Study on the Establishment of Market Monitoring and Improvement of Efficiency of Electricity Trading Platform

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1. Research Background

Since the launch of the electricity trading platform in 2021, Taiwan's centralized day-ahead ancillary service market has been operating under a competitive bidding mechanism for several years. Currently, the market demand is determined by subtracting the ancillary service capacity not subject to competitive bidding from the total system ancillary service requirement. However, this method only partially reflects the actual market demand and the value such services bring to the system. Therefore, it is necessary to consider adjustments based on academic perspectives and the practices of advanced international power grids. Drawing on international experience, several advanced power systems have adopted the concept of the Operating Reserve Demand Curve (ORDC), which integrates various market and system-related information and effectively links power system reliability needs with market operations. In addition, to ensure robust market operation, the electricity trading platform operator must continuously enhance mechanisms for monitoring bidding behavior and market settlement outcomes, as well as develop appropriate responses to mitigate market power and handle market anomalies. These efforts should align with the platform's stage of development, human resources, and technical capabilities.

2. Research Content

This study is structured into three major components: First, it reviews academic literature, both domestic and international, on electricity market operations, market oversight measures, and ORDC design. It also examines the practical experiences of advanced international grids, including the Electric Reliability Council of Texas (ERCOT), the New York Independent System Operator (NYISO), and the Independent Electricity System Operator (IESO) of Ontario, Canada. Second, from the perspectives of system security and the efficiency and fairness of market competition, the study proposes rational evaluation methods for constructing demand curves for various ancillary service products in the day-ahead market. It also offers recommendations on market demand volumes and product design modifications, while suggesting new ancillary service product designs based on potential resources within the power system. Third, the study offers practical recommendations for preemptive measures to mitigate market power, applicable from the bidding stage to settlement, once a market management system (MMS) is introduced. Furthermore, it proposes concrete guidelines for ex-post regulatory mechanisms to handle and mitigate market anomalies.

3. Research Results

The study compiles cases from advanced North American power grids, including ERCOT in Texas, NYISO in New York, and IESO in Canada. Ancillary service product planning is generally categorized into three types: frequency regulation, 10-minute reserves, and 30-minute reserves. These correspond to Taiwan's Regulation Reserve, Spinning Reserve, and

Supplemental Reserve, respectively.

In terms of demand curve design, ERCOT was the first U.S. market to implement an ORDC based on loss-of-load probability. Although the design parameters have been adjusted several times, the demand curve has remained negatively sloped. In contrast, NYISO and IESO implement fixed product demand quantities with price caps, resulting in stepwise vertical demand curves.

Regarding market regulation mechanisms, the prevailing trend in North America is the use of third-party monitoring. Under established structures, authorities, and rules for market surveillance, these entities collect and evaluate operational costs and bidding information from market participants to detect potential violations. Market operators are responsible for ensuring the neutrality of monitoring entities, supplying necessary market data, and reporting market anomalies.

In detecting and mitigating market power, most market operators consider indicators such as market concentration, pivotal supplier status, marginal prices, price-cost markups, and output gaps. These are often supplemented with behavioral and impact assessments to mitigate the influence of market power on operations. A comparative summary of market power mitigation practices in international power markets and the electricity trading platform is provided in Table 1.

Table 1. Comparison of Market Power Mitigation between International Electricity Markets and the Electricity Trading Platform

Electricity Market	Pre-Market (Ex-Ante)	During Market Operation	Post-Market (Ex-Post)
International Electricity Markets	■ Structural Testing ■ Behavioral Testing and Impact Assessment ■ Disclosure of Reference Levels and Mitigation Threshold Information	■ Monitor Bid Price Variations ■ Market Power Mitigation Measures (Automatically Executed)	■ Violation and Dispute Resolution ■ Preparation of Regulatory Reports (Third-Party Monitoring) ■ Provide Operational Data to the Competent Authority
Electricity Trading Platform	■ Compile Market Structure Statistics ■ Disclose Transaction Information	■ Monitor for Significant or Urgent Market Anomalies ■ Assess Whether Anomalies Severely Affect Trading Fairness ■ Market Power Mitigation Measures (Apply Default Pricing or Temporarily Suspend Trading)	■ Monitor the Magnitude of Bid Price Fluctuations ■ Calculate Structural Indicators of Market Power ■ Submit Regulatory Reports to the Competent Authority

Note: The market power mitigation measures of international electricity markets are compiled from CAISO, ERCOT, MISO, NYISO, and PJM.
Source**:** Compiled by this study

When evaluating the operating reserve demand curves, considering the characteristics of each product's demand and current market developments, it is recommended that Regulation Reserve and E-dReg adopt downward-sloping demand curves. For Spinning Reserve and Supplemental Reserve, the study finds that under the condition that pumped-storage plants can serve as reserve capacity, it is feasible to moderately reduce the maximum procurement quantity during off-peak periods while still satisfying reliability standards such as the DCS (Disturbance Control Standard) and statistical loss-of-load indicators. Therefore, it is recommended that the maximum procurement quantities for different periods be further reviewed to enhance dispatch efficiency and optimize budget allocation.

Regarding the reference points for demand curves, the study suggests that the Regulation Reserve should be priced based on the system's highest willingness to pay, ensuring CPS1% < 100%, thereby maintaining market stability, with a maximum procurement cap of 500 MW. For E-dReg, it is recommended to use the average monthly difference of net peak values as the minimum procurement threshold, ensuring a proper supply-demand balance in the market.

In terms of new ancillary service product planning, considering the current ancillary services available on the trading platform, the relative weaknesses of current power dispatch practices, and the status of resource participation, the study proposes the establishment of a Summer Peak Reserve product to address the current shortfall in reserve capacity during summer peak periods.

The primary purpose of examining market management and monitoring mechanisms in electricity markets is to prevent or manage the influence of market power on price formation and resource allocation, and to analyze how mitigation measures can be used to ensure fair market competition. Market power refers to a market participant's ability to influence market prices through output control. If abused, it can cause price distortion and hinder market efficiency.

The market power mitigation mechanisms proposed in this study are divided according to the stage of the Market Management System (MMS) implementation. In the short term (before MMS implementation), the focus is on ex-post monitoring, primarily through abnormal behavior testing and impact testing, combining with structural indicators and recent market settlement prices to detect irregular market behavior. In the medium to long term (after MMS implementation), the approach shifts to ex-ante mitigation by implementing pivotal supplier testing, behavioral testing, and impact testing. With the tests, we can establish a more comprehensive and preemptive framework for mitigating market power, ensuring the competitive fairness of the market. A summary of these mitigation measures is provided in Table 2.

Table 2. Summary of Market Power Mitigation Measures

Category	**Short Term (Before MMS)**	**Medium to Long Term (After MMS)**	
Mitigation Measures	Abnormal behavior and impact testing	Pivotal supplier testing	Behavioral and Impact Testing
Timing of Mitigation	Ex-post	Ex-ante	Ex-ante
Core of Mitigation Approach	■ Calculation of structural market indicators ■ Reference price determination (based on the recent 14-day average for the same type of day and period)	■ Structural Testing – Identification of Pivotal Suppliers ■ Bid Adjustment (Based on Reference Level)	■ Behavioral Testing (Price and Capacity Thresholds) ■ Impact Testing (Effect on Market Settlement) ■ Bid Adjustment (Based on Reference Level)
Practical Implementation	■ Reference settlement prices are based on the recent average for the same period, using the most recent 14 days following current regulations ■ In reference to the definition of monopoly under the Fair Trade Act, entities with a market share below 10% are excluded	■ Refer to the definition of monopoly under the Fair Trade Act ■ Reference levels are based on historical bidding data (considering fuel cost variability) or analyses of unit operational characteristics and demand	■ Maintain existing thresholds (e.g., deviations exceeding 30% compared to the 14-day average) ■ Reference levels are based on historical bidding data (accounting for fuel cost variability) or analyses of unit operational

Category	Short Term (Before MMS)	Medium to Long Term (After MMS)	
	from regulation.	response costs	characteristics and demand response costs
Market Rule Adjustments	■ Establishing competitive HHI thresholds requires only procedural adjustments	■ Incorporate pivotal supplier testing and bid adjustment procedures into the bidding process ■ Introducing a basis for determining reference levels	■ Add behavioral testing, impact testing, and bid adjustment procedures to the bidding process ■ Establish thresholds and mitigation triggers for physical and economic withholding

Note: HHI thresholds are based on FERC guidelines. HHI > 1800 indicates a highly concentrated market; 1000 < HHI ≤ 1800 indicates moderate concentration; and HHI ≤ 1000 indicates an unconcentrated market
Source: Compiled by this study