The Effect of Wind Power Forecasts on Electricity Spot Prices in Denmark

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Short Abstract

The aim of the paper is to examine the effects of wind power forecasts for western Denmark on the spot prices at the Nord Pool. The effects of such forecasts are shown to be substantial. Consequently, it is described how forecasts of wind power generation can be accounted for when modeling spot prices, and how this benefits the accuracy of resulting spot price forecasts. The methodology of the paper appears promising and may be applied in the future to other markets with significant wind penetration and possibly with different gate closures.

Extended Description

It is a known fact that electricity prices on the Nord Pool spot market are mainly influenced in the long run by water level in the reservoirs of Norwegian and Swedish hydropower plants. However, changes in water level happen slowly and are therefore not really relevant when predicting prices on Nord Pool spot market, for which look-ahead times range between 12- and 36-hour ahead.

Each area of the Nord Pool region has a different type of electricity generation mix, which results in different characteristics of price variations with levels of electricity generation. The paper concentrates on the analysis of the effects of both predicted wind power generation and predicted wind power penetration on the spot prices in the Western Denmark price area. Ways of using nonparametric statistical methods to account for these variables in price prediction models are also discussed. The method for parameter estimation uses a Recursive Least-Squares (RLS) algorithm with exponential forgetting in order to accommodate longsfklskfskfdskfksk-term variations in the market characteristics. The analysis

is performed on data spanning the whole year of 2006. Spot price forecasts are produced and evaluated over the same period. The input wind power forecasts for Western Denmark have been provided by Energinet.dk as an output of the Wind Power Prediction Tool (WPPT).

In contrast with results from previously published papers mainly focusing on the effects of measured wind power, this paper demonstrates that wind power has substantial effect on the spot price. But, instead of actual available wind power on the trading hour, it is shown that it is the predicted level of wind generation that significantly influences of the spot price. This is in such manner that prediction of high wind generation tends to lower the spot price. In parallel it is shown that forecasted wind power penetration should be used rather than predicted generation, as it accounts for how much power has to be provided by other generators as well. The proposed statistical models accounting for predicted wind power penetration gives satisfactory description of spot price variations and comprises a good basis for generating accurate day-ahead forecasts of such prices.

Given the results of the paper, it is very likely that the proposed methodology will be appropriate when forecasting prices on other electricity pools with significant wind power penetration, and also markets with other characteristics, such as the Nord Pool regulation market for instance.