

# ***THE INTEGRATION OF RENEWABLES IN CONTINUOUS INTRADAY MARKETS FOR ELECTRICITY***

Alexander von Selasinsky, Chair of Energy Economics, Technische Universität Dresden, Phone +49-(0)351-463-39764, Fax: +49-(0)351-463-39763, e-mail: alexander.von\_selasinsky@tu-dresden.de

## **Overview**

Energy policy strategies in Europe, especially in Germany and Spain, are increasingly concerned with the efficient integration of the feed-in from weather dependent renewable energy sources. Intraday markets for electricity constitute a meaningful element in these strategies – by allowing to trade electricity close to real time, they are an important instrument for balancing forecast errors of renewables. Yet, research on the workings of (continuous) intraday markets – as implemented in e.g. Germany, France and Scandinavia – is very incomplete. The work to be presented proposes an analytical model to explain how the feed-in from uncertain renewable energy sources shapes continuous intraday markets for electricity. The basic idea of the model is to use the day-ahead uniform-price auction as a reference framework to illustrate how the forecast error is balanced in the intraday market. The model is used to give insights into the price-setting decision of market participants, to explain historic prices from the German electricity market and to show some determinants of the costs for balancing forecast errors.

## **Methods**

Analytical model to provide a simple representation of a continuous intraday market. The model's insights are complemented by analyzing market data.

## **Results**

The model and the analyzed market data show that the direction of the forecast error is a fundamental variable for explaining the formation of prices in intraday markets. In case of an underestimation of the output from renewables, the average price in a continuous intraday market is lower than the day-ahead clearing price for a given hour. In case of an overestimation, the average price is higher than the day-ahead price. With respect to price-setting decisions, it is shown that participants in a continuous intraday market do not bid or ask their true valuation of the electricity they buy or sell. This can be understood as a premium for offering their flexibility. Analyzing determinants of integration costs shows that balancing forecast errors becomes more costly as real-time becomes closer since inflexible power generators withdraw their liquidity support and bid prices decrease and ask prices increase more rapidly. It can therefore be reasonable to restrict trading activities with respect to the number of trades and the period of active market participation.

## **Conclusions**

The direction of the forecast error is an important variable for understanding and potentially forecasting transactions in continuous intraday markets. Negative intraday prices will become more frequent as the magnitude of underestimated renewable output becomes larger. Further research which captures the complexities of electricity markets while considering the transactions of profit-maximizing, strategically acting agents will contribute to answering how renewable energy sources can efficiently be integrated in the energy system.

## **Note**

The working paper is available at SSRN (<http://ssrn.com/abstract=2405454>). Researchers seem to be interested in the topic since the paper was at the Top Ten Download List (recent papers) for SRPN: Energy Politics (Topic), SRPN: Other Renewable Energy (Topic) and Renewable Energy eJournal.

## **References**

- Abrell, J., Kunz, F., 2012. Integrating intermittent renewable wind generation - insights from the stochastic electricity market model (stELMOD). <http://dx.doi.org/10.2139/ssrn.2069935>.
- Weber, C., 2010. Adequate intraday market design to enable the integration of wind energy into the European power systems. *Energy Policy* 38, 3155–3163.
- Zipf, M., Möst, D., 2013. Impacts of volatile and uncertain renewable energy sources on the German electricity system, in: 10th International Conference on the European Energy Market (EEM), 2013, pp. 1–8.