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Analysis of drivers affecting the use of market premium for renewables in Germany

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HIGHLIGHTS

- Wind power operator profitability in the German market premium model is analyzed.
- Correlation with the overall wind power feed-in and prediction error is crucial.
- Wind forecast error clearing cost of the analyzed portfolios show clear differences.
- The direct marketing option of wind power can be evaluated as attractive.

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ABSTRACT

In this paper, we identify and analyze parameters that determine the profitability of wind power operators in the German market premium model. Based on an empirical analysis of different German wind power profiles from 2007 to mid-2012, we are able to show that the profitability significantly depends on the correlation of the wind power portfolio with the overall wind power feed-in and prediction error in Germany. Significant differences between the wind forecast errors clearing cost of the analyzed portfolios can be identified. Our analysis shows that a wind power operator would profit in most cases from a reduced forecast error, which could be achieved through an improved forecast model and an increased share of the intraday cleared error. Furthermore significant locational portfolio advantages and disadvantages can be identified when comparing the different market values. In general, the empirical analysis shows that a premium of 3.5 €/MWh is suitable to cover the cost of an imperfect forecast. Taking further into account that for 2012 a premium of 12 €/MWh was granted; the direct marketing option can be evaluated as highly attractive, which is furthermore indicated by the rapid increase of the directly marketed wind power and photovoltaic generation.

1. Introduction

According to national targets, the share of renewable energies in electricity production should rise to 35% in 2020 in Germany (EEG, 2012). A rapid expansion of renewable energies has taken place in recent years. In 2011, the share of renewables in electricity production has reached 20%.[1] The German renewable energy support act (EEG) offers a market premium for renewables as an incentive for market and system integration of renewable energies which gives all operators of renewable energy installations the opportunity to market their electricity on their own. This can be seen as a step towards the better market integration of renewables.

Generally, two goals of supporting renewables can be identified: a fast expansion of installations and efficient market integration. Whereas a rapid expansion requires low investment risks for investors, market integration means taking considerable market risks which could hamper further market growth. The support strategy has to be evaluated concerning these two goals. A well-adapted feed in tariff regime proofed to be well-suited especially to start the development of renewable energy (European Commission, 2008; Hiroux and Saguan, 2010). Through guaranteeing a priority feed-in and a fixed feed-in tariff for a fixed period of time for electricity produced from renewable energy sources (RES-E), the EEG isolates the producers from market signals and risks. With a rising market share of the renewable generation efficient market integration becomes more and more

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[1] In 2015, a share of 32.5% was reported.

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crucial as the impact on the power system and the power market rises. Being acceptable in an initial stage of development to enable a fast capacity expansion, the support strategy of isolating renewable energy producers from market signals should be revised in a second stage in order to guarantee an efficient allocation of the renewable generation (Hiroux and Saguan, 2010; Klessmann et al., 2008). The aim of the new market premium model, which gives operators of renewable energy installations the opportunity of a monthly switch between a fixed feed-in tariff and an optional direct marketing with a market premium on top, is to improve the integration of the renewable generation through exposing the participants to market signals while keeping this risk on the low level of the feed in tariff regime. The market premium (MP) consists of a term that fills the gap between the feed in tariff and the actual market value of the renewable generation and a premium (PM) to cover the costs of the direct marketing. While the market value of adjustable renewable energy installations like biomass plants or hydropower plants is equated with the monthly Phelix Base, the market value of fluctuating wind and photovoltaic generation is calculated ex-post based on the throughout Germany generation (EEG, 2012). In consequence, the market premium acts like a benchmark rewarding a demand-responsive feed-in. Furthermore the premium (PM) gives an incentive for a cost-minimized marketing of the generation which is mainly influenced by the costs of schedule deviations due to inaccurate power forecasts (Consentec and R2B, 2010; Sensfuss and Ragwitz, 2011).

The aim of this paper is to identify parameters that determine the profitability of wind power operators in the market premium model in Germany. Following and extending the approach of Obersteiner et al. (2010), the analysis of the market premium in this paper focuses on the identification of the drivers and the determination of the value of the cost of imperfect forecast and the market value. In order to evaluate the incentive for wind power producers to choose the market premium, wind power forecast and the actual generation data for the control zones of the four German system operators from the years 2007–2012 are used to determine the cost of an imperfect forecast. For a better comparison of the assessed market integration cost of wind power with the values found in the literature and due to the higher liquidity of the day-ahead market, this paper focuses on the evaluation of the direct marketing of wind energy over the day-ahead market. Nevertheless the case of an exclusive intraday direct marketing of wind energy is considered as well.

The paper is structured as follows. In Section 2, an overview of the related literature is given. In Section 3, the possible profit of wind power generators in the German market premium model is derived and parameters influencing the profit of wind power generators in the German market premium model are identified. This includes profile service cost, and the market value of wind. An empirical analysis of the incentive for choosing the market premium is conducted in Section 4. In the last section, conclusions are drawn and policy implications are given.

2. Related literature

From the viewpoint of an inaccurate wind generation forecast the integration cost of wind power have been assessed by several national and international studies. The integration costs can be expressed as imbalance cost or as cost of imperfect forecast. Representing the expenditures for clearing a forecast error on the intraday and/or the imbalance market, imbalance costs differ from the cost of imperfect forecast which also take the opportunity cost on the day-ahead market into account (Obersteiner et al., 2010). Typically imbalance cost or cost of imperfect forecast are estimated through a convolution of simulated or historical wind power generation, the corresponding forecast and market data (Klobasa et al., 2009; Obersteiner et al., 2010). Following this approach, Von Roon (2011) calculates imbalance cost for the settlement of the forecast error using intraday trading, balancing energy and a special EEG reserve in Germany of 2.2 €/MWh (wind) for March till October 2010. In consideration of the opportunity cost resulting from an inaccurate day-ahead trading, the cost of imperfect forecast is calculated with 5.4 €/MWh. Assuming that the whole day-ahead forecast error is cleared with balancing energy Breitschopf et al. (2010) assess imbalance cost for the four German transmission system areas of 6.9-9.4 €/MWh for 2006 and of 4.4–6.4 €/MWh for 2007. Dividing the total imbalance cost through the corresponding fluctuating wind power and photovoltaic generation Sensfuss and Ragwitz (2011) estimate imbalance cost in Germany of 6.7 €/MWh for 2010 and 5.8 €/MWh for 2011, while the TSOs estimation for 2012, which is based on the same approach, drops to 2.5 €/MWh (Rostankowski et al., 2012). Furthermore, imbalance cost in a range of 4–8 €/MWh or 8–16% of the Phelix-Base are indicated by Sensfuss and Ragwitz (2011) based on typically forecast-errors and the price-spread between the day-ahead and intraday market, and balancing market respectively. Much lower imbalance cost of 1.5 €/MWh are calculated by Consentec and R2B (2010) for the year 2009 in Germany. Studies assessing the imbalance cost of wind power generators are also available for several other European countries. For 2008 imbalance cost of 6.0, −0.3 and 6.9 €/MWh are calculated by Obersteiner et al. (2010) for a sample of wind farms in Austria, Demark and Poland, whereas cost of imperfect forecast are estimated with 5.4, 1.7 and 9.9 €/MWh. In Obersteiner and von Bremen (2009) imbalance cost for different arrangements of wind sites in Austria are indicated within a range of 10–13 €/MWh in the reference case for July 2005 till June 2006, while the imbalance cost of a 500 MW portfolio in Denmark are assed with 0.8–2.9 €/MWh for the years 2003–2006. Using real data for the year 2001 Holttinen (2005a) estimates comparable imbalance cost of 2.3 €/MWh for Denmark. Rather low imbalance costs are estimated for the Nordic countries for several samples of wind farms. While Holttinen et al. (2006) assess cost in a range of 0.6–0.8 €/MWh based on 2004 data for Finland, Neimane and Carlsson (2008) indicate cost in a range of 2.8–8.8 kr/MWh (0.8–0.95 $€_{2012}$/MWh) for the year 2006 in Sweden. Comparing the fictional profit of a 14 MW Irish wind farm based on the 2003 wind speed profile in the British and Spanish market Angarita-Marquez et al. (2007) estimate imbalance cost for the year 2006 of 4.2 €/MWh and 3.9 €/MWh, respectively. In Kleinschmidt et al. (2006) imbalance cost of a 100 MW Dutch wind farm are assessed within a range of 5.6–8.8 €/MWh for the years 2005 and 2006 (Fig. 1).

In general it can be stated that the profile service cost depend on the considered year and the considered country. For Germany, about 2–10 €/MWh are identified. The price level on the spot market should be an important driver of the profile service cost.

3. Profits of wind power generators in the German market premium model and influencing parameters

3.1. General derivation of the additional profit through direct marketing

As of January 2012, when the new German renewable energy support act (EEG) came into force, wind power generators can choose between remaining in the fixed feed-in tariff support scheme or switching to a direct marketing option with a market