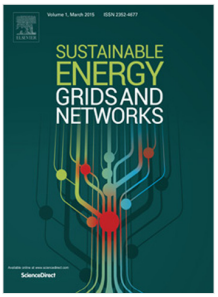
Accepted Manuscript



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PII: S2352-4677(16)30135-7
DOI: http://dx.doi.org/10.1016/j.segan.2017.07.001
Reference: SEGAN 109

To appear in: *Sustainable Energy, Grids and Networks*

Received date : 29 October 2016
Revised date : 7 June 2017
Accepted date : 4 July 2017

Please cite this article as: M. Negrete-Pincetic, G. Wang, M. Arancibia, A. Kowli, E. Shafieepoorfard, S. Meyn, The value of volatile resources in electricity markets, *Sustainable Energy, Grids and Networks* (2017), http://dx.doi.org/10.1016/j.segan.2017.07.001

The Value of Volatile Resources in Electricity Markets

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Abstract

The rapid adoption of renewable generation has brought volatility to the grid as well as electricity markets. There is a need for models and analytical techniques to obtain insight on the cost of volatility, and the benefits of responsive technologies that can provide ancillary services to mitigate this cost.

The model introduced in this paper is based on typical markets in operation today, in which day-ahead and real-time power markets are used to schedule resources to maintain supply-demand balance. The real-time market model is the diffusion model introduced in prior work. Analysis is conducted in an idealized competitive equilibrium setting. The introduction of a coupled day-ahead market is novel, and can be used to quantify the costs and benefits of generation from renewable resources.

Closed-form expressions are obtained for the supplier and consumer surpluses based on computations for an associated two-dimensional diffusion process. These formulae quantify how the value of wind generation falls with volatility, and also how this cost can be reduced with the introduction of responsive ancillary services. Perhaps surprisingly, it is found in numerical experiments that the introduction of generation from wind may result in significant gains for the supplier of traditional generation respect to the case without volatile resources, even when the consumer owns and controls the wind farm.

Keywords: Electricity Markets, Renewables, Stochastic Control.

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Acknowledgement: This research was partially funded by the Complex Engineering Systems Institute, ISCI (ICM-FIC: P05-004-F, CONICYT: FB0816).