Pricing for Variable Renewable Resources in Electricity Markets

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I. OVERVIEW

The generation portfolio available to System Operators (SO) is changing to include Renewable Energy Sources (RES), increasing the opportunities and challenges in the daily scheduling of the electricity resources. In this research, we focus on the effect of discrete changes in availability and uncertainty affecting the market prices. We consider a deregulated electricity market, with an independent system operator (ISO) performing economic dispatch of resources including uncertain RES. We formulate this as a mixed integer linear program (MILP) with probabilistic constraints.

II. METHODS

We posit a theoretical framework, with the economic dispatch problem of an ISO that seeks to minimize the cost of generation and considers integrality constraints, and include uncertainty coming from the RES as a chance constraint with exogenous performance guaranties.

We use the quantile of the probability distribution function for the RES errors, and compare the equilibrium obtained for the ISO problem with the optimal solution for the problem that each individual generator has given the prices provided by the ISO to find optimal contracts for each generator and a clearing condition for the market.

III. RESULTS

We present our results as sequence of models with increasingly complex structures for the uncertainty and the equilibrium in the market. We analyze the costs of the market for different demand and uncertainty levels, illustrating the sensitivity of the solution to these parameters. Our metric includes social welfare and the units that are used in the optimal solution.

IV. CONCLUSIONS

The increase in RES does require to analyze the effects that uncertainty and variability have on the dispatch of conventional sources and the overall welfare of all participants. Our results suggests the need for increased coupling of demand resources to enhance the utilization of the available resources and promote non-confiscatory markets.

NOTES

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