

## **Risk constrained portfolio selection of renewable sources in hydrothermal electricity markets**

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**Abstract—** Renewable sources have recently emerged as a generation option for many countries in order to promote clean energy development. In the case of Brazil, small hydro plants and cogeneration from sugarcane waste (bagasse) have been attractive alternatives during the past years, with hundreds of MW installed since 2004. Despite their advantages, both alternatives are hindered by seasonal yet complementary availability. This forces producers to discount (or price) the risks faced when selling firm energy contracts and may ultimately lead to projects being commercially unattractive. We propose a stochastic optimization model that defines the optimal composition of a portfolio based on these two renewable sources in order to maximize the revenue of an energy trading company. At the same time, this model mitigates hydrological and fuel unavailability risks, thus allowing the participation of both sources in the forward market environment in a competitive manner. A case study is presented, based on data from the Brazilian system.

**Index Terms—** Energy trading, portfolio selection, renewable generation, risk management, stochastic programming.

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**Citation:**

*Street, A.; Barroso, L.A.; Flach, B.; Granville, S.; Pereira, M.; "Risk constrained portfolio selection of renewable sources in hydrothermal electricity markets", IEEE Transactions on Power Systems, vol.24, no.3, pp.1136-1144, August, 2009.*