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A hybrid MILP and benders decomposition approach to find the nucleolus quota allocation for a renewable energy portfolio

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Abstract— Portfolios of renewable electricity sources are interesting risk-management mechanisms for trading in electricity contract markets. When formed by players belonging to different companies, their stability relies on the way the benefit generated by the optimal portfolio is allocated. The challenge of finding a fair and efficient allocation can be mathematically formulated in terms of finding the Core of a cooperative game, which in turn is stated as an optimization problem with a set of constraints that exponentially grows with the number of participants, quickly becoming computationally intractable. Moreover, the right-hand-side of each constraint relies on a given coalition value, which in our case is obtained by a two-stage stochastic optimization model. This paper presents an efficient methodology based on mixed -linear programming and Benders decomposition to find the Nucleolus share of large-scale renewable portfolios. Case studies are presented with data from the Brazilian power system.

Index Terms— Benders decomposition, cooperative game, nucleolus, risk-aversion, renewable energy pool.

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