IEEE Transactions on Power Systems. Volume:30. Number: 4. Pages: 1825-1837. July 2015

Contracting strategies for renewable generators: a hybrid stochastic and robust optimization approach

B. Fanzeres, A. Street, L.A. Barroso

Abstract— We present a new methodology to support an energy trading company (ETC) to devise contracting strategies under an optimal risk-averse renewable portfolio. The uncertainty in the generation of renewable energy sources is accounted for by exogenously simulated scenarios, as is customary in stochastic programming. However, we recognize that spot prices largely depend on unpredictable market conditions, making it difficult to capture its underlying stochastic process, which challenges the use of fundamental approaches for forecasting. Under such framework, industry practices make use of stress tests to validate portfolios. We then adapt the robust optimization approach to perform an endogenous stress test for the spot prices as a function of the buy-and-sell portfolio of contracts and renewable energy generation scenarios. The optimal contracting strategy is built through a bilevel optimization model that uses a hybrid approach, mixing stochastic and robust optimization. The proposed model is flexible to represent the traditional stochastic programming approach and to express the ETC's uncertainty aversion in the case where the price distribution cannot be precisely estimated. The effectiveness of the model is illustrated with examples from the Brazilian market, where the proposed approach is contrasted to its stochastic counterpart and both are benchmarked against observed market variables.

Index Terms— Conditional value-at-risk, power system economics, robust optimization, stochastic optimization.

Citation:
Fanzeres, B.; Street, A.; Barroso, L.A.; "Contracting strategies for renewable generators: a hybrid stochastic and robust optimization approach", IEEE Transactions on Power Systems, vol.30, no.4, pp.1825-1837. July, 2015.