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## **Zone-based Pricing in the Australian Electricity Market**

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Currently, the Working Group on Practical Considerations for Realizing a Ideal Wholesale Electricity Market, Supply-Demand Balancing Market, and Supply-Demand Operations at the Agency for Natural Resources and Energy is reviewing the spot wholesale electricity market in consideration of whether to move from zone-based market pricing to nodal market pricing, which would divide the market in the event of transmission congestion, as a means to address intra-zone congestion. In the standard application, zone-based market pricing determines the marginal price based on the highest matching bid and offer price within the zone when transmission congestion occurs on the tie lines between regions.

However, despite also using the term zone pricing, the National Electricity Market (NEM) in eastern Australia uses a pool-based pricing method similar to PJM in the United States, though the energy market is limited to just the real-time market. Zones are delineated per state based on the historical development of the power system in each state, and the zone price (RRP: reference regional price) is determined based on the marginal price of the marginal plant connected to the substation of the largest consumer in the state. Transmission congestion within zones has become a major problem in Australia, and of particular concern is the increasing cases of solar power generators connected to the substation bidding at  $-\$1,000/\text{MWh}$  (lower limit) to receive a supply order. This occurs because even if congestion occurs at the substation of the solar power generators, those generators can still secure the RRP on the wholesale market.

To incentivize power generators to bid at their true marginal cost NEM is considering to establish a new congestion management market (CMM) that would settle based on the LMP (locational marginal price) as a congestion management margin at locations experiencing transmission congestion, while also settling based on the pre-existing

RRP on the real-time market. Actual supply and demand management would be carried out by cost-type central power supply orders, but settlement calculation for power supplied in the real-time market under the current system is based on virtual price bidding. In this system, the LMP is not based on the substation where the congestion occurs, but is instead determined based on the difference between the marginal cost of the marginal station and the RRP and adjusted based on each power station's contribution to the congestion. This method results in the phenomenon that the income of each power generator connected to the substation increases more than the amount that would be received based on the LMP calculated for each substation. This is similar to the image of allocating the difference (=congestion revenue) between the substation's wholesale price to the consumer and the LMP to the connected power generators.

In Australia, renewable energy power generator operators have thus far been able to sell power at the RRP even if congestion occurs, but if LMP is fully adopted, it could lead to a rapid loss of wholesale market income for renewable energy power stations. Australia is working to transfer from coal-based power to renewable energy, but if further renewable power generators continue to come online, it could lead to annual decreases in wholesale market income for operators. The current reform proposal seeks to alleviate this situation.

Additional solar power generators are expected to come online in Japan, and if the U.S.-style LMP price formation method was adopted in the wholesale electricity market, it would lead to an increased number of hours in which the wholesale electricity price would hit the lower limit of 0.01 yen/kWh. There would be no impact on wholesale market income during the period operators are covered by the subsidies provided through the FIT (Feed-in Tariff) and FIP (Feed-in Premium) systems, but there is risk operators' wholesale market income would drop the moment they are no longer covered by subsidies. Even if such operators bid on the capacity market, they can only receive limited income because a low adjustment factor is applied to variable renewable energy power such as wind and solar on the capacity market. If the nodal pricing system described here is adopted, there is increased risk to the sustainability of variable renewable energy power generation, but when such power generators connect to the grid it is difficult for them to predict how many other power sources will further connect in the future. While it would be difficult to immediately adopt the reform being undertaken by Australia directly because LMP is calculated under a

special method in that market, we must consider a system to ensure a certain degree of income to renewable energy power generators once the subsidy system expires.

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