

## **Portfolio applications in electricity markets review : Private investor and manager perspective trends**

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### **Abstract**

The private sector plays a major role in the expansion and operation of power systems in most countries, especially those running liberalized electricity markets. Policymakers have the task of inducing private agents, through their regulatory designs, to make decisions that point toward social welfare maximization. Conversely, it is a task of private agents to protect themselves against the risks of the sector, including regulatory risks, international fuel price uncertainty, climate change policies, natural resource availability, electricity demand uncertainty, CO<sub>2</sub> clearance prices, etc. Instead of hiding all of these risks within the total project costs and losing competitiveness, private agents can use diversification as a strategy to deal with them. This paper presents a review of the main applications, voids and challenges of portfolio optimization for two key agents of the private sector: investors and managers. The problem of the investor is to design a technology portfolio to invest in that maximizes its expected returns and limits risks, while the manager has to design a portfolio of financial/physical instruments (long-term contracts, futures, etc.) to sell/buy electricity and hedge against price risks. We have found two fundamental issues in the literature; the first and most important is excessive confidence in historical data and statistical analysis for predicting future price behavior for a changing future in detriment of more structural analysis. Structural analysis can include particularities of modern power systems such as future transmission changes, congestion, operational constraints (ramps), new entrants, new technologies, and new demand growth patterns that cannot be taken into account by simply analyzing price historical values. The second is the omission of renewable complementarities, which is a proven characteristic of dispersed renewable plants that may have important risk-mitigation effects, although it has largely been ignored in portfolio analysis due to insufficient data, modeling limitations, and computational complexity..

### **Keywords**

Portfolio, Optimization, Risk, Electricity markets, Private investment.