

# Limits to wind aggregation: empirical assessment in the Spanish electricity system

E. Lobato, K. Doenges, I. Egido, L. Sigrist

**Abstract—** Inaccurate wind forecasts create negative technical and economic effects on power systems such as wind curtailments, increase of operating reserves or economic penalties that wind owners have to face. In the Spanish market, wind energy units deviating against the system incur in significant extra costs. Taking advantage of the geographical dispersion of wind farms, wind aggregation poses a solution to imperfect predicting techniques reducing wind portfolio differences between predicted and real production. In the Spanish electric power system, we measure in this paper the efficacy of aggregating wind promoters in reducing deviations and costs. For this purpose, an empirical method using measures of real productions and schedules is proposed, taking advantage of an optimization model that builds a wind portfolio with the minimum wind deviation, and defining key performance indexes to compute the benefits of the aggregation. To obtain significant and reliable values, the whole year of 2016 is assessed using 67 wind farms representing 7% of the total wind power installed in the Spanish peninsula at the end of 2016. It will be shown that aggregation is able to reduce a maximum of 65% of individual wind deviations which translates in a reduction of no more than 58% of individual wind deviation extra-costs. In addition, this limit of maximum extra-costs reduction represents 2% of loss of income in the daily energy market.

**Index Terms—** Wind forecasting; Wind aggregation; Balancing markets

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