

Tightening Electricity Supply-Demand Balance in 2022 and Challenges for 2030 Energy Mix

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Since the beginning of 2021, Japan has seen multiple cases in which rapid electricity demand growth amid severe weather conditions (unexpected heat and cold waves), a demand increase accompanying a recovery from the COVID-19 crisis, a drop in fossil-fired power generation capacity and other factors were combined to affect stable electricity supply. This paper reviews such cases in 2022 and summarizes relevant medium to long-term challenges, particularly those to strike a balance between the achievement of the 2030 energy mix goal and stable electricity supply.

1. Cases of tightening power supply-demand balance in 2022

Mid-March outage and tightening supply-demand balance on occurrence of Fukushima Earthquake

In 2022, the electricity supply-demand balance tightened twice mainly in the Tokyo region. When an earthquake off Fukushima Prefecture on March 16 led some power plants in Tokyo and Tohoku regions to be shut down, an underfrequency relay was automatically activated, causing a temporary outage that affected about 2.1 million households. Later, power equipment troubles triggered the unscheduled suspension of equipment or power output decline for a total power generation capacity of some 3 million kilowatts in the service area of Tokyo Electric Power Company Holdings Inc.,¹ which were coupled with cold waves in the Kanto region to lower the power generation reserve margin² to 0% at an electricity demand peak on March 22.

Late June tightening supply-demand balance on occurrence of unusual heat waves

As the end of the annual rainy season was declared for the Kanto region on June 27,³ far earlier than usual, heat waves mainly in eastern Japan pushed peak electricity demand in the Tokyo region up to a level that was over 10% more than the 43.74 million kW in the June 27 week of 2018, the highest record since the electricity market deregulation (Figure 1). Then, the electricity supply-demand balance was feared to tighten mainly in the Tokyo region as the record rise in electricity

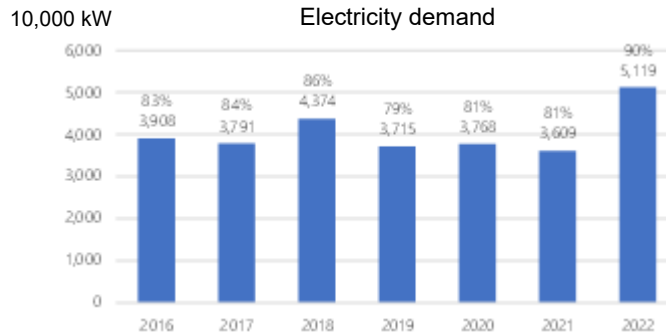
¹ Power generation information disclosure system, covering new power plant troubles in the relevant period.
<https://hjks.jepx.or.jp/hjks/outages>

² The power generation reserve margin, one of power supply stability indicators, represents the ratio of surplus power generation capacity to power demand. Usually, a margin of at least 3% is viewed as desirable for preparing for demand fluctuations and power plant troubles.

³ Later, the end of the rainy season was changed to around July 23.

demand was coupled with regular checks at some power plants ahead of the high—demand season.

Figure 1 Peak electricity demand in the June 27 week in the Tokyo region (weekly average)



* Percentages above bars represent supply capacity utilization rates (electricity demand/supply capacity)

Source: Prepared from data published by TEPCO Power Grid

In the face of the demand increase, TEPCO Power Grid postponed scheduled power plant checks to secure supply capacity and the Organization for Cross-regional Coordination of Transmission Operators made arrangements for procuring electricity from other regions. The government and Tokyo Electric Power Company Holdings provided preparatory information on the tightening supply-demand balance and requested electricity consumption savings through mass media and social networking services. Consequently, TEPCO Power Grid successfully secured the power generation reserve margin of 3-4% then and prevented any supply shortage.

Common points of the two cases: intermediate tightening and fossil-fired capacity decline

A common point of the two cases is that severe weather conditions triggered the tightening of the supply-demand balance in an intermediate period when regular checks on power plants are scheduled amid relatively lower electricity demand between January and August, when such tightening is a matter of concern due to annual demand peaks.

An apparent background factor is that less profitable fossil-fired power plants have been idled or decommissioned in line with the recent spread of renewable energy power generation and the restart of nuclear power plants, resulting in a decline in the electricity system’s capacity to adjust supply to a demand increase amid severe weather conditions. While the decrease in fossil-fired power generation capacity is unavoidable, power utilities are required to enhance measures for stable electricity supply, including the maintenance of indispensable capacity.

2. Challenges for this winter

After the two incidents, the first matter of concern is whether stable electricity supply could be secured in the winter of FY2022. If the winter is the coldest in a decade, the power generation

reserve margin is projected to range from 1.5% to 1.9% for seven regions from Tokyo to Kyushu,⁴ slipping below the threshold of 3% required for stable supply.⁵ If cold waves are coupled with any other adverse factor, electricity supply may fall short of satisfying demand.

The government and power utilities have debated and considered the potential supply shortages. In July, Prime Minister Fumio Kishida instructed then Economy, Trade and Industry Minister Koichi Hagiuda to secure the operation of nuclear power plants and the addition of some fossil-fired power generation capacity. Furthermore, the Organization for Cross-regional Coordination of Transmission Operators has assessed supply capacity in the winter, implemented risk assessment covering rare events and taken relevant measures.

However, risks for which Japan should prepare are not limited to a capacity shortage amid summer or winter peak demand. Capacity shortages triggered by severe weather conditions (and natural disasters like earthquakes) as seen in the intermediate period of 2022 and supply shortages caused by fuel supply interruptions amid the current Ukraine crisis are also matters of serious concern, for which Japan should prepare. A seesawing recovery from the COVID-19 crisis has made it difficult to anticipate electricity demand levels, complicating the problem of the tightening supply-demand balance. Particularly, the massive procurement of gas, which is relatively difficult to store, may entail the risk of failure to sell inventories when demand falls below anticipated levels.

3. Challenges for the 2030 energy mix target

Challenges for achieving the 2030 energy mix goal

The problem is not only for 2022 but also for the long term. I would like to assess challenges for stable electricity supply regarding the 2030 energy mix goal. Cited as such challenges are declining fossil-fired power generation capacity, uncertainties about renewable and nuclear energy power generation capacity, and fluctuating electricity demand.

➤ Declining fossil-fired power generation capacity

The 2030 energy mix goal in the sixth Strategic Energy Plan indicates that power generation would decline to 178 billion kilowatt-hours or 57% of the FY2021 level for coal-fired plants and to 187 billion kWh or 47% of the FY2021 level for liquefied natural gas-fired plants.

Power utilities' supply plans, as tabulated by the Organization for Cross-regional Coordination of Transmission Operators, indicate that power generation estimated for 2031 from power utilities' capacity plans would total 289.7 billion kWh for coal-fired plants and 323.0 billion

⁴ A document for the 74th meeting of a committee on adjustment capacity and supply-demand balance assessment by the Organization for Cross-regional Coordination of Transmission Operators (June 2022)

⁵ According to a document by the minister in charge of green transformation promotion on August 24, the estimated margin was raised to 3-4% for the Tokyo region and to 4-5% for the western Japan region.

kWh for gas-fired plants, deviating far from projections in the energy mix goal (Table 1). If coal-fired power generation capacity is reduced to meet the energy mix goal, dispatchable power capacity may decline faster than assumed in the supply plans, leading to doubts about stable supply.

Table 1 Power utilities' projected fossil-fired power generation capacity (100 million kWh)

	Results	Projections	
		Supply plans	6th Strategic Energy Plan
FY	2021	2031	2030
Fossil-fired capacity total	6,812	5,869	3,840
Coal	2,791	2,897	1,780
LNG	3,230	2,772	1,870
Oil, etc.	173	200	190

(Sources) Organization for Cross-regional Coordination of Transmission Operators: Tabulation of FY2022 supply plans
Agency for Natural Resources and Energy: Survey of Electric Power Statistics, 6th Strategic Energy Plan

➤ **Uncertainties about renewable and nuclear energy power generation capacity**

The energy mix goal indicates the ambitious expansion of nuclear and renewable energy power generation to achieve the greenhouse gas emission reduction goal of 46% from 2013 for 2030 in Japan's Nationally Determined Contribution. As for nuclear, Prime Minister Kishida in August vowed to restart seven more nuclear reactors from next summer in addition to the 10 restarted ones. If the 17 reactors operate at 80% of their capacity, their power generation will stand at around 120 billion kWh, far less than 188-206 billion kWh indicated in the energy mix goal, meaning that more nuclear reactors would be required to become operational.

Japan should make maximum efforts to increase these low-carbon power sources. Even if failing to reach the goal levels, Japan should secure sufficient power generation capacity.

➤ **Fluctuating electricity demand (Demand level and load curve fluctuations)**

Electricity demand fluctuations remain a key challenge.

Electricity demand at 864 billion kWh in the 2030 energy mix goal indicates an ambitious assumption that energy efficiency will improve 1.5 times faster than between 2013 and 2019. Without such energy efficiency improvement, electricity demand may become higher than projected.

Electricity demand curve changes may also be an attention-attracting factor. If electric vehicles diffuse further, electricity demand may increase further in the evening featuring a tighter supply-demand balance. This challenge could be eased through progress in the adjustment of supply and demand using demand responses and parked electric vehicles.

The tightening of the electricity supply-demand balance in 2022 indicated short to long-term challenges regarding stable electricity supply anew. It is indispensable for Japan to promote electricity system transition without affecting stable supply while GHG emission reduction initiatives are implemented toward the 2030 Nationally Determined Contribution goal and the 2050 carbon neutrality goal.