

Development of System Dynamics Wholesale Market Model in Korea

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Abstract

This paper describes the forecast of wholesale market price in a competitive Korean electricity market. In Korea, KEPCO (Korea Electric Power Corporation, fully controlled by government) was responsible for from the production of the electricity to the sale of electricity to customer. However, the generation part is separated from KEPCO and six generation companies were established for whole sale competition from April 1st, 2001. The generation companies consist of five fossil power companies and one nuclear power company in Korea at present time.

The competition in generation wholesale market will start from 2004. ISO (Independence System Operator) will purchase the electricity from the power exchange market. The market price is determined by the SMP (System Marginal Price) which is decided by the balance between demand and supply of electricity in power exchange market. Under this uncertain circumstance, the energy policy planners such as government are interested to the stable power supply in the future. These interests are accelerated due to the recent shortage of electricity supply in California. In the competitive market, private investors like IPP are no longer interested in the investment for the capital intensive, long lead time generating technologies such as nuclear and coal plants. Large nuclear and coal plants were no longer the top choices to IPP. Instead, investors in the competitive market are interested in smaller, more efficient, cheaper, cleaner technologies such as CCGT (Combined Cycle Gas Turbine). Electricity is treated as commodity in the competitive market. The investor's behavior in the commodity market shows that the new investment decision is made when the market price exceeds the sum of capital cost and variable cost of the new facility and the existing facility utilization depends on the marginal cost of the facility. This investor's behavior can be applied to the new investments for the power plant. Under these postulations, there is the potential for power plant construction to appear in waves causing alternating periods of over and under supply of electricity like commodity production or real estate production.

A computer model was developed to study the possibility that construction will appear in waves of boom and bust in Korean electricity market. This model was constructed using System Dynamics method pioneered by Forrester (MIT, 1961) and explained in recent text by Sternman (Business Dynamics, MIT, 2000) and the recent work by Andrew Ford (Energy Policy, 1999). This model was designed based on the Energy Policy results (Ford, 1999) with parameters for loads and resources in Korea. This Korea Wholesale Market Model was developed and tested in a small scale project to demonstrate the usefulness of the System Dynamics approach. Korea electricity market is isolated and not allowed to import electricity from outsides. In this model, the base load such as nuclear and large coal power plant are assumed to be user specified investment and only CCGT is selected for new investment by investors in the market.

This model may be used to forecast the hour by hour wholesale price, quarterly average price, and yearly averaged price. This model can be used to see the impact of LNG price on new investment. This model also can be used to test whether the future power plant construction can meet the government targets for the mix of generating resources and to test whether to maintain stable price in the spot market.