

ANALYSIS OF THE PRICE EFFECT OF RENEWABLE ELECTRICITY GENERATION ON SPOT MARKET PRICES IN GERMANY

Frank SENSFUSS^{*1}, Massimo GENOESE^{*2}, Mario RAGWITZ¹

¹Fraunhofer-Institut für System- und Innovationsforschung Breslauer Straße 48, 76139 Karlsruhe, Tel. +49-721-6809-133, Fax. +49-721-6809-257, E-mail: Frank.Sensfuss@isi.fraunhofer.de

²Institut für Industrielle Produktion, Universität Karlsruhe, Hertzstr. 16, 76187 Karlsruhe, Tel.+49-721-608-4417;massimo.genoese@wiwi.uni-karlsruhe.de

1. Introduction

The electricity generation by renewable energy sources in Germany has been growing considerably throughout the past years. This development has led to an intensive debate on the cost of the German feed-in system. An important aspect which has to be taken into account in the current discussion is the impact of privileged renewable electricity generation on the electricity market in Germany. This paper seeks to analyse the impact of renewable electricity generation on spot market prices.

2. Methodology

Since renewable electricity generation has to be bought in advance the remaining demand load that has to be purchased on the electricity markets is reduced correspondingly. Therefore the guaranteed feed-in of electricity generated by renewable energy sources has the effect of a reduction of the electricity demand. A stylized overview of the discussed effects of renewable electricity generation for a single hour is given in Figure 1. As long as this supply curve has a positive slope the reduced demand on the market leads to lower prices. As this effect shifts market prices along the German merit-order of power plants the effect is called merit-order-effect in this paper. A central goal of this paper is to assess the actual value of the merit-order effect of German renewable electricity generation.

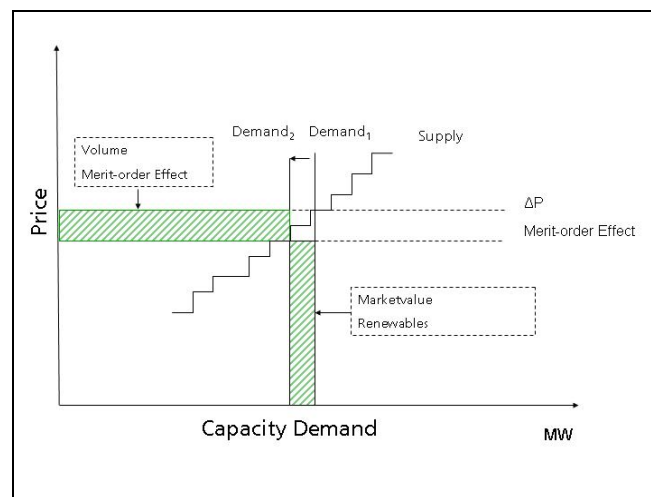


Figure 1 Merit-order effect of renewable electricity generation

In general two approaches are possible in order to try to assess the impact of renewable electricity generation on spot market prices. One approach is to analyse existing time-series on market prices and renewable electricity generation with statistical methods. A recent paper (Neubarth et al., 2006) which focuses on wind-energy selects this approach. The authors can show that days with high electricity production from wind-energy tend to have lower prices. The problem of this approach is that market prices are heavily influenced by other factors like plant outages, electricity demand, fuel

* Both authors are Junior Researches

prices etc. As a consequence it is difficult to isolate the effect of renewable electricity generation on market prices.

Since the electricity demand and renewable electricity generation vary on an hourly level an estimation of the actual value of the merit-order effect is a demanding task. Therefore the analysis is carried out with the very detailed agent-based electricity market simulation platform PowerACE able to simulate hourly spot market prices. The PowerACE simulation platform simulates important players within the electricity sector as computational agents. Among these are agents representing consumers, utilities, renewable agents, grid operators, government agents and market operators. In order to be able to generate realistic results a special emphasis is given to the integration of detailed data on power plants, load and renewable electricity generation. After an extensive calibration of the model to real world spot market prices the analysis of the merit-order effect is carried out. In a first step the model is run 50 times with renewable electricity generation and an average hourly price series is calculated. In a next step the procedure is repeated and the supported renewable electricity generation is switched off.

3. Results

The results indicate that renewable electricity generation can have a significant impact on market prices. But the actual amount of the price difference heavily depends on the load, fuel prices and the CO₂ price. As consequence the price-effect varies between values close to zero and more than 15 Euro/MWh. An example for a given day in March 2004 is given Figure 2.

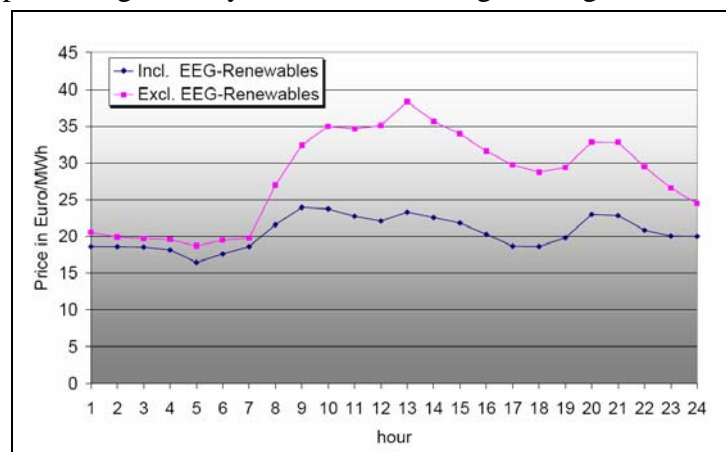


Figure 2 Simulated market price for a day in March 2004

The average electricity price of the year 2004 is reduced by 2.7 Euro/MWh. Assuming that the spot market price is the leading price indicator for all electricity purchases the annual financial volume of the merit-order effect can be calculated with the following formula.

Formula 1 Calculation of the annual financial volume of the „merit-order effect“

$$S = \sum_{h=1}^{h=8760} (p_{RES_h} - p_{NORES_h}) \cdot d_h ; S = \text{Total savings}; p_{RES_h} = \text{Price with renewables in hour } h;$$

$$p_{NORES_h} = \text{Price without renewables in hour } h; d_h = \text{Total electricity demand in hour } h$$

The calculation shows a volume of 1.63 billion Euro for the renewable electricity generation potential of the year 2004. The considerable value of the merit-order effect shows that the cost for the renewable support might not be as high as expected (when ignoring this effect) in an electricity system. Whether this effect materializes for consumers in the real world markets depends heavily on the capability of market players to exercise market power in order to keep prices on a higher level.

References

Codognot Neubarth, J., Woll, O., Weber, C., Gerecht, M., 2006. Beeinflussung der Spotmarktpreise durch Windstromerzeugung. *Energiewirtschaftliche Tagesfragen*, 56 (7), 42-45.