Energy Market Design in Japan

- Findings from the Electricity Market Design Study by GJETC

JAPANESE-GERMAN ENERGY TRANSITION TALKS, 29 October 2024

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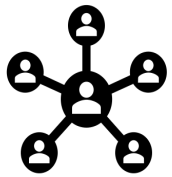
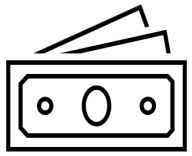
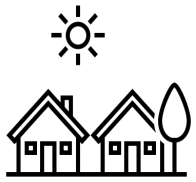
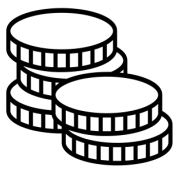
1. Relevance of the Challenges in Germany and Japan









Challenge	Relevance of the Challenge Germany	Relevance of the Challenge Japan
1 Coordination		
1a Wholesale markets	Not as urgent as it seemed in 2022	Less relevant for GJETC
1b Flexibilities	High	Less relevant for GJETC
2 Investment		
2a Renewables	High (but policy is established)	High (but policy is established)
2b Flexible Power Plants	**High**	**High in the long run**
2c Non-Fossil Flexibility Option	**Very high**	**High in the long run**
3 Signals for local differentiation		
3a Wholesale markets	Disputed	Less relevant for GJETC
3b Renewables	Moderate	Less relevant for GJETC
4 Power Prices/Costs	Moderate	Less relevant for GJETC

2. Common Understanding on Flexibilities

"*Flexibility is the modification in the generation and/or consumption pattern of electricity according to an external signal in order to meet energy system needs.*" (Mandatova and Mikhailova, 2014; similar also in Eurelectric, 2014)."

Three uses of flexibility:

1) Portfolio optimization in energy markets
2) Balancing (in balancing power markets)
3) Management of network constraints/congestions

Source: Eurelectric, 2014

3. Possible Case Applications: Types of Flexibility Resources

Flexible Low Carbon Power Plants	Other Flexibility Options
Hydrogen (Green or Blue) Power Plants	Demand Response
Gas Power Plants ready to be converted to 100% Hydrogen or Ammonia	Grid-Integrated Batteries
Flexible Use of Biomass Power Plants	Building - Integrated Batteries
	Battery Electric Vehicles
	Electrolysis
	CHP or Heat Pumps and Other Electric Heat Generators in connection to Heat Storage
	Cold Storage

4. Six Reform Options for Further Analysis

Capacity markets	1) Uniform capacity instruments with uniform price for new and existing assets	2) Uniform capacity instruments with differentiated conditions for new and existing assets but uniform price for each class	3) Specific capacity instruments using capacity auctions with differentiated products, specific by type of asset: e.g., uniform auction for new assets with type-specific caps or multipliers leading to multiple prices; separate auctions by type
Other specific capacity instruments for flexibilities	4) Fixed payments per kW/kWh of demand response; government grants for batteries or V2G systems		
Other reform options to stimulate flexibility investment	5) Allowing for costs of flexibilities in revenue regulation (TSO; DSO)	6) Time of use or dynamic (real-time pricing) price components for final customers: applied to power prices, grid fees, or taxes	

5.1 Analysis of Applicability for the Selected Options in Japan

	Option 1: Uniform capacity instruments with uniform prices	Option 3: Specific capacity instruments using capacity auctions with differentiated products, specific by type of asset: e.g., uniform auction for new assets with type-specific caps or multipliers leading to multiple prices; separate auctions by type.
Status	➢ Capacity market auction started since 2020	➢ Long term decarbonized power source auction started since January 2024
Content	• OCCTO(The Organization for Cross-regional Coordination of Transmission Operators) initiates a capacity market auction four years ahead of the actual supply and demand. • The first capacity market auctions for FY2024 were held in FY2020 and have been held four times already.	• The auction will target the new installation and replacement of decarbonized resources like renewables, hydrogen/ ammonia, storage batteries, pumped-storage, nuclear as well as the renovation of existing thermal plants into decarbonized ones.

5.2 Analysis of Applicability for the Selected Options in Japan

	Option 2: Uniform capacity instruments with differentiated conditions for new and existing assets but uniform price for each class	Option 4: Fixed payments per kW/kWh of demand response; government grants for batteries or V2G systems	Option 5: Allowing for costs of flexibilities in revenue regulation (TSO; DSO)	Option 6: Time of use or dynamic (real-time pricing) price components for final customers: applied to power prices, grid fees, or taxes
Status	➢ Not implemented and not planned	➢ Not implemented and not planned	➢ Not explicitly discussed	➢ Partially discussed
Content	• Japan combines option 1 and 3 instead	• Japan combines option 1 and 3 instead	• Revenue cap system was introduced since 2023 • It is possible for TSOs and DSOs to include investment costs of flexibilities, as long as approved by the government. • However, current investment focus is mostly set on other factors.	• Some retail electricity providers may offer dynamic pricing menus to maximize profits and reduce costs for consumers. • Some TSO/DSO provides the time of use pricing menu on grid fees • However, there is no political and scientific debate of an obligation for time of use or dynamic pricing in power prices, grid fees and taxes.

5.3.1 Analysis of Applicability for the Selected Pptions in Japan

Option 1. Capacity market- Background

- Before the retail electricity market was liberalized in 2016, existing major electric utilities were able to recover the power generation investment cost under the regulated tariffs based on the full cost method.

- However, after the full liberalization, it became necessary to recover the power generation investment cost through the wholesale electricity market(kWh market), but some power plants are not able to properly recover the costs.

- At the same time, in recent years, with the increase of FIT power plants, renewable power plants with relatively low marginal costs have entered the wholesale electricity market.
- This has resulted in a decline in wholesale electricity market(kWh market) prices.

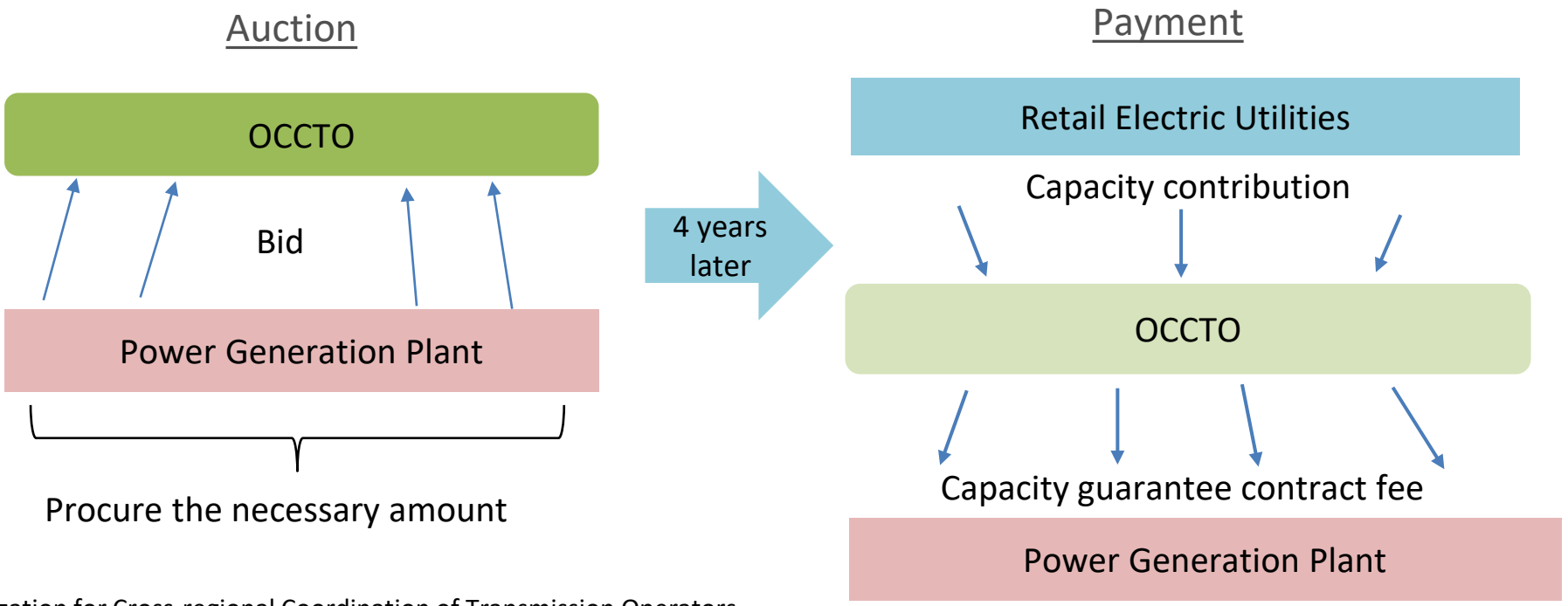
- Decline in the wholesale market prices benefit consumers in the short term.
- However, it led to a decline in the utilization ratio(capacity factor) of thermal power plants, and it is no longer possible to recover the fixed costs (kW costs) that should originally be recovered in the wholesale market.

[Source]
https://www.meti.go.jp/shingikai/enecho/kihon_seisaku/denryoku_kaikaku/shijo_seibi/pdf/02_03_00.pdf
https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/seido_kento/pdf/045_s01_00.pdf

5.3.2 Analysis of Applicability for the Selected Options in Japan

Option1. Capacity Market- Overview

- To ensure an adequate supply capacity in the medium to long term, a capacity market(kW market) has been introduced to guarantee the necessary supply capacity in advance.
- OCCTO(※) initiates a capacity market auction four years ahead of the actual supply and demand. The first capacity market auctions for FY2024 were held in FY2020 and have been held four times already.
- Power generation plants receive a capacity guarantee contract fee based on the contracted price. These funds are primarily covered by capacity contributions paid by retail electric utilities.



(※)OCCTO: The Organization for Cross-regional Coordination of Transmission Operators

[Source] https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/pdf/054_04_01.pdf

5.3.3 Analysis of Applicability for the Selected Options in Japan

Option 1. Capacity Market- Problems

Problem① : Long-term contracts cannot be concluded

- The capacity market offers power suppliers contracts for only one year.
- Therefore, depending on the year, power supplier may not be successful at auction, which is not a sufficient measure for new power plants that will recover fixed costs over a long period of time.

Problem② : Decrease in capacity income due to transitional measures

<Disincentives for existing power sources>

- Existing power sources (constructed before 2010) are subject to transitional measures that reduce capacity income until 2029.

5.4.1 Analysis of Applicability for the Selected Options in Japan

Option 3. Long-Term Decarbonized Power Source Auction - Background

- Even if a capacity market is introduced, the prospect of long-term investment recovery is uncertain due to the full liberalization and one-year capacity contracts.
- There are concerns that investments in the power plants, which require long construction periods and large amount of investment, will stagnate.

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- It is necessary to introduce a system to secure long-term fixed income for new power source investments.

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- To ensure the predictability for power generation companies and encourage active investment in decarbonized power plants, long-term decarbonized power source auction is being considered.

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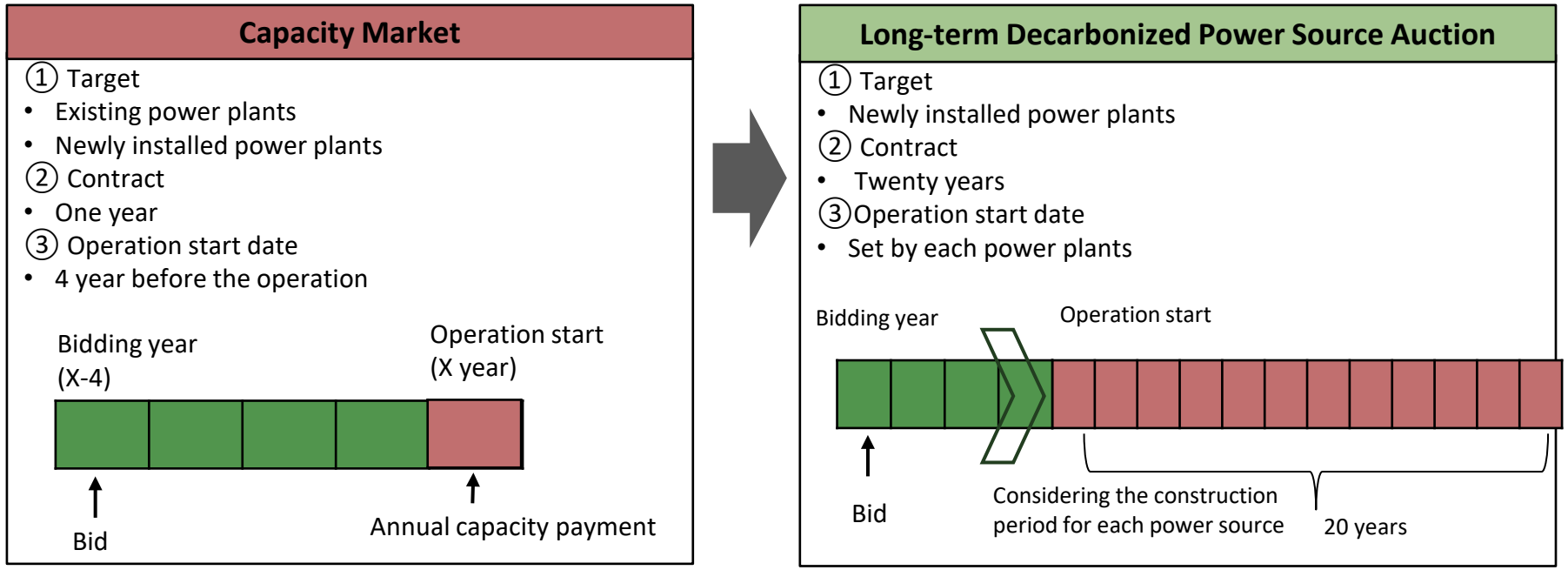
- Furthermore, in order to achieve carbon neutrality by 2050, it is also necessary to invest in new and replacement of decarbonized power plants as well as to replace the thermal power source with decarbonized power one.

5.4.2 Analysis of Applicability for the Selected Options in Japan

Option 3. Long-Term Decarbonized Power Source Auction – Overview

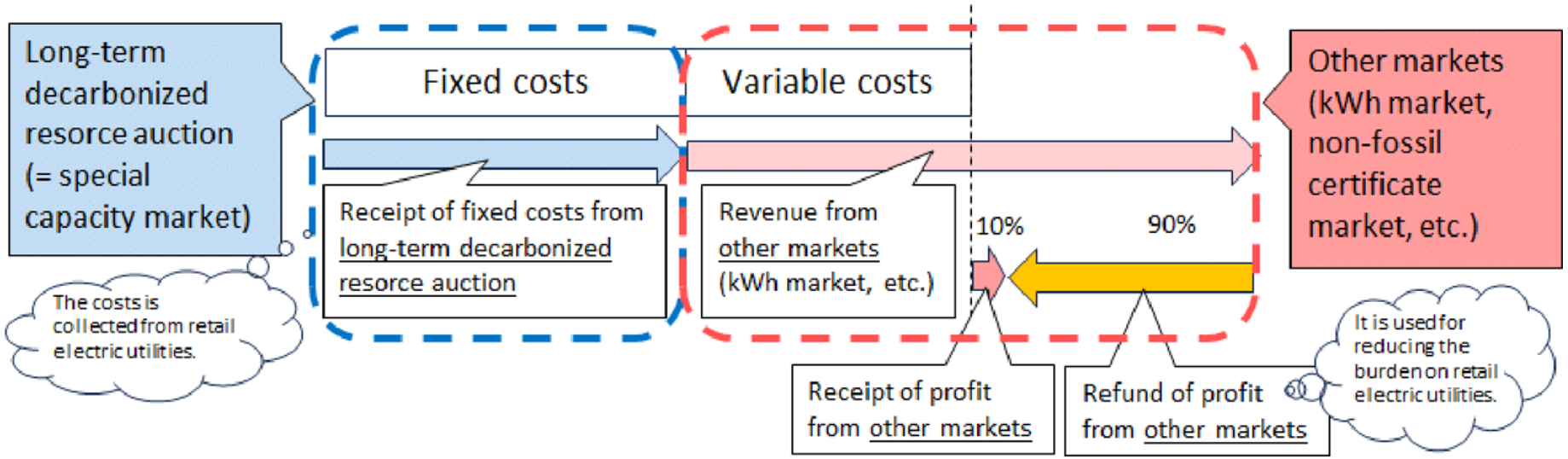
- Long-term decarbonized power source auctions commenced in January 2024.
- This auction targets the new installation and replacement of decarbonized resources like renewables , hydrogen/ammonia, batteries, pumped-storage, nuclear as well as the renovation of existing thermal plants into decarbonized ones.
- Successful bidders receive a fixed cost (construction cost, operation and maintenance cost, capital cost, etc) for 20 years.
- Unlike capacity market, considering the construction lead time, this auction allow for individual operation start date per power sources.



5.4.3 Analysis of Applicability for the Selected Options in Japan

Option 3. Long-Term Decarbonized Power Source Auction – Problems

- The long-term decarbonized power auctions ensures the fixed cost while the income from variable cost is gained from the other markets.
- Regarding variable costs, if there are no upper limit, power generation companies can potentially earn as much additional income as they want.
- Therefore, this system requires a refund. To be specific, 90% of the profits earned in other markets will be refunded later, but there will be no compensation for losses.
- However, the condition of 90% refund of profits from other markets may not make the system attractive to some power generators.

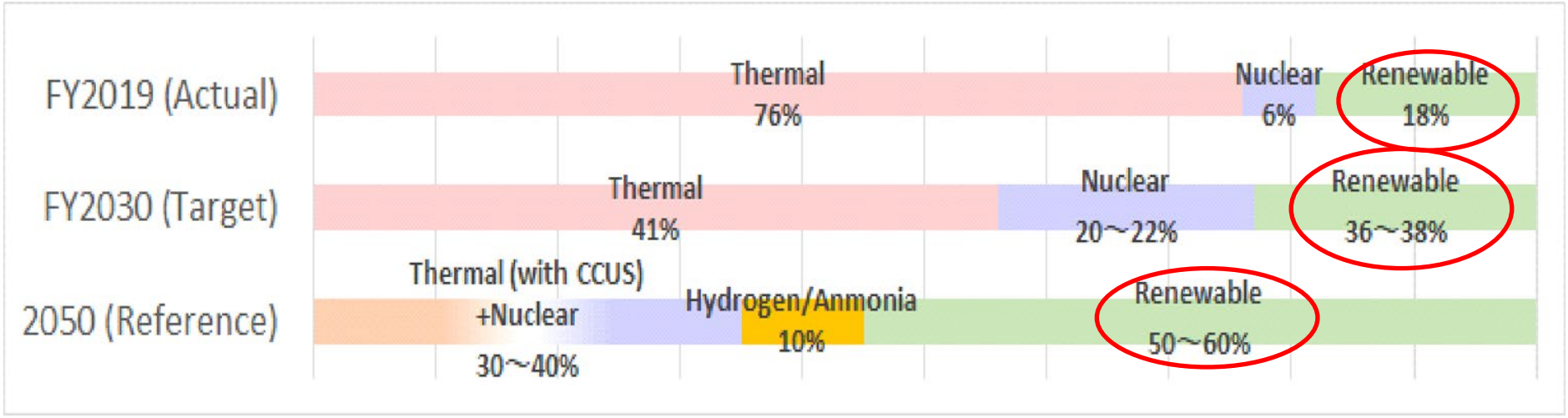


[Source] https://www.occto.or.jp/market-board/market/oshirase/2023/files/202306_youryou_gaiyousetsumei_long_r.pdf

6.1 Policy Recommendation

Background: Power Generation Mix in Japan

- In October 2020, Japan announced its goal to achieve carbon neutrality by 2050.
- In the electricity sector, the share of renewable power generation in the generation mix will be 50-60% by 2050.
- In addition, the "6th Strategic Energy Plan" released in 2021 aims for a generation mix of 36-38% renewable power generation.
- As of FY 2019, the renewable power generation accounted for 18% of the generation mix.



[Source] https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/2021/043/043_004.pdf
https://www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/6th_outline.pdf

6.2 Policy Recommendation

➢ The government systematically procures the supply capacity

- Electricity industry in Japan has more focused on competition since full liberalization in 2016.
- However, in recent years, as carbon neutral become important policy issue, the expansion of renewables is expected to accelerate further.

- Conversely, with the increase of FIT power plants with low marginal cost into wholesale market, the capacity of thermal power plants, which has traditionally functioned as balancing power sources, is decreasing.
- This highlights the need to secure the balancing capacity, particularly for decarbonized power sources.

- Yet, within the framework of free competition, it is not necessarily possible to systematically procure the necessary capacity.
- Therefore, government support is crucial to facilitate investment.
- Japan has already initiated measures such as capacity market and long-term decarbonized power source auction.
- These policy measures are expected to systematically secure the decarbonized balancing power sources required towards carbon neutrality.

Thank you for your attention

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