Yassin Bouyraaman, Joerg Bendfeld and Stefan Krauter

INTEGRATION OF OFFSHORE WIND ENERGY INTO THE GRID SYSTEM IN GERMANY MODELING OF A MARKET-ORIENTED CONCEPT

Yassin Bouyraaman, University of Paderborn, Department of Sustainable Energy Concepts, University of Paderborn, Germany, Phone: +49 5251 603469, Fax: +49 5251 603235, yassin.bouyraaman@upb.de
Jörg Bendfeld, University of Paderborn, Department of Sustainable Energy Concepts, University of Paderborn, Germany, 05251 602302. Joerg.Bendfeld@upb.de
Stefan Krauter, University of Paderborn, Department of Sustainable Energy Concepts, University of Paderborn, Germany , 05251 602301. Stefan.krauter@upb.de

Overview

Sustainable energy sources play a more and more leading role in future energy generation. Operating offshore wind turbines under economic considerations puts to the challenge that wind forecasts and actual output do often differ widely. This makes it difficult to participate in the free electricity market and destabilizes the electric supply network without appropriate countermeasures.

Methods

This paper investigates whether the combination of a wind farm with a methane-based energy storage can provide relief. The basic idea is to compensate the differences between forecast and actual output of offshore wind energy with the help of the methane based storage system. To accomplish this, a concept for intelligent scheduling, i.e. the predictions derived from nominal supply, is developed. This enhanced scheduling is based on forecast wind data, corrected by a factor derived from a temporal analysis of the deviation of forecast to actual value with an added impact to control the storage level. Furthermore, the obtained concept for scheduling is analyzed using a set of real data of a given wind farm and optimized experimentally. Moreover, the paper also examines how such a system of wind turbine and storage meets the criteria for participation in the balancing energy market and how such participation in return affects the system. A consideration of incomes attainable by this system using the developed method of optimized scheduling under conditions of free electricity market participation completes the paper. Some commercialization scenarios concerning offshore wind-farms are discussed. The focus is set to energy-exchange trading combined with offering control reserve (Secondary Control Reserve (SCR) or Minute Reserve (MR) or only offering control reserve without participating in Energy Exchange (EEX)-trading.

Results

In case of EEX-trading combined with MR the best results in an economical as well as in a technical manner are achieved. The overall turnover increases. In other words, the wind-farm and storage system operates in an appropriate way, neither great under-performance nor much over-stressing. EEX-trading combined with SCR achieves also great increase regarding overall turnover (+ 35%) but due the fact that no adaptions with regard to weather conditions can be made, the amount of called correctional control reserve is about five times greater compared to EEX & MR. As mentioned before, only offering control reserve (MR) without participating in EEX-trading does not make sense under the given circumstances but in case of decreasing EEX-prices and increasing amounts of control reserve and/or increasing prices of control reserve, this assessment may change in the future.

Conclusions

An offshore wind-farm combined with a high performance storage system is capable to participate in EEX trading as well as control reserve market which opens up new economical perspectives. In case of offering control reserve, minute reserve is the more suitable choice compared to secondary control reserve because offers has to be made only one day in advance. Nevertheless, at the end of the day the development of EEX prices, gas prices and the progress in the control reserve market will determine the most appropriate way of direct marketing. On the other hand great investments has to be made and thus also financial risks has to be taken. Nowadays EEG-marketing is still the most simple and low-risk method of operating a regenerative energy power plant, but as mentioned at the beginning of this paper, EEG-compensation will decrease annually by 7%. The lower the EEG-compensation, the higher is the incentive for regenerative power plant operators to strike new paths with respect to marketing strategies.

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Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZWS); Pressemitteilung: Weltweit größte Power-to-Gas-Anlage zur Methan- Erzeugung geht in Betrieb - Vorstufe für die industrielle Anwendung er reicht; Stuttgart, 30. Oktober 2012; http://www.zsw-bw.de/uploads/media/ pi-2012-ZSWIWESSolarFuel-Einweihung250kW-Anlage_01.pdf