WIND POWER GENERATION IN KOREA –IMPLICATION ON ELECTRICITY PRICE AND ESTIMATION OF ITS VALUE

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Overview

Wind power is one of the widely used resources as a renewable energy in power generation. It is advantageous in that it has no fuel cost, or no concern on greenhouse gas emission. However, we have no control on thefuel, wind, including magnitude and variability. As a result, wind power has no other choice but to be sold at any given price in a market, and this brings up an issue of discrepancy in timing between wind power supply and market price. In fact, PJM have negative correlation between wind power output and demand because of the discrepancy in timing of wind power generation and load; wind blows more at night than daytime, while demand has a peak in the afternoon or early evening. (Fernandez et al., 2012)

There have been studies indicating risk of wind power generator due to high uncertainty of supply, including works by(Meyn, S. el al.,2010).Furthermore, studies showdifferent perspectives on the impact of penetrating more wind power on the price dynamics: some support that more wind power would increase the price in the market, (EIA, 2002) (Parsons, B. et el., 2004),while others support that more wind power would lead the price to be lower due to its zero fuel cost.(Bode, S.,2006) (Sáenz de Miera, G. et al., 2008)

As South Korea has stimulated more usage of renewable energy for power generation with RPS (Renewable Portfolio Standard), it would be meaningful to observe the timing discrepancy between energy supply from the wind and demand without storage first. Then, we can evaluate comparative value of energy in a market with different time frames, hours, months, or seasons, to analyze potential value of wind power generation.

For this study, we will perform wind power value analysis with wind generation output (measured hourly in MWh) in 8 locations in Jeju for energy supply from wind. Also, hourlyJeju SMP (in KRW/KWh) is used as a proxy to hourly demand, as actual load of energy is not available. Both wind output and SMP data are imported from the Korea Power Exchange (KPX), for three-year-long study from Jan.1st, 2009 to Dec.31st,2011, providing us 26,280 data points for each wind power output per a location, and for hourly Jeju SMPs. [1]

Methods

First, correlation-coefficient (ρ)between output from wind generation and demand.is adopted to evaluate the statistical relationship between of wind generation output and demand in Jeju applying correlation-coefficient (ρ)

$$\rho = \frac{E(w_t - \overline{\mu_w})(p_t - \overline{\mu_p})}{\sigma_w \sigma_p}$$

where w_t is the hourly wind generation output vector, $\overline{\mu_w}$ is the mean of the wind output for the three years, p_t is the vector of the hourly SMP, and $\overline{\mu_p}$ is the mean SMP of Jeju for the three years. Also σ_w and σ_p are standard deviation of wind output generation output and SMP in Jeju respectively.

[1] epsis.kpx.or.kr

After examining the mutual relationship between wind output and price, we can examine average value of wind power generation in Jeju on hour *h*, by assigning weight with hourly SMP, p_h to the relative output on hour *h* to the total output for the three years form '09 to'11.

$$Average\ \ Wind\ Value_h = \frac{w_h}{\sum_t w_t} \cdot p_h$$

Expected Results

This study is expected to provide two main results with the two methodologies suggested in the methodology part. First, we will be able to observe the relationship between the energy supply from wind generation and demand. If the coefficient-covariance between the output and demand is positive, it would suggest that wind power generation have a potential of constraining the market price from increasing by supplying more energy at lower price. Second, such a relationship would be elaborated with average value of wind power. We will be able to calculate wind output value from a variety of time perspective: by hour, month, or season. These comparative results would provide implications on a dynamics of wind output value with a variety of time window.

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