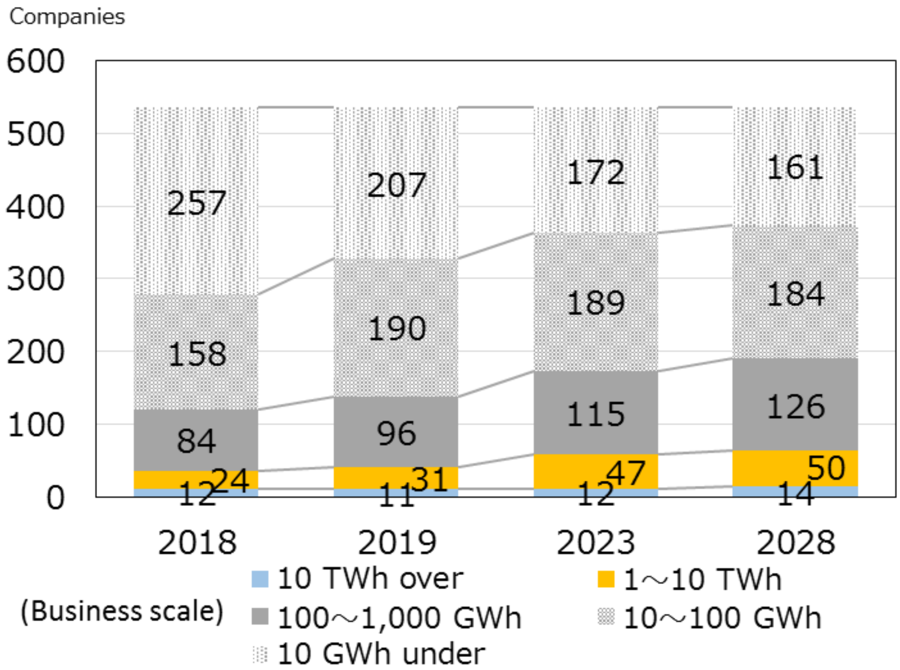


Figure 6-3 Distribution by Business Scale of Retail Company Energy Sales

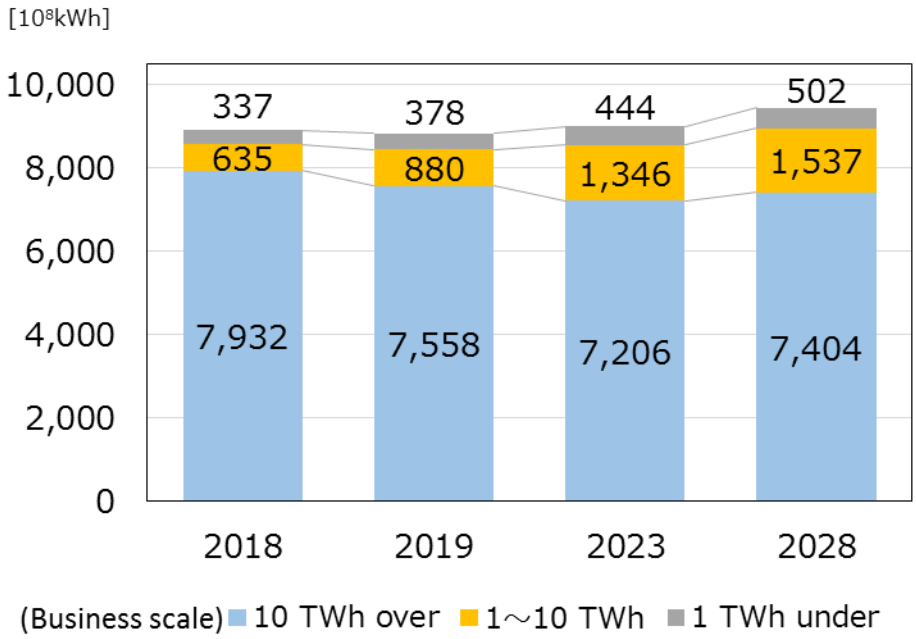


Figure 6-4 Distribution by Retail Company Accumulated Energy Sales

2. Retail Company Business Areas

Figure 6-5 shows the ratio of retail companies by the number of areas where they plan to conduct their business. Figure 6-6 shows the number of retail companies by their business planning areas in FY 2019. The figures exclude 68 retail companies that had not yet developed their retail business plans. Half of the retail companies plan their business in a single area.

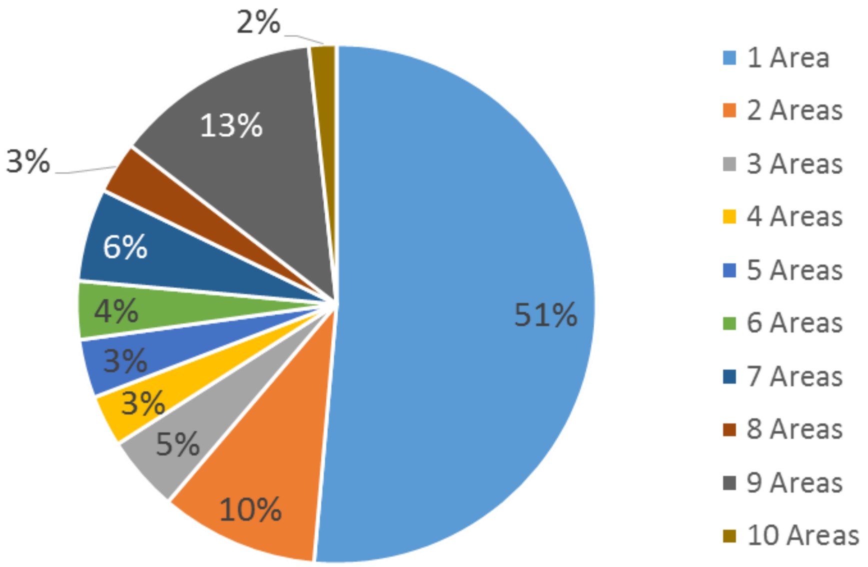


Figure 6-5 Ratio of Retail Companies by the Number of Planned Business Areas in FY 2019

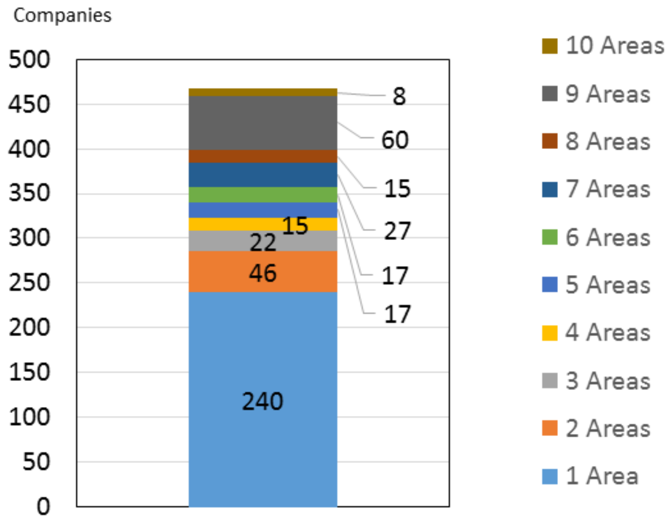


Figure 6-6 Number of Retail Companies by their Business Planning Areas in FY 2019

Figure 6-7 shows the number and the retail demand of retail companies in each regional service areas for GT&D companies in FY 2019. In general, the number of companies is comparable with the scale of retail demand in the regional service area.

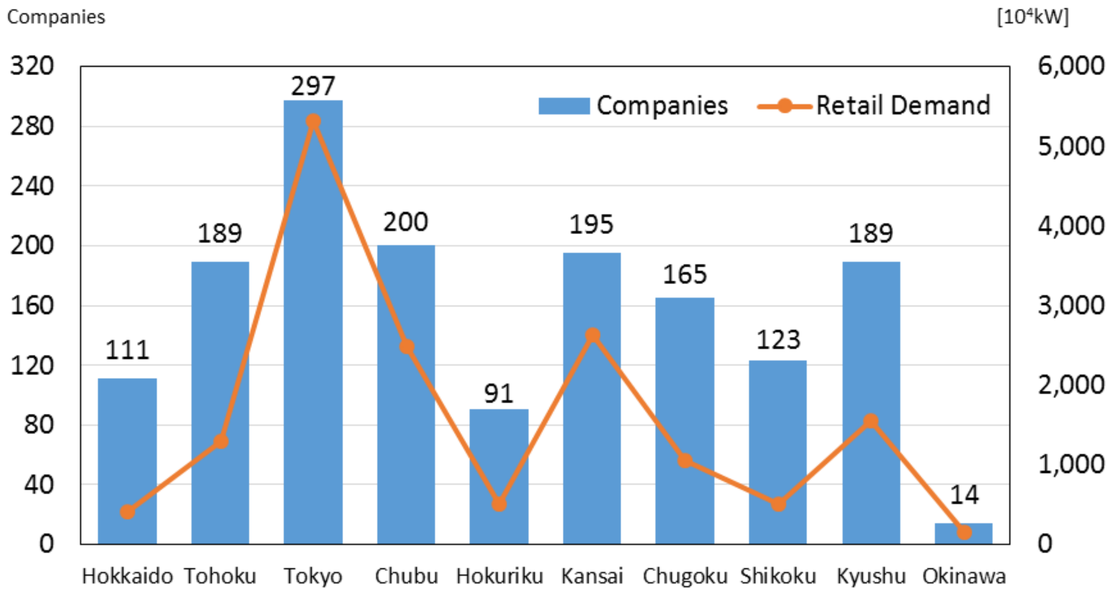


Figure 6-7 Number and Retail Demand of Retail Companies in Each Regional Service Area

3. Supply Capacity Procurement by Retail Companies

Table 6-1 and Figure 6-8 respectively show the supply capacity secured by retail companies according to their forecasted demand, and the ratios of the secured supply capacity[39] for the 10-year period FY 2019–2028, respectively. Particularly in the mid-to-long term, retail companies have planned their supply capacity as "unspecified procurement."[40]

Table 6-1 Supply Capacity Secured by Retail Companies According to Their Demand for the 10-year Period FY 2019–2028
(at 15:00 in August, 10^4 kW at the sending end)

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Peak Demand Nationwide	15,907	15,877	15,855	15,833	15,814
Secured Supply Capacity	15,334	15,368	14,721	14,453	14,239
Ratio[39]	96.4%	96.8%	92.8%	91.3%	90.0%
	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
Peak Demand Nationwide	15,792	15,771	15,749	15,757	15,735
Secured Supply Capacity	14,110	14,015	12,112	12,105	12,048
Ratio[39]	89.3%	88.9%	76.9%	76.8%	76.6%

39 Ratio of the secured supply capacity to areal peak demand is the sum of secured supply capacity of retail companies divided by the peak demand nationwide, expressed in %.
40 "Unspecified procurement" means that retail companies plan to procure their future supply capacity by means of various procurement choices, including procurement from the market, as described in the format of the electricity supply plan.

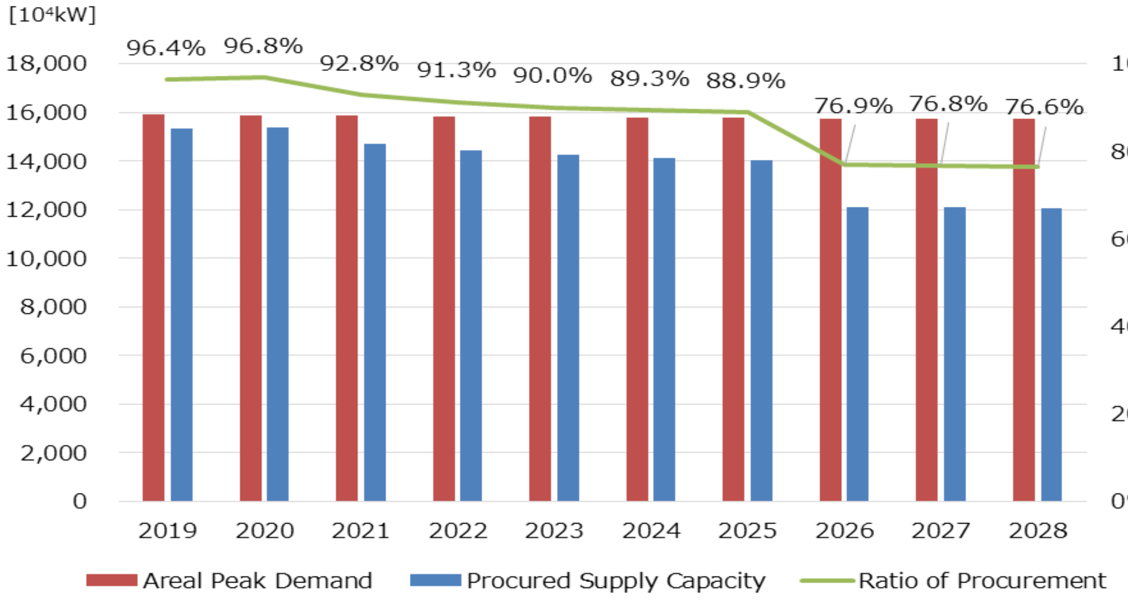


Figure 6-8 Supply Capacity Procured by Retail Companies According to Their Demand for the 10-year Period FY 2019–2028 (at 15:00 in August; at the sending end)

Figure 6-9 shows the retail demand forecasted in the regional service area by the retail department of former general electric utilities and their procured supply capacity to the retail demand. The retail and generation department of the former general electric utilities secure sufficient supply capacity procured to the retail demand of their own area.

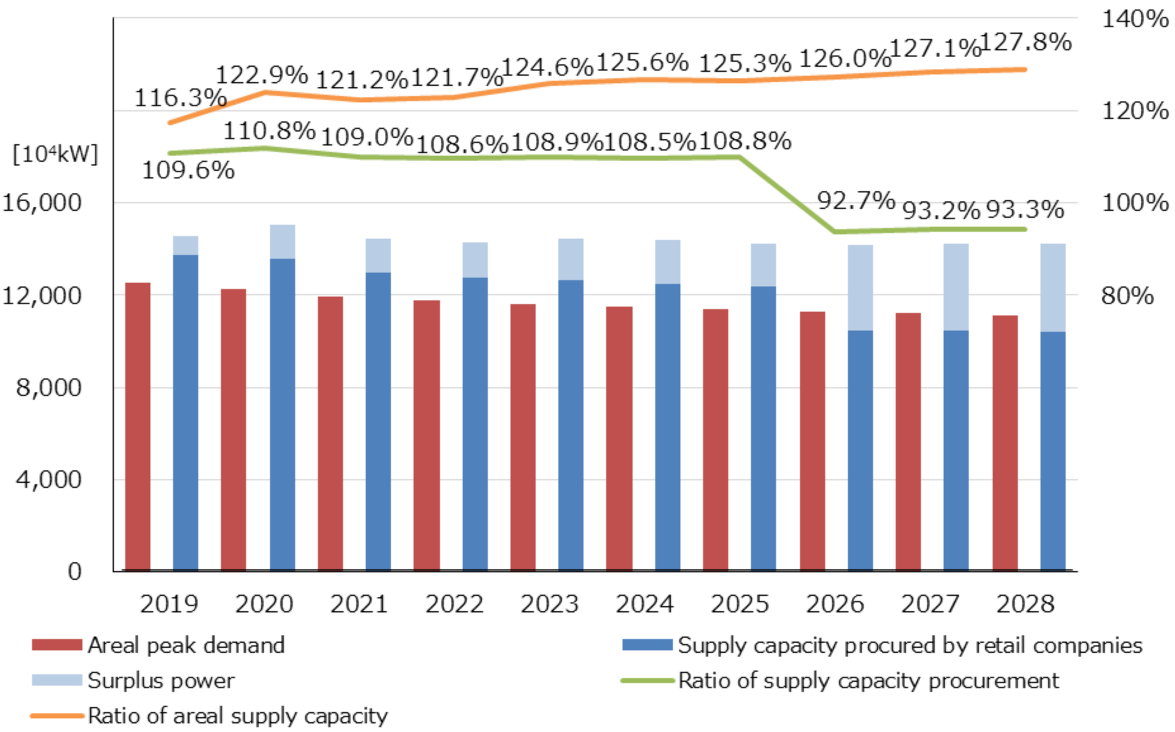
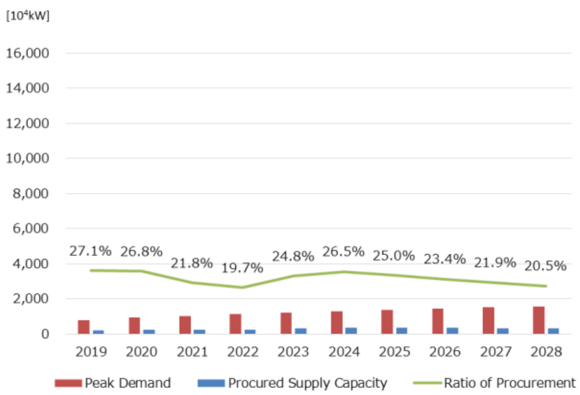


Figure 6-9 Ratio of Secured Supply Capacity to Forecast Retail Demand of Their Own Area for Former General Electric Utilities[41] (at 15:00 in August, at the sending end)

[41] Includes surplus power of group companies deducting balancing capacity to the secured supply capacity by retail companies.

However, according to a review by the Organization, the ratio of secured supply capacity to forecast retail demand of the external areas that retail departments of former general electric utilities forecast as their own demand (including the demand of companies consisting of those majorly funded by former general electric utilities) has a tendency of procuring the supply capacity as "unspecified procurement", as is the case with other power producers and suppliers (PPSs) in the more competitive conditions among the former general electric utilities. In addition, the ratio of secured supply capacity procured by other PPSs to their own forecast peak demand nationwide will decline in the mid-to-long term as indicated in Figure 6-10.



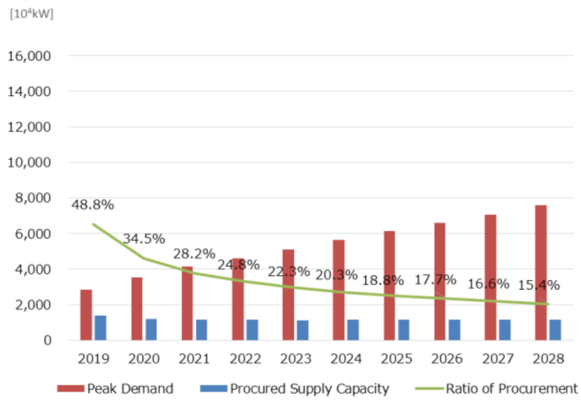


Figure 6-10 Ratio of Procured Supply Capacity to Forecast Retail Demand by Former Electric Utilities in the External Areas (left) and by PPSs (right) (at 15:00 in August, at the sending end)

Figure 6-11 shows the secured supply capacity (including surplus power) nationwide of retail departments of former general electric utilities (including companies consisting of those majorly funded by former general electric utilities). The retail departments of former general electric utilities have secured sufficient supply capacity for both their own service area and other external areas.

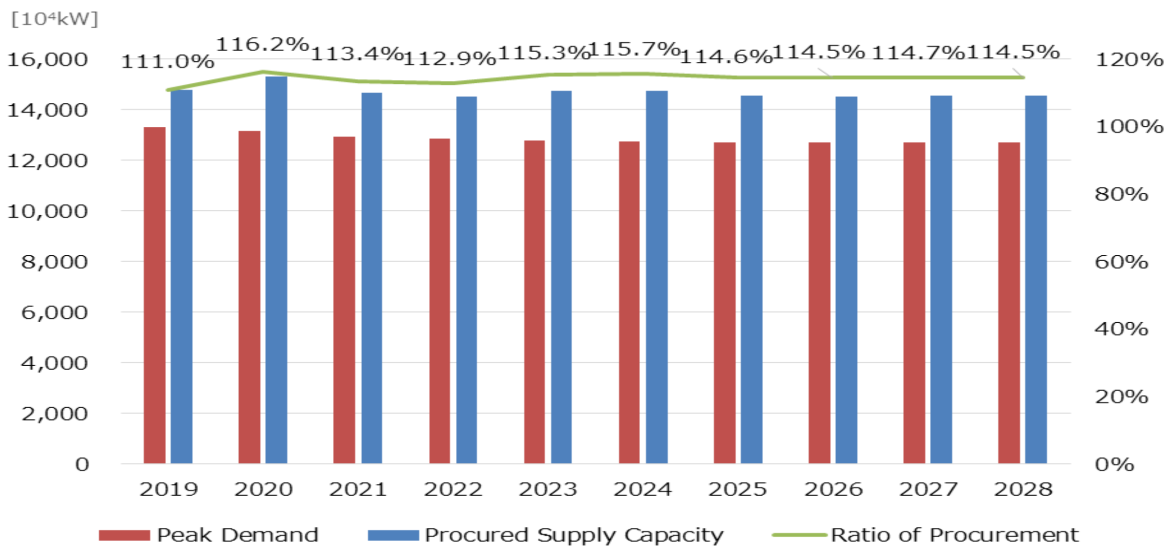


Figure 6-11 Ratio of Procured Supply Capacity to Forecast Retail Demand by Former Electric Utilities and Companies Consisting of Those Majorly Funded by Former Electric Utilities (at 15:00 in August, at the sending end)

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

In total, 725 generation companies submitted their electricity supply plans, and these are classified by the business scale of the installed capacity operated by the corresponding companies. Figure 6-12 shows the distribution by business scale and Figure 6-13 shows the installed capacity operated by the corresponding companies.

Generation companies with an installed capacity of under 100 MW are planning to enlarge the scale of their business.

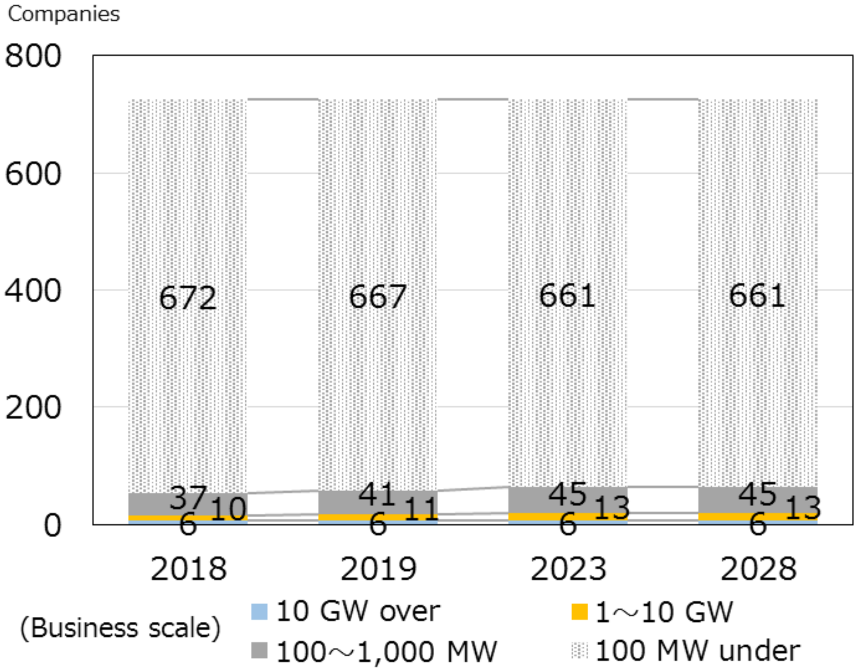


Figure 6-12 Distribution by Business Scale of Generation Company Installed Capacity

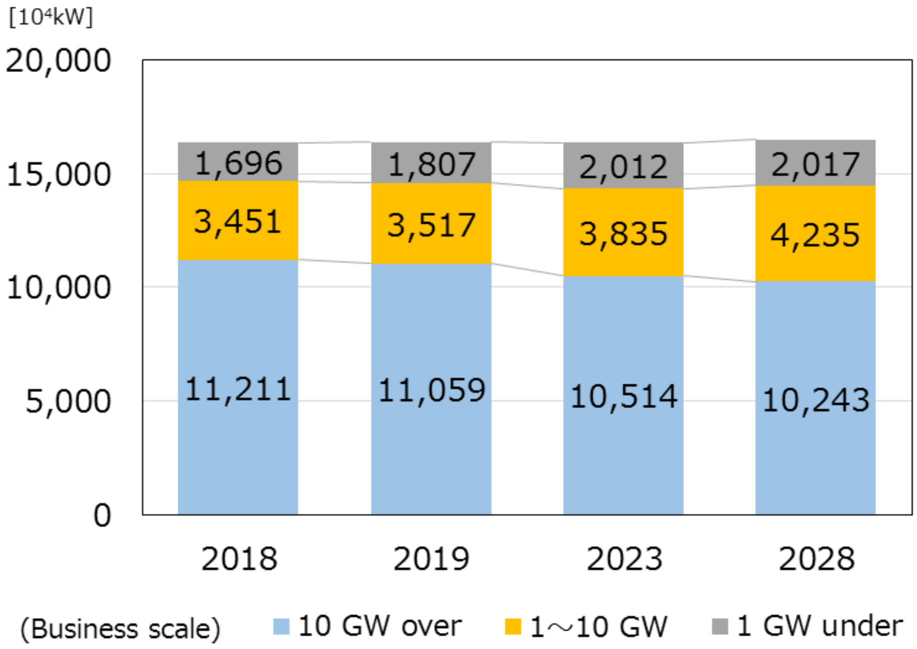


Figure 6-13 Distribution by Generation Company Accumulated Installed Capacity

Similarly, generation companies are classified by the business scale of the corresponding company energy supply forecast. Figure 6-14 shows the distribution by the business scale of the energy supply and Figure 6-15 shows the distribution by the corresponding company accumulated energy supply forecast.
Generation companies with an energy supply of under 10 TWh are planning to decrease their energy generation.

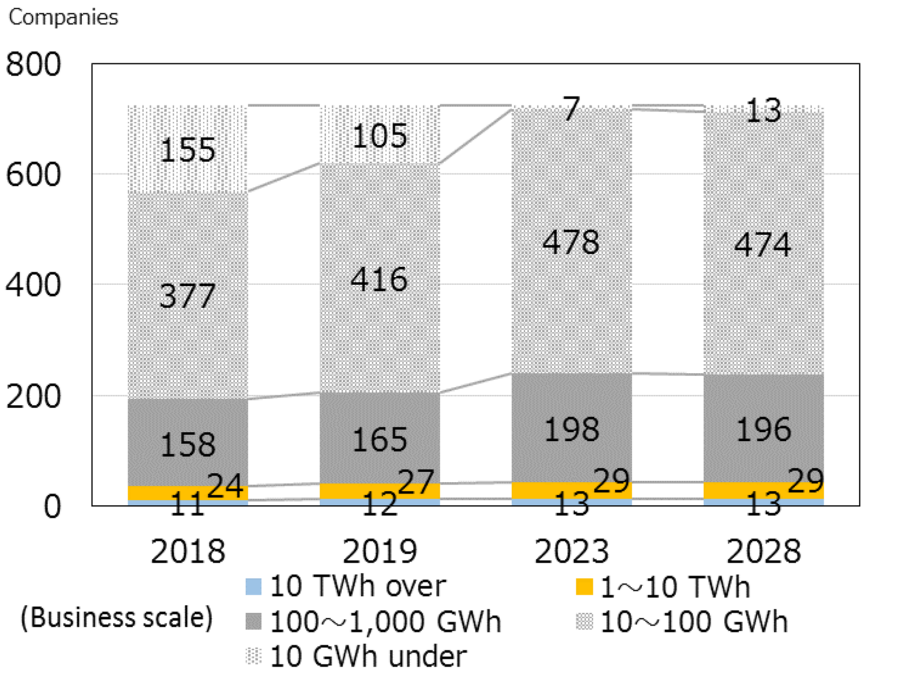


Figure 6-14 Distribution by Business Scale of Generation Company Energy Supply

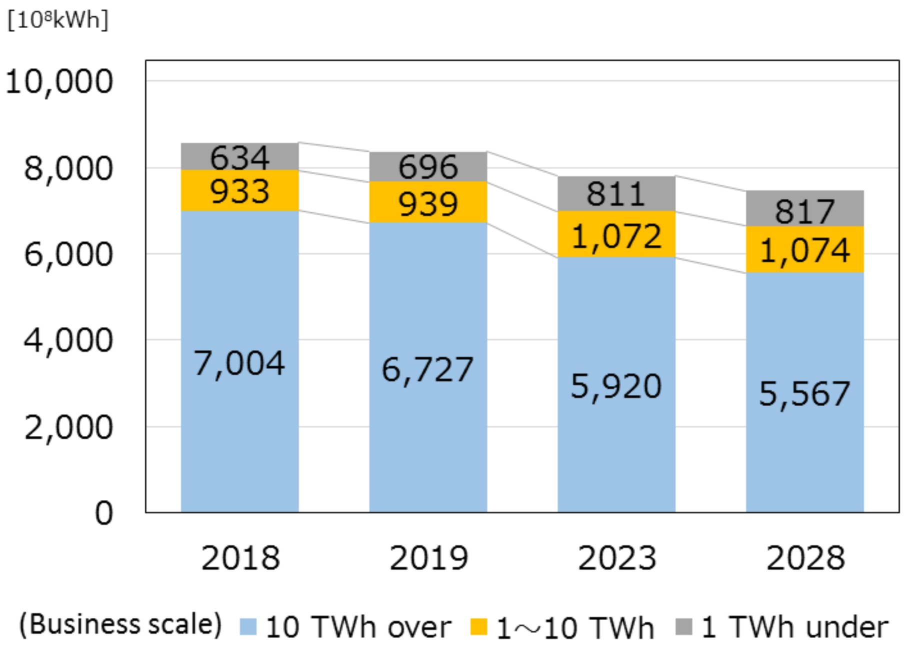


Figure 6-15 Distribution by Generation Company Accumulated Energy Supply

Figure 6-18 shows the number of generation companies by the power generation sources of their own generators at the end of FY 2019.　The figures exclude 84 generation companies that do not own their generation plants. Approximately 75% of all generation companies solely own renewable energy generation facilities.

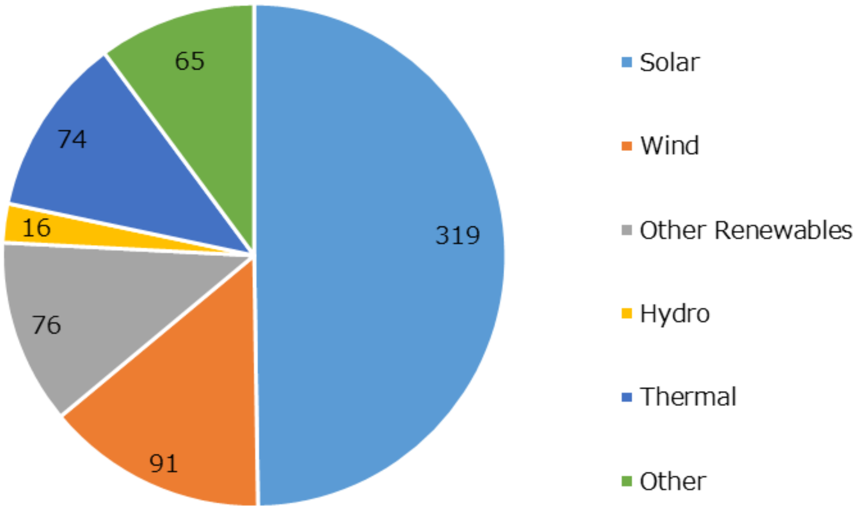


Figure 6-16 Number of Generation Companies by Power Generation Sources

5. Generation Company Business Areas

Figure 6-17 shows the ratio of generation companies to the number of areas where they plan to conduct their business. Figure 6-18 shows the number of generation companies by their business planning areas in FY 2019. The figures exclude 117 generation companies that do not own their generation plants. Approximately 75% of all generation companies plan their business in a single area.

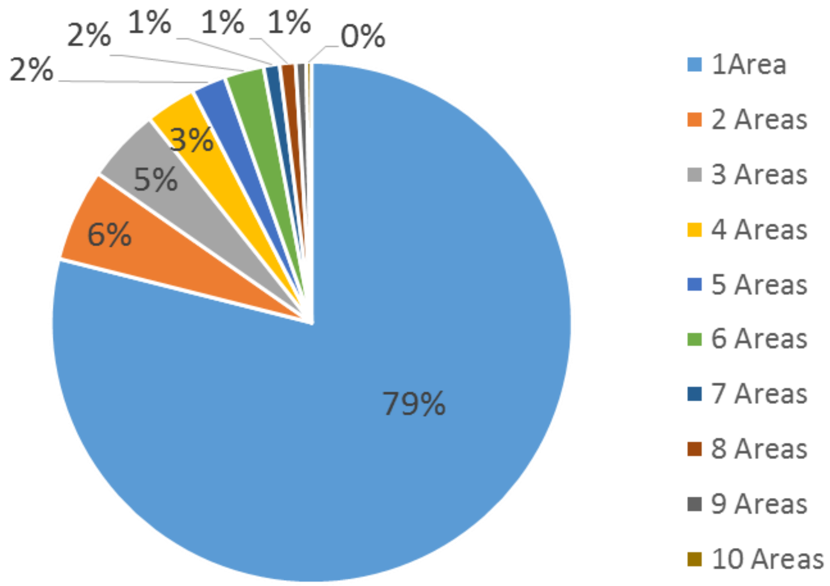


Figure 6-17 Ratio of Generation Companies by the Number of Planned Business Areas in FY 2019

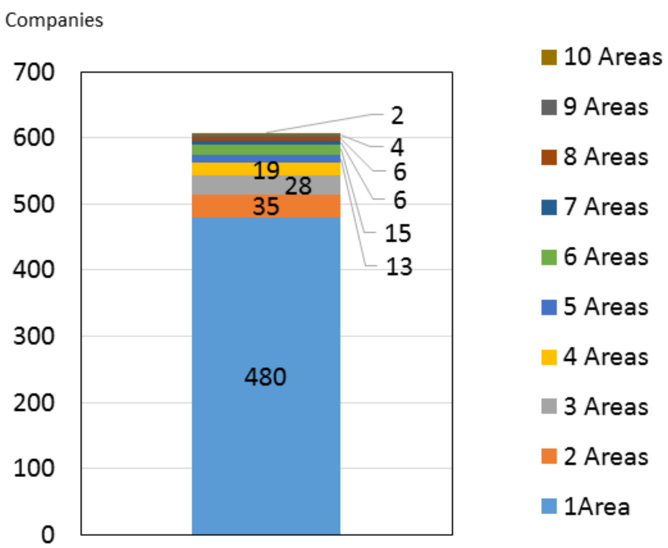


Figure 6-18 Number of Generation Companies by Their Business Planning Areas in FY 2019

Figure 6-19 shows the number and installed capacity of generation companies in each regional service area for GT&D companies in August 2019. In the Hokkaido, Tohoku, Chugoku, Shikoku, and Kyushu regional service areas, the scale of generation companies is rather small and their supply capacity is comparatively small despite the number of generation companies in these regional service areas.

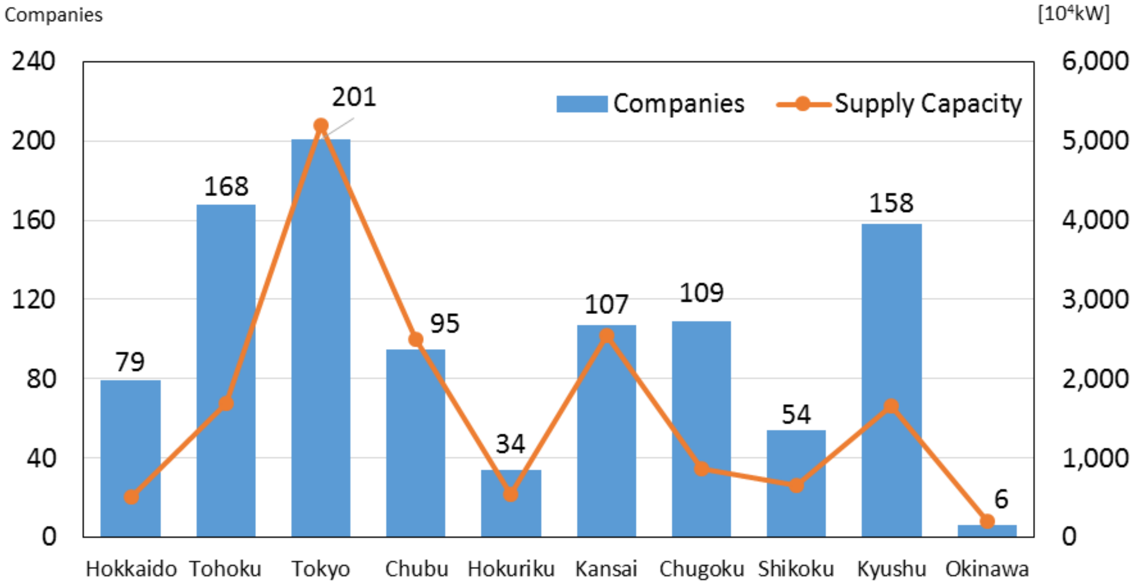


Figure 6-19 Number and Installed Capacity of Generation Companies in Each Regional Service Area

VII. Findings and Current Challenges

The current challenges relating to the aggregation of electricity supply plans are as follows.

i. Toward the security of stable supply until the functioning of the capacity market

The following conditions were recognized at the previous year's aggregation of the plans: a) former general electric utilities will decrease their supply capacity according to the decrease in their customers; b) small-to-medium-sized retail companies will grab market share without procuring their supply capacity, which will remain "unspecified procurement." Both conditions lead to declining reserve margins in regional service areas and this tendency is likely to continue. At the current aggregation, the Organization has again recognized this tendency.

In addition, the following new tendencies or conditions are recognized at the current aggregation.

<u>Movement toward increasing supply capacity</u>

· The Organization requested the cooperation of all electric power companies in securing supply capacity, and made individual requests to major electric power companies and solicited their feedback. As a result, the maintenance work schedule of planned outages of generators was coordinated to avoid summer or winter peak periods. However, based on the actual conditions or feedback from the electric power companies, it cannot be expected that greater coordination of the maintenance work schedule will occur in the future simply by request from the Organization due to constraints of workers and economic reasons.

· Moves were made to ensure a balance of supply and demand, such as canceling discontinuance plans of generators, taking into account supply–demand conditions during the severe cold of the previous winter in 50 Hz areas.

<u>Movement toward decreasing supply capacity</u>

· The demand forecasts of retail or generation departments of former general electric utilities indicate a significant loss in their shares in their own regional service areas, and they plan their generators anew based on their demand forecasts. They intend to actively utilize an electronic bulletin board system for information on generating facilities (launched by the Organization in April 2019) before the stage of deciding on generator discontinuance plans in their companies, thereby maintaining the generators in a rapid power-generatable mode in anticipation of launching the capacity market.

· Under the condition that competition between retail departments of former electric utilities becomes fierce, such retail companies (including companies consisting of those majorly funded by former electric utilities) will indicate the tendency of their supply capacity as "unspecified procurement," as is the case with other PPSs in external areas other than in their own service areas.

Given the tendencies stated above, the Organization has aggregated the supply–demand balance of electric supply plans for FY 2019, and reached the projection that the adequate reserve margin of 8% will be secured in the supply–demand balance with the utilization of cross-regional interconnection lines in both the short- and the mid-to-long term.

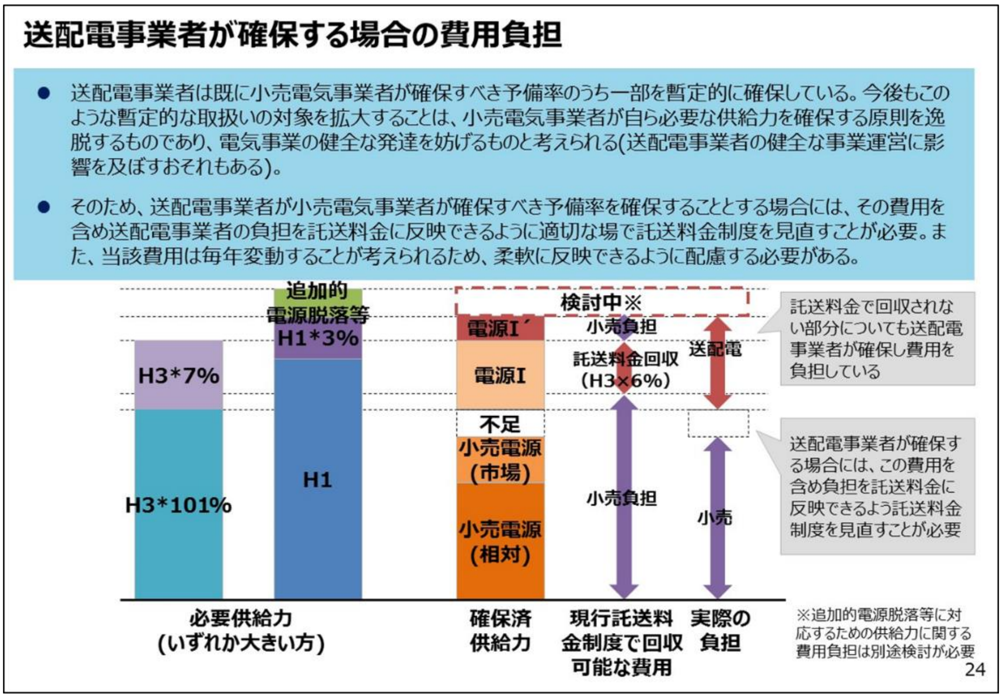
From the perspective of enhancing the resilience of the electric power grid, there are discussions on the necessary reserve capacity against severe weather or rare occurrence risk, and on the evaluation method for calculating renewable energy generation (kW value). The Organization recognizes that the necessary supply capacity will be secured if maintenance work schedules are adequately coordinated and discontinued generators are effectively utilized.

However, it cannot be denied that more generators will be discontinued or retired until FY 2024 when supply capacity is secured in the capacity market. If retail companies are projected to fail to secure the necessary supply capacity, GT&D companies independently have to secure supply capacity as an unavoidable response during the transition period.

The Organization will review the details of the supply capacity-securing scheme including the requirement for generators to clearly and flexibly implement securing supply capacity measures such as coordination of maintenance work schedules of generators, delayed discontinuance of generators, or restoring generators with appropriate timing. The Organization recommends the Government to examine institutional measures including cost allocation and the accompanying security of generators.

In parallel with the above-stated actions and the circumstances outlined in which it is crucial to finely and successively perceive the security of supply capacity in the future, the Organization will focus on the apprehension of discontinuance or retirement of generators in advance, and explore measures such as the utilization of an electronic bulletin board system for information on generating facilities, which aims at effective utilization of generators to be discontinued or retired.

<Reference 1> Review by the National Council



Source: Documents from the 29th task forth meeting of the Strategic Policy Subcommittee, Electricity and Gas Industry Committee, Advisory Committee for Natural Resources and Energy (February 28, 2019)

The original document [only in Japanese] is available at
https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/seido_kento/pdf/029_03_01.pdf

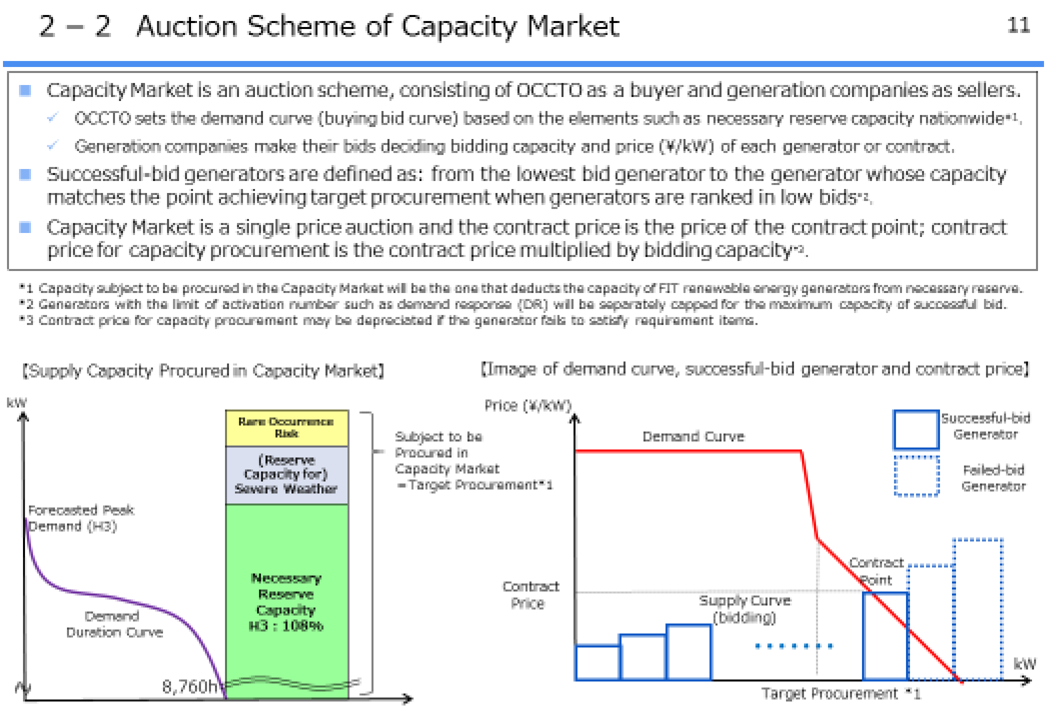
ii. Ideal electricity supply plan after the launch of the capacity market

Currently, supply capacity has been reviewed with respect to whether the necessary capacity is secured in the electricity supply plan. At the same time, a detailed review has been undertaken for the launch of the capacity market, after which the necessary supply capacity will be secured in the market scheme. Increased implementation of securing the supply capacity under the tendency that supply capacity is defined as "unspecified procurement" or "generation without sales destination" is vital.

Regarding the electricity supply plan after the launch of the capacity market, there will be an overlap with the capacity market in terms of aims and roles; these will be distinguished from the current plan for contents and items required for each business license (retail companies, generation companies, and GT&D companies). Therefore, the electricity supply plan will be changed to become a more efficient and effective scheme in the future by clarifying the aims and roles of each business license.

The Organization will review the information to be collected and the aims of the electricity supply plan in anticipation of review of the imbalance tariff system examined by the National Council, such as the Strategic Policy Subcommittee of the Advisory Committee for Natural Resources and Energy, and the Meeting for System Design of Electricity and Gas Market Surveillance Commission, and the balancing capacity market after outlining the information to be secured in the capacity market scheme. The Organization recommends the Government to proceed to examine the ideal electricity supply plan after launching the capacity market in cooperation with the Organization.

<Reference 2> Supply capacity procured in the capacity market



Source: Documents from the Capacity Market Orientation Meeting in March 2019
The original document [only in Japanese] is available at
http://www.occto.or.jp/kaiin/oshirase/files/youryou_setsumei0311.pdf

iii. Balancing capacity toward strengthening resilience of the power grid under the greater integration of renewable energy generation

With publication of the interim report of the Working Group on Electricity Resilience, the Organization continues to review the subject scope of supply capacity in the capacity market to include measures against severe weather or rare occurrence risk; these stand in aspect of adequacy (necessary capacity) of the supply capacity.

Regarding the events that might have led to a power shortage in the Chubu EPCO area due to output decrease of solar power in cloudy weather and demand increase in severe cold in January 2019, it is suggested that maintaining the supply–demand balance requires not only ensuring sufficient supply adequacy but also securing and operating the balancing capacity.

In relation to the abovementioned events, the ideal balancing capacity has been currently reviewed by the Subcommittee on Greater Introduction of Renewable Energy and Advanced Electric Network; balancing capacity will be secured by changing the procurement of Generator I' to year-round operation for the time being. Beyond launching the balancing market, the balancing capacity will be secured by procuring delta kW of Replacement Reserve for FIT and to be operated.

The Organization will proceed to review the ideal balancing capacity and its operation toward launching the balancing market in anticipation of greater integration of renewable energy generation. The Organization recommends the Government to examine a detailed system design such as an imbalance tariff system or cost allocation method.

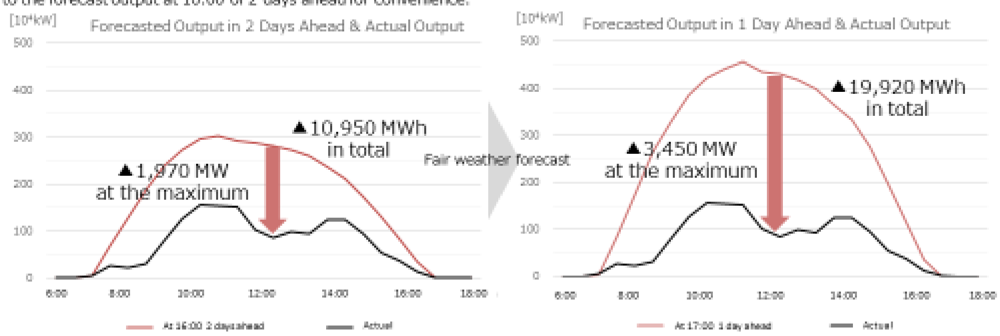
<Reference 3> Supply–demand state in the Chubu EPCO area on January 10, 2019

Forecast Error in Output of Solar Power with FIT Exceptional Contract

8

- Output forecast for solar power generation (distribution of output for FIT exceptional contract type 1) is implemented at 16:00 of 2 days ahead.
- The forecast output of solar power generation for January 10 was substantially higher than the actual output by 1,970 MW in capacity at the maximum and 10,950 MWh in total energy generated.
- In addition, weather forecast after 16:00 of 2 days ahead assumed fair weather, output forecasts afterward were further risen; the difference between forecast at 17:00 of 1 day ahead and actual output has become larger by 3,450 MW in capacity at the maximum and 19,920 MWh in total energy generated.

*For output forecast of solar power of FIT exceptional contract type 3 is implemented in the previous day, the forecast output was added to the forecast output at 16:00 of 2 days ahead for convenience.



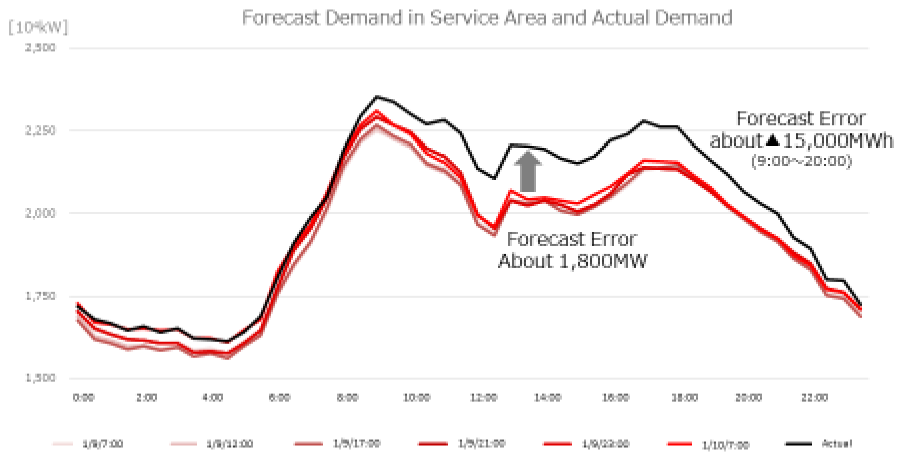
	1/8/16:00	1/9/7:00	1/9/12:00	1/9/17:00	1/9/21:00	1/9/23:00	1/10/7:00
Maximum Error [10^4kW]	197	278	345	345	340	316	276
Total Forecasted Error [10^4kWh]	1,095	1,537	1,992	1,992	1,820	1,608	1,401

<Reference 4> Supply–demand state in the Chubu EPCO area on January 10, 2019

Forecast Demand and Actual Demand

11

- Demand forecasts for January 10 by Chubu EPCO from the previous day to the current morning were lower than the actual demand with average value of 5 to 6%, and 1,800 MW in capacity at the maximum, and 15,000 MWh in energy required.
- Despite of demand forecast review of 5 times in total from the previous morning to the current morning, the actual demand was substantially higher compared with all reviewed forecast.



Source of References 3 and 4:Document 2-1 from the 36th Meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply–Demand Balance Evaluation (February 19, 2019)
The original document [only in Japanese] is available at
https://www.occto.or.jp/iinkai/chouseiryoku/2018/files/chousei_jukyu_36_02_01.pdf

<Reference 5> Review by the National Council

必要な調整力の具備についての検討の方向性 73

- 自然変動電源（太陽光・風力）の導入量の増加に伴い、必要となる調整力が増大し得るが、**適切な量の調整力を確保し、費用回収するための仕組みの構築が必要**。
- かかる問題意識から、第４回の本小委において、現在の**「ピーク需要の７％」という調整力確保の基準が十分か、定量的に検証した上で負担の在り方についても検討が必要**ではないか、という問題提起をしたところ。
- この点、別途、レジリエンス強化の観点から、別の審議会において「暫定的に追加確保すべき予備力」の議論を進めているところであるが、**再エネ主力電源化に向けて必要な調整力を具備するために、どのような検討を進めるべきか**。
- また、**再生可能エネルギー主力電源化、及びレジリエンス強化双方の観点から、グリッドコードの整備の在り方について検討を深化**させるべきではないか。

Source: Document 4 from the 11th Meeting of the Subcommittee on Greater Introduction of Renewable Energy and Advanced Electric Network, Committee on Energy Efficiency and Renewable Energy/ Electricity and Gas Industry Committee, Advisory Committee for Natural Resources and Energy (December 16, 2018)
The original document [only in Japanese] is available at
https://www.meti.go.jp/shingikai/enecho/denryoku_gas/saisei_kano/pdf/011_04_00.pdf

<Reference 6> Review by the National Council

Ⅲ－２．適切な調整力の確保
３．目指すべき自然変動再エネの出力調整の在り方
（２）再エネ予測誤差に対応するための調整力の費用負担

【アクションプラン】

- 一般送配電事業者による出力予測の予測誤差自体を減らすなど、再生可能エネルギーに起因するインバランスを小さくし、国民負担の抑制を図るため、データの予測精度や運用実態、全体のインバランス設計も踏まえ、実現可能な方策について検討を進める。
【➡資源エネルギー庁、電力・ガス取引監視等委員会、広域機関、一般送配電事業者（2019年度中目途）】
- 一般送配電事業者による再エネ予測誤差の削減について広域機関が適正に監視・確認する仕組みとした上で、なお生じざるを得ない相応の予測誤差が残る場合には、予測誤差を削減し確保するべき調整力を減らすインセンティブが働くようにしつつ、その調整力の確保にかかる費用を FIT 交付金により負担する仕組みを構築する。
【➡資源エネルギー庁、電力・ガス取引監視等委員会、広域機関（2020 年度を目途に具体化）】

Source: The Second Interim Report of the Subcommittee on Greater Introduction of Renewable Energy and Advanced Electric Network Committee on Energy Efficiency and Renewable Energy/ Electricity and Gas Industry Committee, Advisory Committee for Natural Resources and Energy (January 28, 2019)
The original document [only in Japanese] is available at
https://www.meti.go.jp/shingikai/enecho/denryoku_gas/saisei_kano/pdf/20190128001_01.pdf

VIII. Conclusions

1. Electricity Demand Forecast

The AAGRs of both peak demand nationwide (average of the three highest daily loads) and electric energy requirement nationwide in the mid-to-long term are forecast to decrease by 0.1%. AAGRs have become negative, and this is attributable to a number of major factors, such as efforts to reduce electricity use, wider utilization of energy-saving electric appliances, a shrinking population, and load-levelling measures.

2. Electricity Supply and Demand

Regarding the supply–demand balance evaluation in each regional service area during the 10-year period, the criterion of a stable supply, i.e., a reserve margin of 8% (supply capacity over peak demand by deducting the capacity of the largest generating unit and balancing capacity with frequency control [Generator I] in Okinawa) is projected to be secured in all areas and years by sharing power from other areas with sufficient supply capacity through cross-regional interconnection lines. The Organization will continuously and carefully evaluate the supply–demand balance, by monitoring the submission of changing supply plans and the accompanying supply–demand balance.

3. Analysis of the Transition of Power Generation Sources Nationwide

Regarding the transitions of installed power generation capacity and gross electricity generation, renewable energy such as solar power is projected to increase greatly; at the same time, coal and LNG will increase their capacity but remain the same or decrease in terms of energy generation. For nuclear power plants, energy generations calculated as zero for their capacity is reported as “uncertain”.

4. Development Plans for Transmission and Distribution Facilities

Regarding the development plans for major transmission lines or substations, there are no changes for cross-regional interconnection lines from the previous year’s plans.

5. Cross-Regional Operation

For procuring supply capacity or energy from the external service areas, aggregated results are almost the same in both the areas with higher procurement from the external service areas and in the areas with higher transmission to the external areas.

6. Analysis of Characteristics of Electric Power Companies

Distributions are calculated for retail companies and generation companies according to business scale and business areas, and aggregated to the projection during the 10-year period. In addition, the ratios of the secured supply capacity are reviewed. In particular, small-to-medium-sized retail companies have planned their supply capacity as “unspecified procurement,” as in the previous year's plan. As a result, the ratios of the secured supply capacity indicate declining tendency.

7. Findings and Challenges

The Organization has communicated its opinions to the Minister of Economy, Trade and Industry concerning three major challenges relating to electricity supply plans, the ideal evaluation method for the supply–demand balance, and current challenges in the electricity business in relation to the aggregation of electricity supply plans for FY 2019.

Attached are the Appendices on the aggregation of the electricity supply plans.

APPENDIX 1 Supply–Demand Balance for FY 2019

Tables A1-1 to A1-4 show the monthly peak demand, monthly supply capacity, monthly reserve capacity, and reserve margin for each regional service area in FY 2019, respectively. Table A1-5 shows the monthly projection of the reserve margin for each regional service area recalculated with power exchanges to areas below the 8% reserve margin from areas with over 8% reserve margin.

Table A1-1 Monthly Peak Demand Forecast for Each Regional Service Area

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	403	369	365	407	420	401	415	456	486	499	493	459
Tohoku	1,060	975	1,047	1,262	1,270	1,145	1,067	1,187	1,312	1,375	1,360	1,268
Tokyo	3,848	3,649	4,081	5,311	5,311	4,512	3,695	4,026	4,382	4,698	4,698	4,312
50 Hz area Total	5,311	4,993	5,493	6,980	7,001	6,058	5,177	5,669	6,180	6,572	6,551	6,039
Chubu	1,837	1,905	2,056	2,416	2,416	2,188	1,961	1,964	2,215	2,311	2,311	2,149
Hokuriku	373	372	410	495	495	458	373	424	476	499	499	471
Kansai	1,847	1,842	2,141	2,607	2,607	2,308	1,913	1,993	2,367	2,420	2,420	2,176
Chugoku	756	757	842	1,028	1,028	911	779	837	998	1,016	1,016	909
Shikoku	350	355	402	503	503	441	364	375	464	464	464	414
Kyushu	1,044	1,044	1,157	1,484	1,482	1,320	1,162	1,179	1,486	1,506	1,506	1,281
60 Hz area Total	6,207	6,274	7,008	8,533	8,531	7,625	6,551	6,772	8,006	8,216	8,216	7,400
Interconnected	11,518	11,267	12,501	15,513	15,532	13,683	11,728	12,441	14,186	14,788	14,767	13,439
Okinawa	104	121	139	148	148	143	132	112	99	104	103	97
Nationwide	11,623	11,389	12,640	15,661	15,680	13,826	11,861	12,552	14,285	14,892	14,870	13,536

Table A1-2 Monthly Projection of Supply Capacity for Each Regional Service Area

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	549	544	573	493	513	501	497	545	608	597	599	568
Tohoku	1,270	1,236	1,224	1,443	1,416	1,294	1,171	1,330	1,460	1,525	1,523	1,425
Tokyo	4,624	4,773	4,846	5,761	5,773	5,531	4,574	4,692	5,260	5,561	5,481	5,336
50 Hz area Total	6,442	6,553	6,643	7,697	7,702	7,326	6,243	6,566	7,327	7,683	7,603	7,329
Chubu	2,332	2,306	2,461	2,618	2,660	2,577	2,335	2,301	2,409	2,545	2,584	2,527
Hokuriku	478	461	471	575	550	529	422	458	541	546	545	547
Kansai	2,412	2,308	2,441	2,778	2,751	2,678	2,293	2,390	2,573	2,706	2,673	2,553
Chugoku	938	923	984	1,157	1,143	1,045	929	942	1,004	1,102	1,116	1,060
Shikoku	500	497	523	605	584	507	450	472	537	483	489	424
Kyushu	1,415	1,315	1,304	1,627	1,553	1,443	1,351	1,366	1,566	1,650	1,644	1,610
60 Hz area Total	8,075	7,809	8,184	9,359	9,241	8,778	7,781	7,930	8,631	9,033	9,049	8,719
Interconnected	14,517	14,362	14,827	17,056	16,944	16,105	14,023	14,496	15,958	16,716	16,652	16,049
Okinawa	162	172	188	197	197	198	194	172	172	177	184	179
Nationwide	14,679	14,535	15,016	17,253	17,141	16,303	14,218	14,668	16,130	16,893	16,836	16,228

Table A1-3 Monthly Projection of Reserve Capacity for Each Regional Service Area

[10^4kW]

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	146	175	208	86	93	100	82	89	122	98	106	109
Tohoku	210	261	177	181	146	150	104	143	148	150	163	157
Tokyo	776	1,124	765	450	462	1,019	879	666	878	863	783	1,024
50 Hz area Total	1,131	1,560	1,150	717	701	1,269	1,066	897	1,147	1,111	1,052	1,290
Chubu	495	401	405	202	244	389	374	337	194	234	273	378
Hokuriku	105	89	61	79	55	71	50	34	65	47	46	76
Kansai	565	466	300	170	144	370	380	397	206	286	253	377
Chugoku	182	166	142	129	115	134	150	105	6	86	100	151
Shikoku	150	142	121	102	81	66	86	97	73	19	25	10
Kyushu	371	271	147	142	72	123	189	187	80	144	138	329
60 Hz area Total	1,867	1,535	1,176	826	710	1,153	1,229	1,158	625	817	833	1,320
Interconnected	2,998	3,095	2,326	1,543	1,411	2,422	2,295	2,056	1,772	1,928	1,885	2,610
Okinawa	58	51	50	49	50	55	62	60	73	73	80	82
Nationwide	3,056	3,146	2,376	1,592	1,461	2,477	2,357	2,116	1,846	2,001	1,966	2,692

Table A1-4 Monthly Projection of Reserve Margin for Each Regional Service Area
(resources within own service area only, at the sending end; see Table 2-3)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	36.2%	47.4%	57.0%	21.1%	22.2%	24.9%	19.7%	19.5%	25.0%	19.6%	21.5%	23.8%
Tohoku	19.8%	26.8%	16.9%	14.3%	11.5%	13.1%	9.8%	12.0%	11.3%	10.9%	12.0%	12.4%
Tokyo	20.2%	30.8%	18.7%	8.5%	8.7%	22.6%	23.8%	16.5%	20.0%	18.4%	16.7%	23.8%
50 Hz area Total	21.3%	31.2%	20.9%	10.3%	10.0%	20.9%	20.6%	15.8%	18.6%	16.9%	16.1%	21.4%
Chubu	26.9%	21.1%	19.7%	8.4%	10.1%	17.8%	19.0%	17.2%	8.7%	10.1%	11.8%	17.6%
Hokuriku	28.1%	24.0%	15.0%	16.1%	11.0%	15.6%	13.3%	8.1%	13.7%	9.4%	9.3%	16.2%
Kansai	30.6%	25.3%	14.0%	6.5%	5.5%	16.0%	19.9%	19.9%	8.7%	11.8%	10.4%	17.3%
Chugoku	24.1%	21.9%	16.8%	12.6%	11.2%	14.8%	19.3%	12.6%	0.6%	8.4%	9.8%	16.6%
Shikoku	42.9%	39.9%	30.1%	20.2%	16.1%	14.9%	23.8%	26.0%	15.8%	4.2%	5.3%	2.4%
Kyushu	35.5%	26.0%	12.7%	9.6%	4.8%	9.3%	16.3%	15.9%	5.4%	9.6%	9.1%	25.7%
60 Hz area Total	30.1%	24.5%	16.8%	9.7%	8.3%	15.1%	18.8%	17.1%	7.8%	9.9%	10.1%	17.8%
Interconnected	26.0%	27.5%	18.6%	9.9%	9.1%	17.7%	19.6%	16.5%	12.5%	13.0%	12.8%	19.4%
Okinawa	55.3%	41.9%	35.7%	33.1%	33.5%	38.1%	46.9%	53.9%	73.8%	70.3%	78.0%	84.3%
Nationwide	26.3%	27.6%	18.8%	10.2%	9.3%	17.9%	19.9%	16.9%	12.9%	13.4%	13.2%	19.9%

Below Criteria of 8%

Table A1-5 Monthly Projection of Reserve Margin for Each Regional Service Area
(with power exchange through cross-regional interconnection lines, at the sending end; see Table 2-4)

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Hokkaido	21.3%	29.8%	45.2%	11.3%	12.4%	19.2%	19.6%	16.0%	16.9%	15.4%	14.6%	22.3%
Tohoku	21.3%	28.9%	17.8%	11.3%	9.0%	19.2%	19.6%	16.0%	16.9%	15.4%	14.6%	19.3%
Tokyo	21.3%	28.9%	17.8%	9.8%	9.0%	19.2%	19.6%	16.0%	16.9%	15.4%	14.6%	19.3%
Chubu	30.1%	26.3%	17.8%	9.8%	9.0%	16.8%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Hokuriku	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Kansai	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Chugoku	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Shikoku	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.3%
Kyushu	30.1%	26.3%	17.8%	9.8%	9.0%	16.4%	19.6%	17.0%	9.1%	11.1%	11.3%	19.5%
Interconnected	26.0%	27.5%	18.6%	9.9%	9.1%	17.7%	19.6%	16.5%	12.5%	13.0%	12.8%	19.4%
Okinawa	55.3%	41.9%	35.7%	33.1%	33.5%	38.1%	46.9%	53.9%	73.8%	70.3%	78.0%	84.3%
Nationwide	26.3%	27.6%	18.8%	10.2%	9.3%	17.9%	19.9%	16.9%	12.9%	13.4%	13.2%	19.9%

Improved to over 8%

APPENDIX 2 Long-Term Supply–Demand Balance for the 10-year Period FY 2019–2028

Tables A2-1 to A2-4 show a 10-year projection of the annual peak demand, annual supply capacity, annual reserve capacity, and reserve margin for each regional service area from FY 2019 to FY 2028, respectively. Table A2-5 shows the annual projection of the reserve margin for each regional service area recalculated with power exchanges from areas with over 8% reserve margin to areas below the 8% reserve margin. Tables A2-6 to A2-9 show a 10-year projection of the annual peak demand, annual supply capacity, annual reserve capacity, and reserve margin for winter peak areas of Hokkaido and Tohoku, respectively.

Table A2-1 Annual Peak Demand Forecast for Each Regional Service Area (at 17:00 in August)

[10^4kW]

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	420	420	419	419	419	418	418	418	418	418
Tohoku	1,270	1,268	1,267	1,263	1,259	1,254	1,249	1,244	1,239	1,234
Tokyo	5,132	5,109	5,112	5,115	5,118	5,122	5,127	5,131	5,148	5,152
50 Hz area Total	6,822	6,797	6,798	6,797	6,796	6,794	6,794	6,793	6,805	6,804
Chubu	2,416	2,419	2,407	2,397	2,386	2,375	2,365	2,354	2,357	2,346
Hokuriku	495	495	495	495	495	495	494	494	494	494
Kansai	2,607	2,597	2,588	2,581	2,574	2,567	2,560	2,552	2,545	2,538
Chugoku	1,028	1,030	1,029	1,027	1,025	1,024	1,022	1,020	1,019	1,017
Shikoku	496	495	494	492	491	490	488	487	486	485
Kyushu	1,544	1,544	1,544	1,544	1,545	1,545	1,546	1,546	1,547	1,547
60 Hz area Total	8,586	8,579	8,556	8,536	8,516	8,496	8,475	8,453	8,448	8,427
Interconnected	15,408	15,377	15,354	15,332	15,312	15,289	15,269	15,246	15,253	15,231
Okinawa	148	149	150	150	151	152	152	153	153	154
Nationwide	15,556	15,526	15,504	15,483	15,463	15,441	15,421	15,399	15,406	15,385

Table A2-2 Annual Projection of Supply Capacity for Each Regional Service Area (at 17:00 in August)

[10^4kW]

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	513	509	573	576	580	581	582	580	627	627
Tohoku	1,416	1,379	1,500	1,515	1,514	1,521	1,521	1,549	1,550	1,551
Tokyo	5,594	5,743	5,614	5,452	5,623	5,740	5,975	5,940	5,944	5,951
50 Hz area Total	7,523	7,631	7,688	7,543	7,717	7,842	8,077	8,069	8,121	8,129
Chubu	2,660	2,642	2,432	2,498	2,501	2,504	2,496	2,501	2,503	2,503
Hokuriku	550	553	545	544	544	543	537	536	535	535
Kansai	2,751	2,895	2,674	2,700	2,756	2,759	2,646	2,662	2,663	2,663
Chugoku	1,143	1,196	1,227	1,140	1,175	1,177	1,181	1,183	1,180	1,181
Shikoku	576	645	561	549	595	594	594	595	595	595
Kyushu	1,684	1,801	1,783	1,799	1,813	1,733	1,734	1,715	1,718	1,718
60 Hz area Total	9,364	9,732	9,222	9,229	9,384	9,310	9,189	9,193	9,195	9,194
Interconnected	16,887	17,364	16,910	16,772	17,102	17,151	17,266	17,262	17,316	17,323
Okinawa	201	211	204	208	202	214	214	214	214	214
Nationwide	17,088	17,575	17,113	16,980	17,303	17,365	17,480	17,476	17,530	17,537

Table A2-3 Annual Projection of Reserve Capacity for Each Regional Service Area (at 17:00 in August)

[10^4kW]

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	93	89	154	157	161	163	164	162	209	209
Tohoku	146	111	234	253	256	267	272	305	311	317
Tokyo	462	634	502	337	505	618	848	809	796	799
50 Hz area Total	701	834	890	746	922	1,048	1,284	1,276	1,316	1,325
Chubu	244	223	25	101	115	129	131	147	146	157
Hokuriku	55	58	50	49	49	48	44	43	42	41
Kansai	144	298	85	119	182	192	86	110	119	125
Chugoku	115	166	198	113	150	153	159	163	161	164
Shikoku	80	150	67	57	104	104	106	108	109	110
Kyushu	140	258	240	255	268	188	188	169	170	170
60 Hz area Total	778	1,153	666	693	868	814	714	740	747	767
Interconnected	1,479	1,987	1,556	1,440	1,790	1,862	1,997	2,016	2,063	2,092
Okinawa	53	63	54	58	51	62	62	61	61	60
Nationwide	1,532	2,050	1,610	1,498	1,841	1,924	2,059	2,077	2,123	2,152

Table A2-4 Annual Projection of Reserve Margin for Each Regional Service Area
(resource within own service area only, at 17:00 in August, at the sending end; see Table 2-8)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	22.2%	21.3%	36.8%	37.4%	38.5%	39.0%	39.3%	38.7%	50.0%	50.1%
Tohoku	11.5%	8.7%	18.5%	20.0%	20.3%	21.3%	21.8%	24.6%	25.1%	25.7%
Tokyo	9.0%	12.4%	9.8%	6.6%	9.9%	12.1%	16.5%	15.8%	15.5%	15.5%
50 Hz area Total	10.3%	12.3%	13.1%	11.0%	13.6%	15.4%	18.9%	18.8%	19.3%	19.5%
Chubu	10.1%	9.2%	1.0%	4.2%	4.8%	5.4%	5.6%	6.3%	6.2%	6.7%
Hokuriku	11.0%	11.7%	10.2%	9.9%	9.9%	9.8%	8.8%	8.6%	8.4%	8.3%
Kansai	5.5%	11.5%	3.3%	4.6%	7.1%	7.5%	3.4%	4.3%	4.7%	4.9%
Chugoku	11.2%	16.2%	19.3%	11.0%	14.6%	15.0%	15.6%	16.0%	15.8%	16.1%
Shikoku	16.1%	30.2%	13.6%	11.5%	21.2%	21.2%	21.7%	22.1%	22.5%	22.8%
Kyushu	9.1%	16.7%	15.5%	16.5%	17.3%	12.1%	12.1%	10.9%	11.0%	11.0%
60 Hz area Total	9.1%	13.4%	7.8%	8.1%	10.2%	9.6%	8.4%	8.7%	8.8%	9.1%
Interconnected	9.6%	12.9%	10.1%	9.4%	11.7%	12.2%	13.1%	13.2%	13.5%	13.7%
Okinawa	35.7%	42.1%	36.1%	38.5%	33.9%	41.1%	40.7%	40.0%	39.5%	39.0%
Nationwide	9.8%	13.2%	10.4%	9.7%	11.9%	12.5%	13.4%	13.5%	13.8%	14.0%

Below Criteria of 8%

Table A2-5 Annual Projection of Reserve Margin for Each Regional Service Area
(with power exchanges through cross-regional interconnection lines, at the sending end; see Table 2-8)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	12.4%	12.3%	27.6%	27.2%	28.3%	28.8%	29.0%	29.0%	40.4%	40.4%
Tohoku	9.5%	12.3%	9.6%	8.7%	11.2%	11.7%	14.6%	14.8%	14.6%	13.2%
Tokyo	9.5%	12.3%	9.6%	8.7%	11.2%	11.7%	14.6%	14.8%	14.6%	13.2%
Chubu	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Hokuriku	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Kansai	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Chugoku	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Shikoku	9.5%	13.4%	9.6%	8.7%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Kyushu	9.5%	13.4%	9.9%	10.5%	11.2%	11.7%	11.1%	11.3%	11.4%	12.8%
Interconnected	9.6%	12.9%	10.1%	9.4%	11.7%	12.2%	13.1%	13.2%	13.5%	13.7%
Okinawa	35.7%	42.1%	36.1%	38.5%	33.9%	41.1%	40.7%	40.0%	39.5%	39.0%
Nationwide	9.8%	13.2%	10.4%	9.7%	11.9%	12.5%	13.4%	13.5%	13.8%	14.0%

Improved to over 8%

Table A2-6 Annual Peak Demand Forecast for Winter Peak Areas of Hokkaido and Tohoku (at 18:00 in January)

[10^4kW]

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	499	499	498	498	497	497	497	496	496	496
Tohoku	1,375	1,373	1,371	1,368	1,364	1,360	1,356	1,352	1,348	1,344

Table A2-7 Annual Projection of Supply Capacity for Winter Peak Areas of Hokkaido and Tohoku (at 18:00 in January)

[10^4kW]

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	597	599	571	580	580	581	582	631	631	631
Tohoku	1,525	1,508	1,524	1,539	1,538	1,541	1,542	1,568	1,571	1,572

Table A2-8 Annual Projection of Reserve Capacity for Winter Peak areas of Hokkaido and Tohoku (at 18:00 in January)

[10^4kW]

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	98	100	73	82	83	84	85	135	135	135
Tohoku	150	135	153	171	174	181	186	216	223	228

Table A2-9 Annual Projection of Reserve Margin for Winter Peak Areas of Hokkaido and Tohoku
(at 18:00 in January; see Table 2-10)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hokkaido	19.6%	20.1%	14.7%	16.5%	16.8%	17.0%	17.1%	27.2%	27.2%	27.2%
Tohoku	10.9%	9.8%	11.2%	12.5%	12.8%	13.3%	13.7%	16.0%	16.5%	16.9%

V. Review of the Adequate Level of Balancing Capacity in Each Regional Service Area

Evaluation of Proper Standard of Soliciting Balancing Capacity for FY 2020

[only in Japanese]

http://www.occto.or.jp/houkokusho/2019/files/20190724_chousei_hitsuyoryo_kentoukekka.pdf

July 2019

Organization for Cross-regional Coordination of Transmission Operators, Japan

VI. Research and Study

・Research on Balancing Market in Overseas

"Overseas Report of Research on Balancing Market" (July 2018)

[in Japanese only]

http://www.occto.or.jp/iinkai/chouseiryoku/files/jukyuchousei_kaigaicyousa_houkokusyo.pdf

・Research on Policy on Cross-regional Networks in Overseas

"Overseas Report of Rules and Actual Operations of Transmission Network" (March 2019) *[in Japanese only]*

http://www.occto.or.jp/iinkai/kouikikeitouseibi/files/2018kaigaihoukokusyo.pdf

・Network Simulation Study on the Major Blackout by the 2018 Hokkaido Eastern Iburi Earthquake

"Final Report of the Major Blackout by the 2018 Hokkaido Eastern Iburi Earthquake" (December 2018)

http://www.occto.or.jp/iinkai/hokkaido_kensho/files/Final_report_hokkaido_blackout.pdf

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