

Study Committee C5

Electricity markets and regulation

10727_2022

Dealing with a severe power shortage due to fuel shortage

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Background

- In Japan, we operated severe electricity supply-demand balance for about one month from late December in 2020 to mid-January in 2021. This problem mainly came from **energy (kWh) based supply shortage** due to **LNG fuel shortage**.
- Our paper and this poster summarize the investigation and measures to manage the risks.

Investigation for severe electricity supply-demand balance

- There were two main reasons. (Fig.1)
 - **Demand Increase.** Colder weather than expected made us consume much more energy.
 - **Supply Decrease.** Limited LNG-fired thermal generation output caused by reduced LNG inventories due to incidental troubles in LNG supply facilities around the world, etc..
 - In addition, there were structural background and incidental factors that led us to rely on LNG-fired.

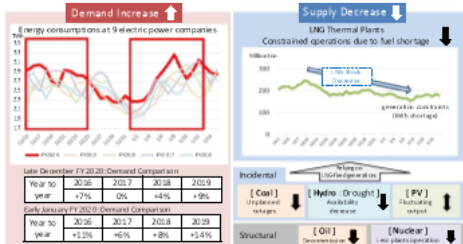


Fig.1 Factors of severe supply-demand balance (supply-demand side)

- Japan is an island country and relies on gas import. Difficulty in immediately procuring fuel due to lead time for procurement which is about 1 to 1.5 months from arranging LNG suppliers to transportation.
- As for Gas storage, tank storage at LNG terminals is more common rather than pipeline networks or underground storage with large capacities which is mainly used in European countries. (Fig.2)

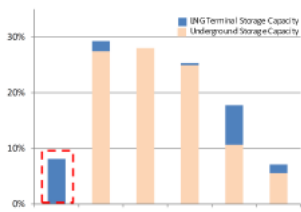


Fig.2 Gas storage capacity per annual demand

- Many LNG-fired thermal generation owners got concerns about fuel shortages. They decided to limit plant outputs in order to have enough stock until the additional fuel are procured. (Fig.3)
- As a result, the number of selling bids on the day-ahead market significantly decreased.

Measures to manage risks

- A list and details of the measures are provided in our paper, and the latest information is shown on the next page. The main measures are as follows:
 - Stable supply**
 - Measures to prevent plants retirement which is necessary for stable supply page2 (1)
 - Providing long-term predictability for promoting new investments achieving CN and stable supply page3 (3)
 - Managing risks for fuel shortage**
 - Adding Supply-demand balance outlook (kWh based)
 - Improving business environments for fuel security
 - Upgrading capacity market ; Securing kWh by requirements of capacity market
 - Fuel procurement preparing for kWh shortage that cannot be predicted by fuel storage outlook page2 (2)
 - Actions for market design**
 - Safety Net for kWh shortage
 - Activating hedge market and promoting risk managements
 - Demand reduction**
 - Restriction orders or conservation requests page3 (4)
 - Activation of demand response page3 (5)

Conclusion

- First of all, it is important to secure supply capacity (adequacy) over the future, and it is necessary to have new rules to encourage investment in power resources that meet the necessary supply capacity in each area.
- Fuel supplies are unstable around the world, and **securing fuel is also important**.

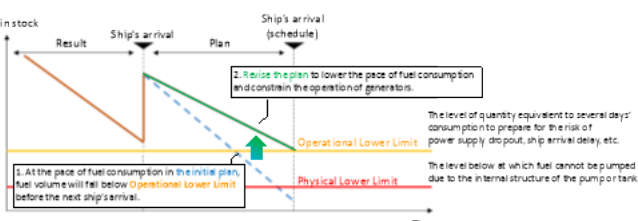


Fig.3 Image of limited generation output

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The latest information

(1) Measures to prevent plants retirement which is necessary for stable supply

- The capacity market starts in 2024, but the risk of severer electricity supply-demand is increasing because more power sources being idled or retired than new power sources being installed.
- To confirm availability for idleness or retirement of power sources, the government conducted a matching in November 2021 between generators owned power sources (100 MW or more) planned to be idled or retired during FY2022 and retailers wished to secure supply capacity. However, no contracts were concluded.
- The government considered it necessary to secure **additional supply capacity**, and it tentatively let TSOs offer publicly as similar to the reserve for severe weather since it takes time to develop the new rules.
 - **2022 winter (Jan. – Feb.)** : 550 MW was offered by the TSO in Tokyo to secure the necessary reserve ratio of 3% in Tokyo area.
 - **2022 summer (July –Aug.)** : The necessary reserve ratio of 3% had been secured, but in consideration of the uncertainties in both supply and demand, the government made the TSOs jointly offer 1,200 MW, equivalent to the unexpected outage risks of two standard thermal power units, as a kind of social insurance against unforeseen situation.
 - **2023 winter** : 3,600 MW is planned to be publicly offered, including the amount equivalent to 1% of the reserve ratio as social insurance, in addition to the amount short of 3% of the reserve ratio.
- On the basis of a reserve ratio of less than 8%, the TSOs order launching providers at least 3 hours before severe supply-demand balance happen, and providers bid in the market. In the case of failure to contract, the TSOs use them as the regulation power.
- The procurement cost of the TSOs' public offering is basically recovered from the revenues of the providers' market offering. If there is shortage for the procurement, the cost is recovered from the grid tariff.
- If the government considers it necessary to secure additional supply capacity, a public offering may be conducted in the future. The public offering is targeted mainly for idle thermal plants, but it is difficult to keep them in expectation of a public offering, and it is possible that they may be retired. Then, a framework for keeping idle plants that can be restarted for unforeseen events in the capacity market is being discussed.
- Securing more than the necessary amount is a temporary measure as the government's social insurance, but will it be integrated into the rules?

(2) Fuel procurement preparing for kWh shortage

- The government let the TSOs jointly publicly offer additional **kWh as a kind of social insurance** against unforeseen risks. The government noted that the additional kWh offer was different from fuel procurement by each operator on its own initiative.
- The concept of the procurement volume is as follows;
 - **2022 winter** : The volume is conservatively estimated from the viewpoint of minimizing social costs, then 300 GWh was offered. It is equivalent to about 1% of the 10-day electricity demand during the high-demand winter season.
 - **2022 summer** : The risk of fuel procurement is higher than ever due to the Russian-Ukrainian crisis and international fuel prices stay high, then 1,000 GWh was offered. It is equivalent to two LNG carriers (a standard LNG carrier is equivalent to about 500 GWh), as 2-3 times of 2022 winter volume.
- The additional kWh offers must be confirmed accountability for additionality based on the fuel procurement plan submitted to the government and based on the past demand plan for DR. Note that DR has not been contracted.
- Providers are required to bid on the wholesale power market for the entire contracted amount, and return a certain ratio of the revenue earned in the market to the TSOs. The procurement cost of the TSOs' public offering is basically recovered from the revenues of the providers' market offering. If there is shortage for procurement, the cost is recovered from the grid tariff.
- From the viewpoint of minimizing social cost, the bid hours were focus on when the market prices are higher than usual and the principle minimum market bid price was set based on marginal price of the general LNG-fired.
- Public offering may be conducted in the future if the government believes it is necessary to secure additional kWh. Measures to promote generators to secure enough fuel more than ever before, and to be taken when fuel supply and demand actually become tight (e.g., fuel flexibility across industry boundaries) will be considered. It is also important to maximize the use of renewable energy and nuclear power, which are not affected by fuel procurement risks such as LNG and coal.

	Offering amount	Bid amount	Successful bid amount	Successful tender amount	Average contract price
	(GWh)	(GWh)	(GWh)	(billion yen)	(yen/kWh)
2021 winter	300	496	419	15	35.88
2022 summer	1,000	930	930	33	36.04

	Offering amount	Bid amount	Successful bid amount	Successful tender amount	Average contract price
	(MW)	(MW)	(MW)	(billion yen)	(yen/kWh)
2021 winter	550	644	631	9	14,440
2022 summer	1,200	1,457	1357	11	7,761

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(3) Providing long-term predictability for promoting new investments

- In response to the stagnation of investments in large scale power sources due to long construction period and uncertain expectations of long-term recovery of large investment, "Long-term decarbonized power source auction" is discussed to secure long-term fixed revenues for new power source investments.
- It is planned to be implemented as a special auction, which is set in part of the capacity market, for new investments in decarbonized power sources.
- To ensure predictability of return on investment, income is earned for 20 years after the start of supply. If there is a provider who wish to apply for a longer period, this will be allowed.
- For each type of power source, supply start-up deadlines were set based on the general construction lead time. For example, 8 years for wind power.
- New projects will not be invested in unless the bid is successful, so the estimated other market revenue to be deducted in the bid of the capacity market will be estimated low. In the special auction, it will be set to zero, accordingly bids will be based on a fixed cost basis. However, actual other market revenues will be refunded at a certain percentage based on 90%, while considering the operation incentive.

(4) Restriction orders or conservation requests

- Electricity supply and demand for 2023 winter is forecasted to be the most severe since FY2012, when the effects of the Great East Japan Earthquake were still remaining. In addition to supply-side measures, demand-side measures are also important.
- During the severe supply-demand balance in Tokyo area in March 2022, proactive efforts to save electricity at home and workplaces led to avoid large-scale power outages due to supply shortages.
- Further review of the timing of alerts and the timing and method of power conservation requests are under consideration.
- There is no limit for demand measures, if the burden and disadvantage of demand suppression is excluded from consideration. How can the optimal combination of measures be found?

Restricted use order	Rolling blackout	Conservation request
Various customization of limits is possible Easy to grasp the amount of suppression	Easy to grasp the amount of suppression	The entire nation at large can cope with this without difficulty.
Requires a certain amount of time for preparation.	The burden will be on the entire nation at large. Difficult to coordinate with exempted facilities.	The effect gradually fades away. Difficult to grasp the amount of suppression.
1 month in advance to decide	The day before	Same day

(5) Activation of demand response

- To promote the use of DR, the government holds study sessions for retail electricity providers, as well as informing and encouraging industry.
- In order to promote the efficient use of electricity by consumers, it is effective to take an integrated approach to each of the three elements: increasing the registration rate for power-saving programs, increasing the participation rate, and increasing the amount of electricity saved.
- The government has decided to grant points worth 2,000 yen to households and 200,000 yen to corporations that join retailers' electricity conservation campaigns for the following winter.

Declining thermal power generators

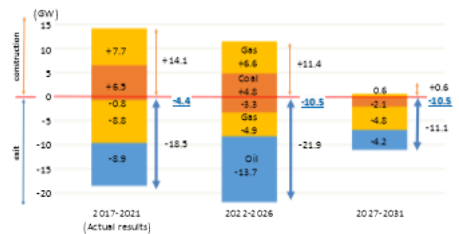


Fig.4 Outlook for thermal power supply capacity for the next 10 years

"Strategic Energy Plan" in Japan

- Updated in October 2021.
- Ambitious target because it cannot be reached by building on existing policies.
 - Achieve carbon neutrality by 2050
 - 46% reduction of greenhouse gas emissions in 2019-2030

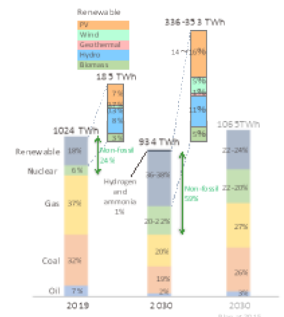


Fig.5 Plan for power supply composition