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# Multi-market energy procurement for a large consumer using a risk-aversion procedure

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ABSTRACT

This paper provides a technique to derive the bidding strategy in the day-ahead market of a large consumer that procures its electricity demand in both the day-ahead market and a subsequent adjustment market. Price uncertainty is modeled using concepts derived from *information gap decision theory*, which allows deriving robust decisions with respect to price volatility. Risk aversion is built implicitly within the proposed model. Correlations among prices in the day-ahead and the adjustment markets are properly modeled. The proposed technique is illustrated through a realistic case study.



## 1. Introduction

### 1.1. Aim

In an electricity market, the consumers procure their electricity needs from the market, bilateral contracts or from self-production facilities. In this paper, we focus on a large consumer that participates in the day-ahead and adjustment markets with the objective of procuring its electricity demand at minimum cost while controlling the risk of cost volatility. We also consider that this consumer may supply part of its electricity demand using a self-production facility.

In order to buy electricity from the day-ahead and adjustment markets the consumer must submit a bidding curve for each of these markets and for each trading hour. Thus, considering a short-term planning horizon of 24 h, we focus on the problem of determining the optimal hourly bidding curves that the consumer should submit to the day-ahead market.

The major difficulty in this problem comes from the lack of information about electricity prices in the day-ahead and adjustment markets when the consumer submits its bidding curves for the day-ahead market. This uncertainty implies that the final procurement cost is unknown for the consumer. Thus, we propose a risk-averse model to find robust strategies against experiencing procurement costs higher than the expected one. The risk modeling is based on concepts derived from information gap decision theory (IGDT) [1]. This technique allows maximizing the robustness of the bidding strategy against the risk associated with uncertain day-ahead and adjustment market prices.

The IGDT-based model proposed in this paper is similar to other models that explicitly consider risk, such as mean–variance models and scenario-based models that include risk control through risk metrics, e.g., the CVaR (conditional value at risk). The distinct feature of IGDT-based models is that they do not require any assumption of the nature of uncertainty. This is not the case for scenario-based models that explicitly require a procedure to generate scenarios based on some uncertainty assumptions, and for mean–variance models that also require some assumptions on the random variables that describe the uncertainty of the model.

### 1.2. Procedure

Uncertainties are generally quantified by mathematical abstractions such as probability density functions or fuzzy logic membership. IGDT is an alternative approach for decision-making under uncertainty that makes minor assumptions on the structure of the uncertainty. Specially, IGDT is useful when the decisions are made under significant uncertainty. IGDT models assume neither

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