

Investment incentives in the Korean electricity market

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Abstract

This paper develops a model-based analysis of the effects of various capacity incentive systems on new investment in the Korean electricity market. The restructuring process in Korea allocated power generation to six firms, competing within a wholesale market, albeit strictly on a cost basis. Because of this cost-based pool, capacity payments were also introduced to encourage new investment. However, it is an open question whether the current fixed capacity payment scheme is enough to secure resource adequacy, and consideration is being given to alternative mechanisms such as the use of LOLP. Using a detailed market simulation model, based on system dynamics, we compare these approaches in terms of how they may influence the investors' decisions and thereby determine the system reserve margin. The simulation results suggest that there may be serious problems in staying with the current fixed capacity payments in order to achieve resource adequacy. In contrast, an LOLP-based capacity mechanism may, in the longer term, increase the reserve margin compared with a fixed capacity payment. More generally, this paper indicates how crucial the effective modeling of the investment behavior of the independent power producers is for adequate policy support, even if they only constitute a fringe in a substantially centrally influenced market.

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1. Introduction

The government of South Korea has designed a cautiously staged progression toward full restructuring of its electricity sector, which it intends, ultimately, to culminate in full wholesale and retail competition. The nation is currently in an early stage of this process, where generation facilities have been allocated to six firms, who compete in a wholesale market, albeit strictly on a cost basis (Lee and Ahn; 2006). However, the separation of distribution from the national utility, KEPCO, was halted after the California market crisis. To meet the growth in energy demand, resource adequacy continues to be a very fundamental and crucial political concern. Without firm central planning, there is no obligation on the generating companies (Gencos) to collectively maintain an adequate reserve margin, and so, while the government does produce

a basic plan, this is only indicative based on the reasonable, survey-based, inclinations of the firms to invest, together with some central estimates. New capacity investments in the 3rd long-term basic plan (2006) are displayed in Table 1, for the six main Gencos, plus independent power producers (IPPs). Although this indicative plan does provide some coercive pressure on the six main Gencos to the extent that they are subsidiaries of KEPCO, their autonomous requirements to achieve profitability means that they will still evaluate each investment on its merits at the time. Furthermore, new investment by the IPPs is always essentially opportunistic. Thus, overall there is considerable uncertainty in the plan, such that, for example, even compared with the 2nd long-term basic plan of 2004, there have already been several substantial delays and even cancelations.

As with most cost-based pools around the world, a fixed capacity payment was introduced to provide the additional financial return for new investment. The fixed payment system is controversial, however, as it is generally set in an

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Table 1
The 3rd basic plan for new capacities (2006–2020), MW

Year	KHNP		KOSEP	KOMIPO			WP		KOSPO			KEWESPO	IPPs		
	Hydro	Nuclear	Coal	Coal	Oil	LNG	Coal	LNG	Coal	Oil	LNG	Coal	Coal	Oil	LNG
2006	–	–	–	–	–	–	–	–	–	–	–	500	–	14.3	989.2
2007	–	–	–	–	–	–	500	–	–	200	–	500	–	–	–
2008	–	–	870	500	–	–	500	–	–	–	–	500	–	664.9	500
2009	–	–	–	500	40	–	–	–	1870	–	–	–	–	–	500
2010	–	–	–	–	–	–	–	700	–	–	–	–	200	953.2	–
2011	60	1000	–	–	–	500	–	–	–	–	900	–	200	747.3	2000
2012	–	2000	–	–	–	500	–	–	–	–	–	–	–	100.3	2250
2013	–	1000	–	–	–	700	–	–	–	–	–	–	–	–	300
2014	–	1400	870	–	–	–	–	–	–	–	–	1000	–	–	700
2015	–	1400	870	–	–	–	–	–	–	–	–	1000	–	–	–
2016	–	1400	–	–	–	–	–	300	–	–	–	–	–	–	–
2017	–	1400	–	–	–	–	–	–	–	–	–	–	–	–	–
2018	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2019	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2020	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total capacity													33,599.2		

ad hoc way for a period of time, not precisely and transparently linked to actual market conditions, and therefore presents an additional element of regulatory risk to market participants. Hence, an alternative, explicit formulaic approach, such as linkage to the periodic loss of load probability (LOLP) has theoretical appeal and some market attraction. Although the dynamic properties of the LOLP-based approach have been modeled before (e.g. Bunn and Larsen, 1992), a direct comparison with fixed payments remains under-researched.

Thus, in this study, a simulation model based on system dynamics is developed in order to analyze the effects of different capacity payments on investment decisions and hence the system reserve margin. Two cases are considered for this study. In the first, the reserve margin together with wholesale prices and fuel mix are estimated for a fixed capacity payment system. And in the second case, the reserve margin, wholesale prices and fuel mix were calculated with an LOLP-based system. Then, these results are compared with the 3rd long-term basic plan developed by the government. Even though new plants are included in the 3rd long-term basic plan, if the expected return on investment is lower than their criteria, the companies will cancel or delay the new investment. In our model, we recognize that different investment criteria may be applied depending on technology and type of company, and a survey was undertaken to identify this aspect.

This paper is organized as follows: Section 2 gives an overview of the Korean wholesale power market and investigates some issues of the current fixed capacity payments. Section 3 presents the results of the survey conducted to find out how Gencos make their investment decisions. In Section 4, the system dynamics model is described and the experimental simulations are discussed in Section 5. Section 6 provides some conclusions.

2. Overview of the Korean electricity market

2.1. Gencos and IPPs' real investment behavior

The Ministry of Commerce, Industry, and Energy (MOCIE) has published the Basic Plan for Long-Term Electricity Supply and Demand (BPE) biannually to ensure stable electricity supply pursuant to Article 25 of the Electricity Business Act (EBA) since the divestiture of Gencos. The BPE details the basic supply and demand directions and long-term prospects, construction plan for electrical equipment, demand-side management, etc. The government has established the BPE in accordance with the market participants' autonomous business plan, which differs from KEPCO's monopolistic Long-Term Power Development Plan before the restructuring of the electricity industry. Market participants carry out the electricity business autonomously in accordance with the national policy on electricity supply and demand through the BPE.

The procedure for the BPE is described in Fig. 1 (KPX, 2006). After careful reviews of data including Gencos' investment plan, each of the five subcommittees (Demand Forecast, Demand Side Management, Transmission System, Generating Capacity, and General Policy, a total of 63 experts) prepare a field report. Prospects and measures are determined based on the mid- and long-term demand forecast provided by the Korea Power Exchange and through consultation of the future expectations of the Gencos. After reviewing the final draft of the Electricity Policy Review Board and conducting a public hearing on the first draft of the BPE to collect various opinions and ideas, MOCIE releases the final BPE. Considering the changing electricity supply and demand status and subsequent electricity industry restructuring, the government revises and adjusts the BPE biannually.

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