

Study Committee C5

Electricity markets and regulation

10728_2022

Evolution of Japanese market design and regulation to secure appropriate reliability and price rationalization

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【Capacity Market Background

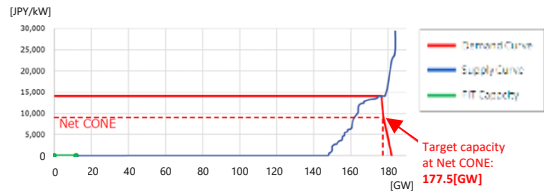
- Capacity market auction, a centralized nationwide single price (pay as clear) auction was held in 2020.
- As a result, capacity of approximately 168 GW(180GW if FIT capacity is included) was secured for 2024 and the clearing price was near the upper price limit set at 1.5 times Net CONE. (Figure 1)
- Including coherence with carbon neutrality for 2050 declared by the prime minister in 2020, several market development have been discussed and applied to the subsequent main auction for 2025.

Approach

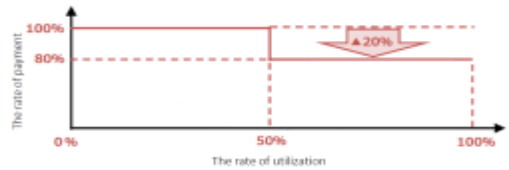
- Coherence with Carbon Neutrality for 2050(Figure 2)**
With respect to inefficient coal power plants, the revenue will reduce by 20%, if the rate of utilization exceeds 50%.
- Reviewed amount of procurement in the main auction(Figure 3)**
Considering power plants that will ensure to provide supply capability closer to the delivery year, 2% of H3 demand will be reduced from the procurement capacity in the main auction.
- Capacity offer obligation for decommissioning power plants**
Basically, power plants whose period of out of operation is less than 1 year at the main auction timing are obliged to offer their capacity.
- Consideration of unoffered capacity**
In the 1st main auction, there would be 20GW unoffered capacity at most (e.g. FIT applied biomass mixed combustion coal) while it will be possibly in operation in 2024, therefore, how to calculate such capacity has been discussed and consideration measures were established.

Result

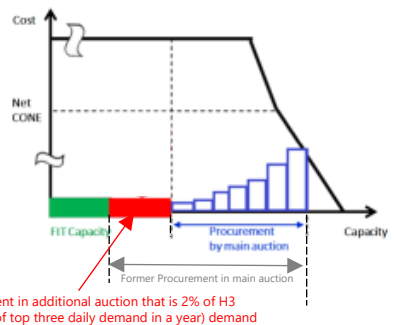
- As a result, capacity of approximately 165 GW (187GW if FIT capacity and procurement amount in additional auction are included) was secured for 2025 and the clearing price was lower than Net CONE. (Figure 4)
- 3GW capacity was not secured in the main auction but will be secured in additional auction.
- FIT capacity increased by 7GW from 12GW in 2024 to 19GW in 2025 due to consideration of unoffered capacity as well as renewable installation.
- Consequently, total secured capacity for 2025 decreased compared to that for 2024 even though supply price curve of 2025 became mild and the clearing point went right side compared to 2024.



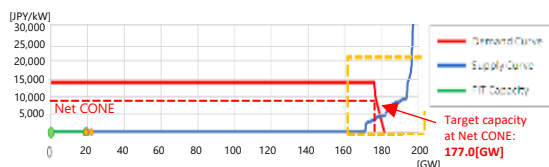
**Figure 1 The result of 2020's main auction
(Delivery year : 2024)**



**Figure 2 Image of reduction of the revenue
for inefficient coal power plants**



**Figure 3 Reviewed amount of
procurement in main auction**



**Figure 4 The result of 2021's main auction
(Delivery year : 2025)**
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[Balancing Market]

<RR-FIT transaction launched in 2021>

Background

- The balancing market in Japan started in FY2021, and it is a multi-price (pay as bid) auction and the installation schedule per product is RR-FIT in 2021, RR in 2022 and the other products in 2024. (Table 1, Figure 5, 6, 7)
- With respect to the clearing results of RR-FIT, there were shortages of procurement bidding in almost all areas through FY2021. (Table 2, Figure 8)

	Frequency Containment Reserve (FCR)	Synchronized Frequency Restoration Reserve (S-FRR)	Frequency Restoration Reserve (FRR)	Replacement Reserve (RR)	Replacement Reserve for FIT (RR-FIT)
Operative Control	Online (locally controlled)	Online (LFC)	Online (EDC)	Online (EDC)	Online
Monitor	Online (Offline record can be submitted)	Online	Online	Online	Online
Communication line	Dedicated line (for processing)	Dedicated line	Dedicated line	Dedicated line or DRAG*	Dedicated line or DRAG*
Full Activation Time	within 10 sec	within 3 min	within 3 min	within 15 min	within 45 min
Minimum Delivery Period	5 min	30 min	30 min	3 hours	3 hours
High-standby	Mandatory	Mandatory	Optional	Optional	Optional
Dispatch interval	(locally controlled)	0.5-few tens of sec	a few sec - a few min	a few sec - a few min	30 min
Monitor interval	1 - a few sec	1 - 5 sec	1 - 5 sec	1 - 5 sec (5 min for DRAG*)	1 - 30min
Minimum bid	3 MW (1 MW for those offline)	3 MW	3 MW	3 MW (1 MW for DRAG*)	300W (1 MW for DRAG*)
Minimum Unit Classification	Ramp up/down	1 kW	1 kW	1 kW	1 kW

*Demand Response Automatic Server

Table 1 Product specification of balancing market

Approach (Figure 9, 10)

- Segmentation of block resolution
- Dealing with BG's downward margin shortage
- Extending activation time

<Other products transaction launched in 2024>

Background

- For 2024's start of FCR, S-FRR and FRR transaction, more efficient and cheaper procurement measures have been discussed.

- Product extents with respect to cross-regional procurement considering stable supply operation under the isolated situation in case that intertie's faults occur. (Figure 11)
- Possibilities of efficient procurement considering "coincidence factor" if there are power plants with multiple balancing capabilities. (Figure 12)

Approach

- By securing the same amount of balancing reserve through the interties as a ΔkW margin, the frequency drop would be suppressed in advance and the cross-regional procurement should not induce a power outage. Hence, it has been decided that cross-regional procurement of S-FRR will proceed after its cross-regional operation is able to be realized with KJC (Keystone Japanese Coordinating system). (Figure 11)
- Based on FY2020 data, total required reserve can be reduced by about 40% by considering the "coincidence factor". (Figure 13) It is found that the amount of overlap in S-FRR(LFC) and FRR (EDC) that makes FRR unavailable is at most about 10% against the total amount of the required reserve considering coincidence factor. By prioritizing to secure the availability of FCR(GF) and S-FRR(LFC), the reserve amount for FRR and RR might be insufficient. However, contribution of FRR and RR(EDC) through interties from other areas can be expected, and also the insufficient amount is expected to be covered by S-FRR(LFC). (Figure 14)

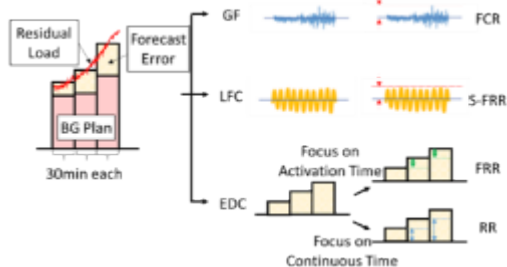


Figure 5 Classification of control functions

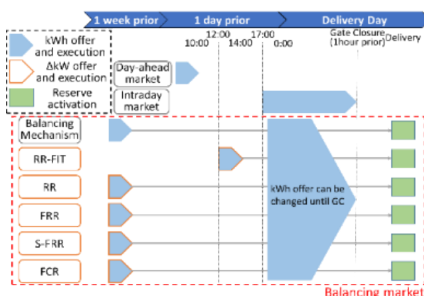


Figure 6 Transaction Schedule

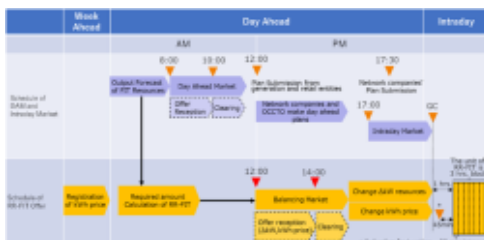


Figure 7 Transaction Schedule of RR-FIT

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	Hokkaido	Tohoku	Tokyo	Chubu	Hokuriku	Kansai	Chugoku	Shikoku	Kyushu	9 areas
Required [MW] (Daily Average)	88	439	651	506	37	357	251	187	494	3,012
Offered [MW] (Daily Average)	165	275	1,065	600	60	1,064	293	361	469	4,352
Cleared [MW] (Daily Average)	78	351	561	416	34	343	241	188	453	2,669
Highest Price (JPY/kW*30min)	86.98	59.46	89.73	206.75	64.16	109.44	70.00	40.57	45.30	-
Lowest Price (JPY/kW*30min)	0.01	0.01	0.01	0.00	0.02	0.02	0.02	0.02	0.01	-
Averaged Price (JPY/kW*30min)	6.21	1.81	0.98	4.66	4.01	3.81	2.03	1.30	2.41	2.58

Table 2 Balancing market result FY2021

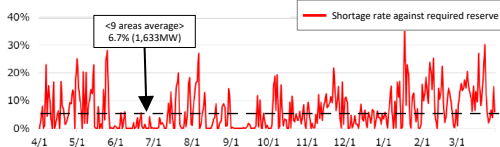


Figure 8 Procurement Shortage Rate FY2021

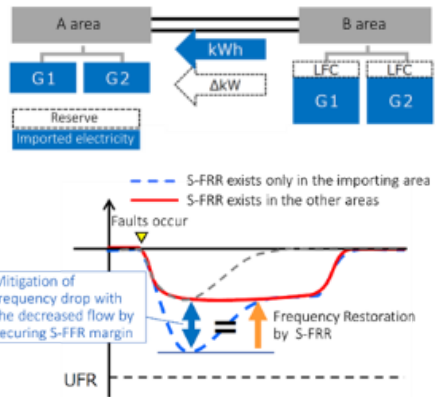


Figure 11 Image of frequency response in case of faults of the interties

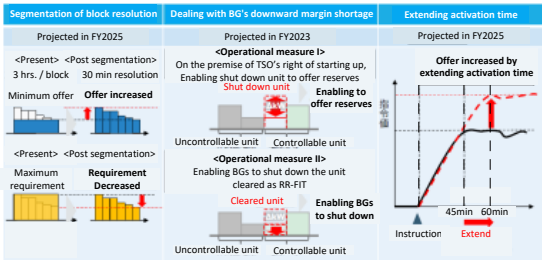


Figure 9 Projected countermeasures for procurement shortage

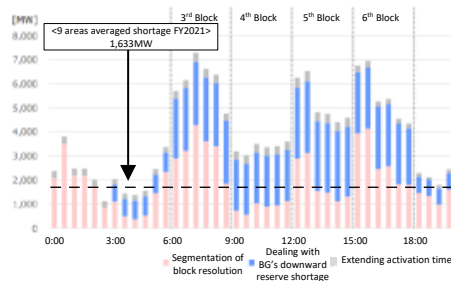


Figure 10 Expected procurement increase per countermeasure

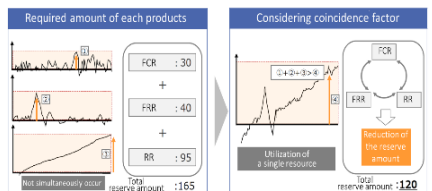


Figure 12 Image of procurement of each product and considering the "coincidence factor"

The ratio to H3 demand (projected demand of FY 2020) (%) (Average in a year)

	Hokkaido	Tohoku	Tokyo	Chubu	Hokuriku	Kansai	Chugoku	Shikoku	Kyushu	Average
RR (A)	7.9	7.0	5.2	5.1	5.5	5.4	6.0	5.9	7.0	6.1
FRR (B)	3.4	2.9	2.5	2.3	2.3	1.5	2.9	3.3	2.7	2.6
S-FRR (C)	2.4	2.2	1.7	2.0	2.0	1.8	2.4	1.9	2.2	2.1
FCR (D)	2.2	2.3	1.8	2.0	2.4	2.0	2.9	1.9	2.2	2.2
Total (E) (=A+B+C+D)	15.9	14.4	11.2	11.4	12.0	10.7	14.1	13.0	14.1	13.0
Coincidence factor (F)	9.3	8.6	6.3	6.4	6.2	6.3	8.3	8.1	8.6	7.6
Reduction of procurement (=E-F)	6.5	5.8	4.8	5.0	5.9	4.4	5.8	5.0	5.5	5.4

Figure 13 Image of procurement of each product and considering the "coincidence factor"



Figure 14 Overlap in LFC and EDC in considering "coincidence factor"
<http://www.cigre.org>