Exploiting Flexibility in Coupled Electricity and Natural Gas Markets: A Price-Based Approach

Natural gas-fired power plants (NGFPPs) are considered a highly flexible component of the energy system and can facilitate the large-scale integration of intermittent renewable generation. Therefore, it is necessary to improve the coordination between electric power and natural gas systems. Considering a market-based coupling of these systems, we introduce a decision support tool that increases market efficiency in the current setup where day-ahead and balancing markets are cleared sequentially. The proposed approach relies on the optimal adjustment of natural gas price to modify the scheduling of power plants and reveals the necessary flexibility to handle stochastic renewable production. An essential property of this price-based approach is that it guarantees no financial imbalance (deficit or surplus) for the system operator at the day-ahead stage. Our analysis shows that the proposed mechanism reduces the expected system cost and efficiently accommodates high shares of renewables.

General information
State: Published
Organisations: Department of Electrical Engineering, Center for Electric Power and Energy, Energy Analytics and Markets
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Number of pages: 6
Publication date: 2017

Host publication information
Title of host publication: Proceedings of IEEE PES PowerTech Conference 2017
Publisher: IEEE
ISBN (Print): 9781509042371
Keywords: Bilevel programming, Electricity markets, Natural gas markets, Stochastic programming
Electronic versions: Exploiting_Flexibility_in_Coupled_Electricity_and_Natural_Gas_Markets_A_Price_Based_Approach.pdf
DOIs: 10.1109/PTC.2017.7981047
Source: PublicationPreSubmission
Source-ID: 131772441
Research output: Research - peer-review › Article in proceedings – Annual report year: 2017