

# Development of A Power Market Simulator for Deregulated Electricity Market in Japan

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## Abstract

This paper describes a power market simulator that can be used for electricity price forecasting, market analysis, bid evaluation, etc. in the deregulated electricity market in Japan.

In March 2000, Japanese electricity retail market was partially deregulated, and many new entrants, power producer and suppliers (PPSs) started their businesses for eligible customers using power utilities' transmission lines. The utilities have continued to be vertically integrated after the deregulation, and still have responsibility to supply electricity for all customers in the service area.

In April 2005, Japan Electric Power Exchange (JEPX) started its operation. JEPX has wholesale spot and forward market with nine bidding areas according to the present utilities, while it doesn't have real-time market. In the spot market, day-ahead 48 (30-minutes each) energies are contracted by uniform-price-single-auction system. When any tie lines including frequency conversion station are expected to be overloaded, nine bidding areas are split into two parts at the tie line, and in each part, the energy is contracted by the same manner. We call the methodology as market splitting auction method. The forward market has one-month flat and peak energies in one year ahead, and is operated in continuous session.

All utilities and many PPSs participate in the JEPX but they don't have any obligation to sell or buy electricity through JEPX. They have sufficient generators or contracts to supply their own demand, therefore, only when they have extra energy and it can be sold with high price enough to cover the production cost, they sell the energy. And only when the energy prices are enough lower than production cost, they buy the energy.

We have developed a power market simulator based on the fundamentals approach in which a production cost model and a spot market model are integrated. The production cost model has a unit commitment and economic load dispatch method for thermal units, and an economic operation method for pumped storage hydro units. The spot market model has the market splitting auction method. The short-term marginal cost in each market participant can be obtained by the production cost simulation, and bid data can be generated by taking some markup into account with the short-term marginal cost. The spot market prices and trading volumes can be obtained by spot market simulation. The profit from the spot market can be obtained by re-calculating production cost including the spot market trading.

Power market simulator can be a useful tool for power market participant to verify the bidding strategy. It can give us spot market price forecasting, market analysis, and bid evaluation under any assumptions. Therefore, we can choose the best policy before the actual bidding.