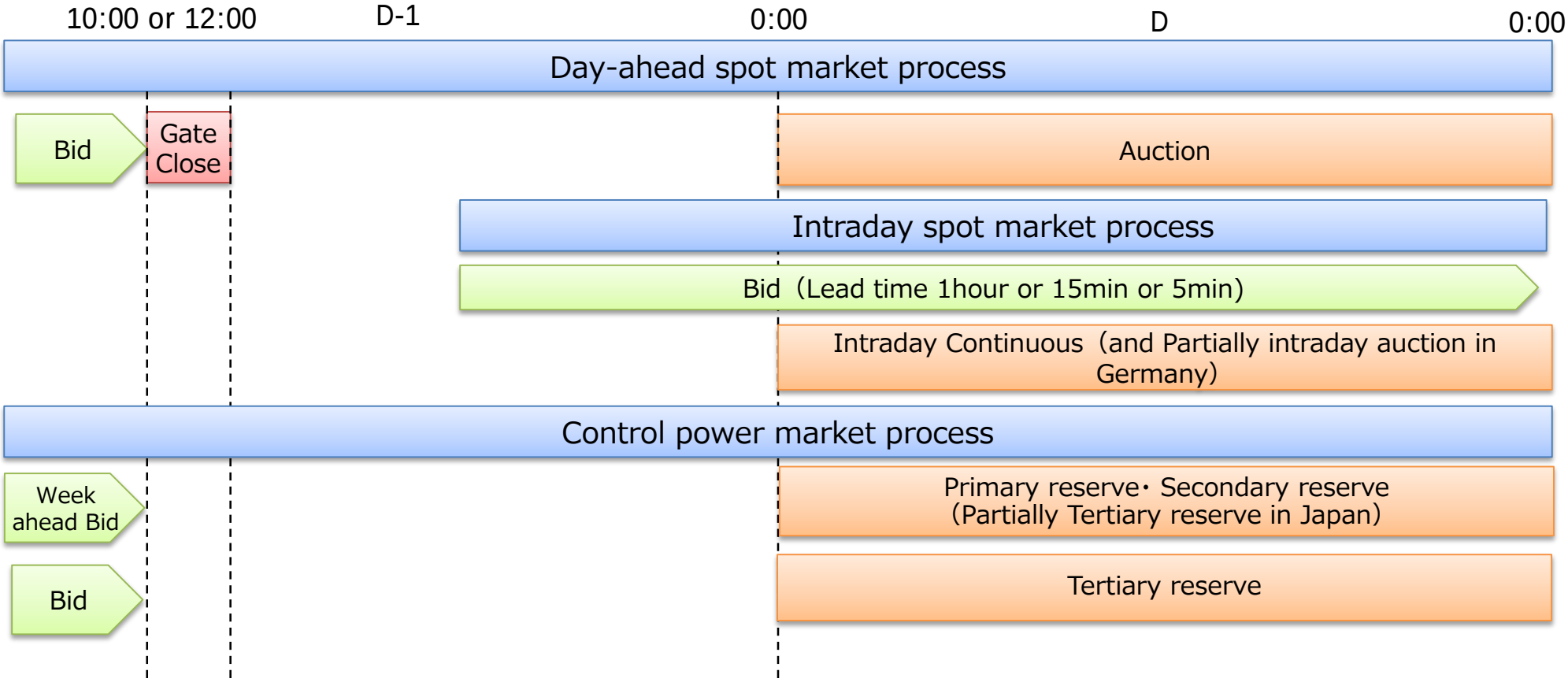
Wholesale market integration of Renewable energy generation

The Institute of Energy Economics, Japan
Junichi Ogasawara, Senior Research Fellow

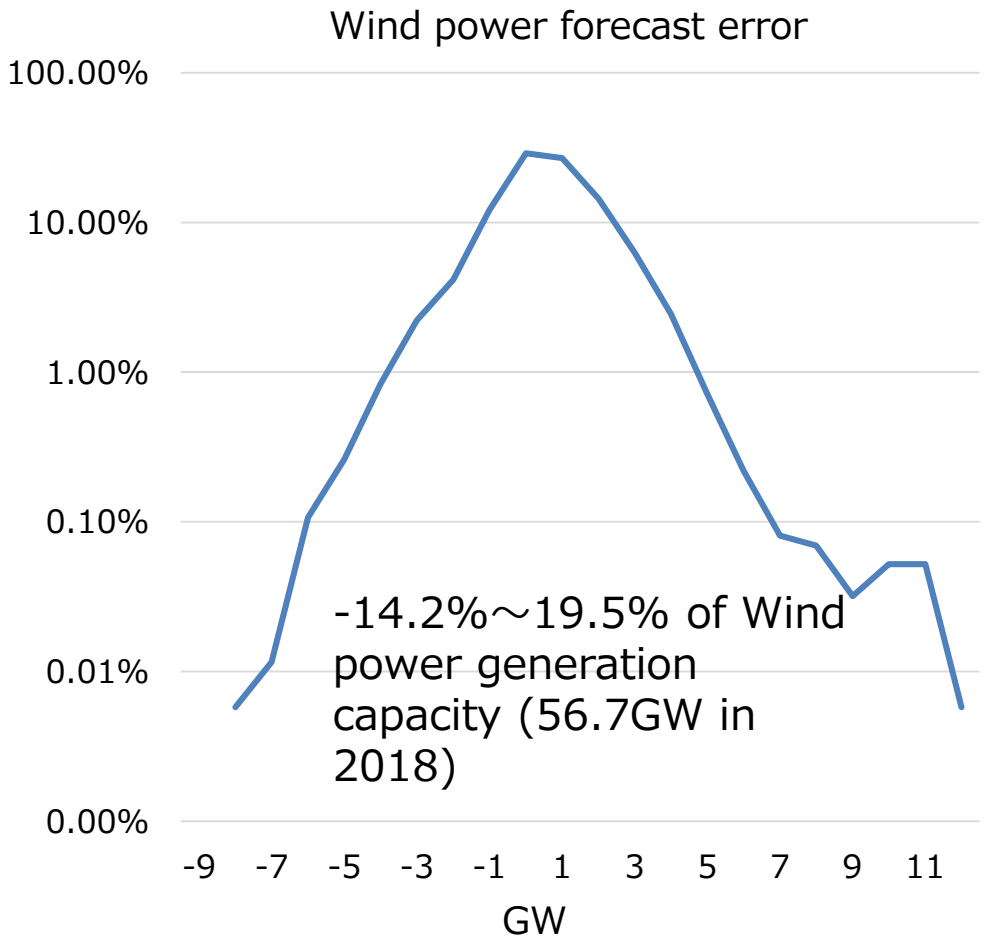
Wholesale market in Japan and Germany

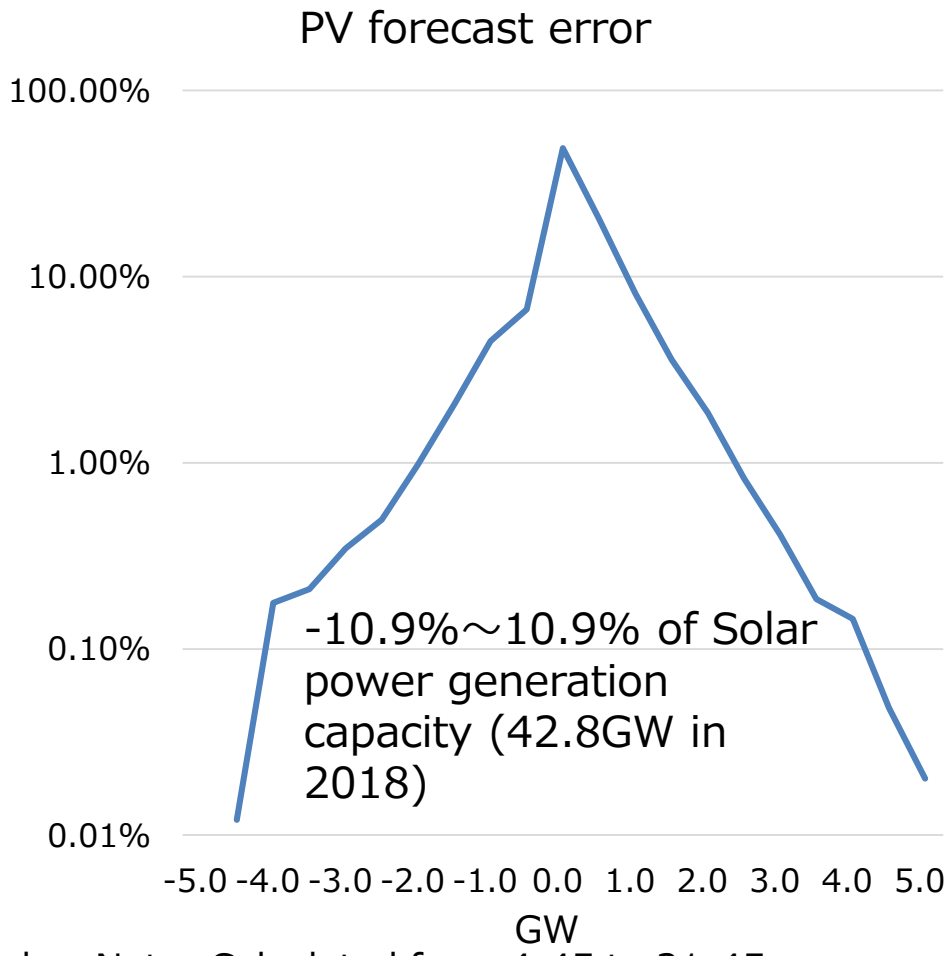
- In Japan and Germany, after day-ahead spot trading (auction), Intraday spot trading (mainly continuous) start. Before day-ahead spot trading, TSO procure primary reserves and secondary reserves before week-ahead and tertiary reserves before day-ahead spot trading.
- It is difficult to deal with a large amount of renewable energy forecast errors using intraday continuous trading. In Japan, we discuss to use tertiary reserves.



Forecast errors of wind power and solar power in Germany (2018)

- Since output of wind power generation / solar power generation is determined by weather conditions, ふおforecast errors occur between day-ahead forecast and actual output based on deviations of weather forecasts. Although it is rare, very large forecast errors occur.





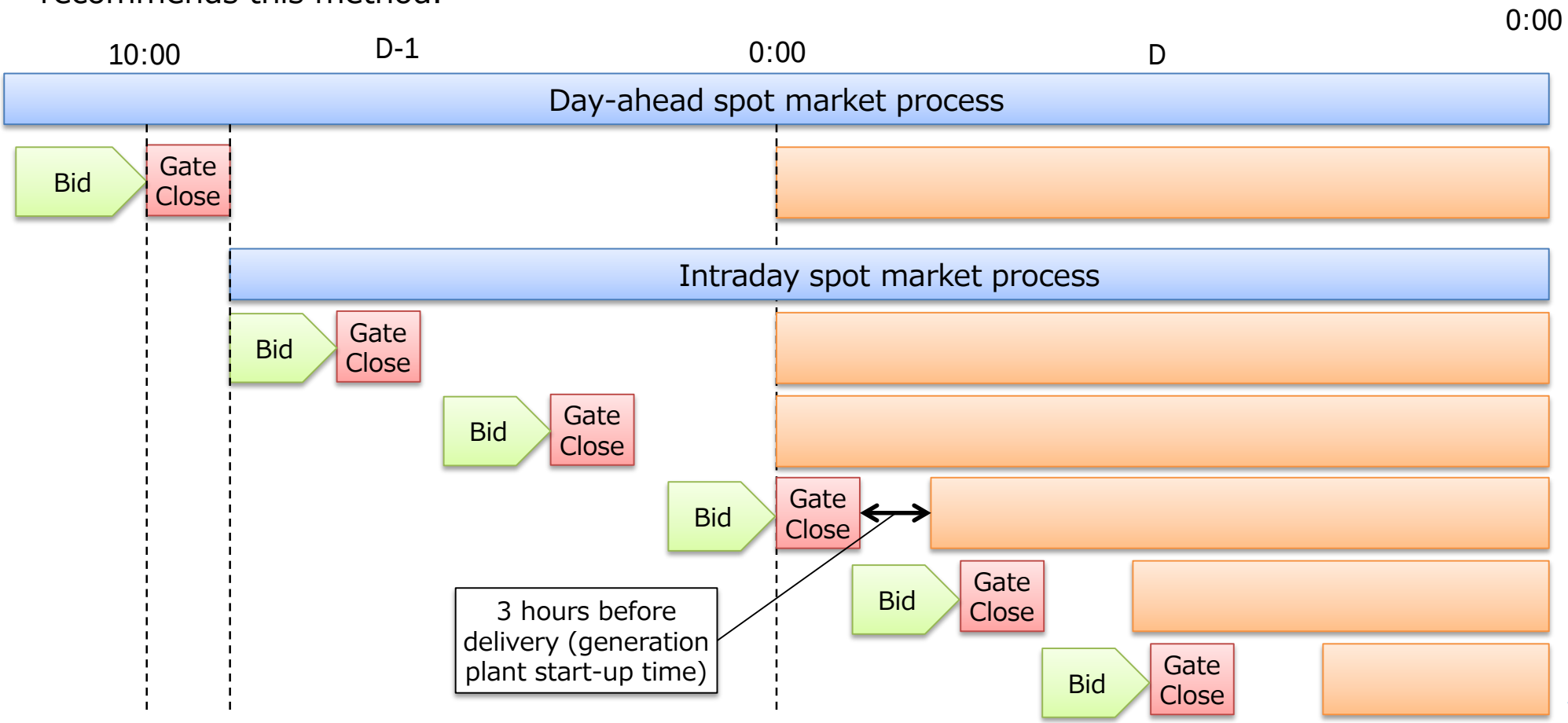
Note: Forecast errors= Real output – Day-ahead forecast
Sources: ENTSO-E, “Transparency Platform”

Note: Calculated from 4:45 to 21:45

Intraday auction market in Italy and Spain

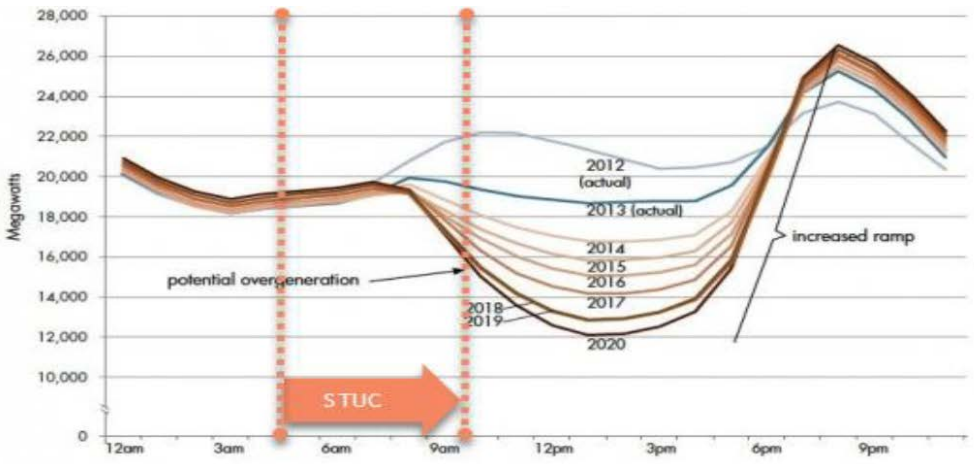
- Italy and Spain established multi-step intraday auction markets. After Day-ahead spot market, they can trade same 24hours auction products and they can trade multi-hours auction products on the day.
- They can easily modify the power generation plan based on the results of the day-ahead spot market and can modify generation schedules including to start/stop of generation plants.

※ European commission's study," The future electricity intraday market design" (2019/2) recommends this method.

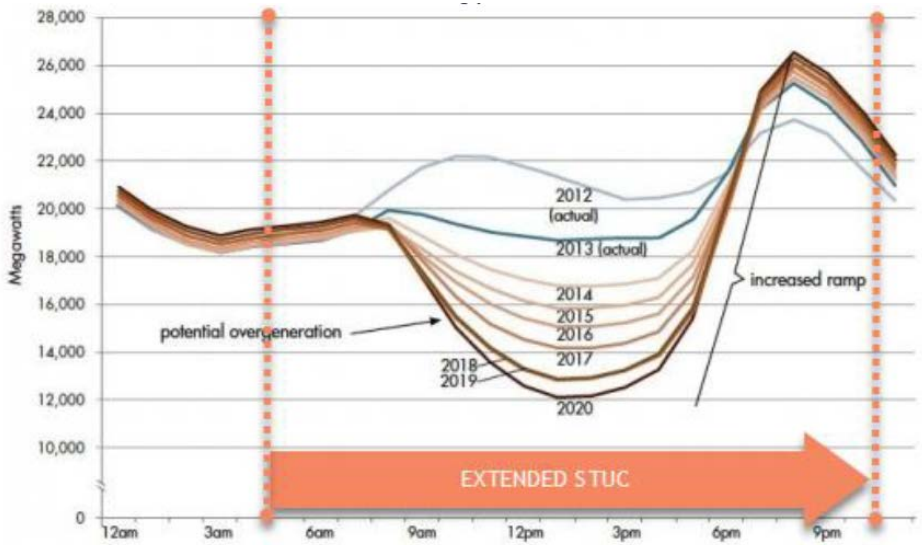


Short-term Unit Commitment of CAISO

Short-term Unit Commitment (STUC)



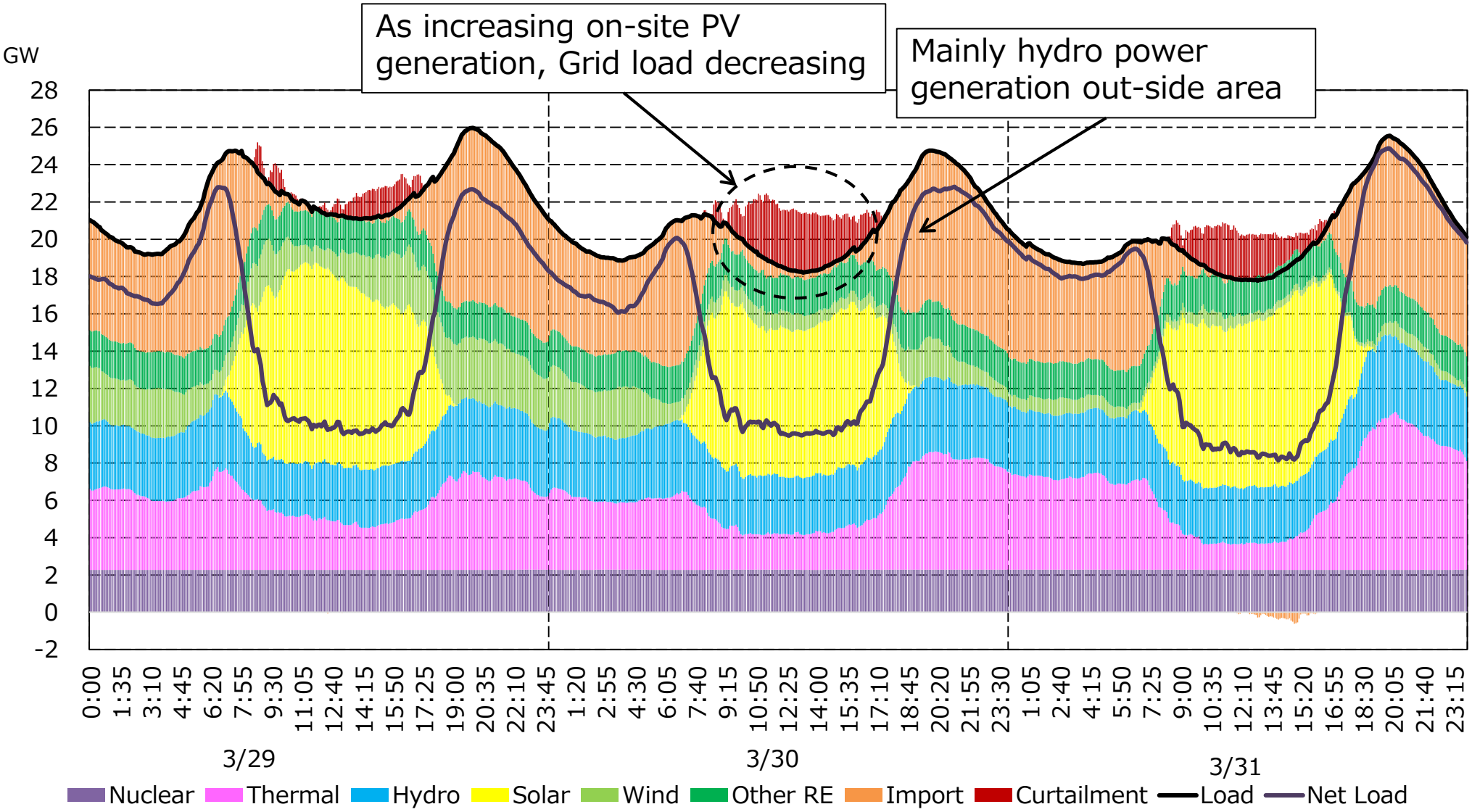
Extend the STUC



Source: CAISO, "Extended Short-Term Unit Commitment Draft Final Proposal", 2018/3

- CAISO's real-time market consists of three steps.
- ✓ Short-term Unit Commitment: CAISO evaluates generation schedules at 15-minute intervals 4.5 hours before and issues binding start-up instructions based on resources' start-up times if necessary.
- ✓ Fifteen-Minute Market: The security constrained economic dispatch used by the CAISO on a 15-minute basis as a part of the RTUC process to determine 15-minute settlements and clear bids for energy and ancillary services.
- ✓ Real-Time Dispatch: The security constrained economic dispatch used by the CAISO on a 5-minute basis to calculate LMPs and determine which ancillary service and imbalance energy resources to dispatch.
- ※ **The CAISO proposes to extend the short-term unit commitment horizon from 4.5 hours to 18 hours.**

2019/3/29～31 Renewable curtailments in CAISO



Source: California ISO, “Historical wind and solar curtailment”

Conclusion

- Rarely large-scale prediction errors of wind power generation and solar power generation occured. It is effective to 1) widen intraday market and balancing market and 2) review unit commitment before several hours.
- When the ratio of solar power generation is large, the net load (load -wind power / solar power generation) becomes “duck-curve”. It is needed to deal with twice peak in the morning and evening and change significant generation schedules including start/stop generation units if the weather forecast deviates greatly.
- In Japan, the forecast error of renewable energy generation will be dealt with in the framework of tertiary reserves. This type is not reflected in the price mechanism. The mechanism introduced this time can be dealt with within the framework of wholesale spot markets.
- As variable renewable energy generation increases, several challenges arise. The US views that the value of renewable energy power generation (= REC) does not reflect the status of renewable energy power generation output and hourly marginal CO2 reduction costs, and that there is distortion in energy markets prices and capacity market prices are spreading. I believe that further research is needed on how to create purchase prices for renewable energy power generation.

Contact:report@tky.ieej.or.jp