

# MARKET INTEGRATION OF RESPONSIVE CUSTOMERS: APPLICATION TO ENERGY AND BALANCING MARKETS

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## Abstract

The lack of demand resources participation is one of the main problems currently investigated in deregulated electricity markets. In this paper, an existing methodology for creating offers and bids of large customers is applied to analyse their daily and monthly energy consumptions. This analysis allows their participation in both energy and ancillary services markets. A simulation for a large customer participating in Spanish Electric Energy Markets (Day Ahead, Intra-Daily and Balancing) is developed in the paper to show the customer potential. The paper shows the real viability of the participation of the demand response resources in these markets, and the results obtained can be easily expanded to other markets and contracts for this type of resources.

## Key Words

Demand response resources, demand modelling, electricity markets, responsive demand participation

## 1. Introduction

The lack of demand resources participation is one of the barriers that should be removed to enhance the performance of deregulated electricity markets. Active demand-side participation can decrease the market power of supply side agents [2], and help these markets to obtain a better operation [3]. Several demand response programs have been implemented, or are in progress, for this purpose both in USA and Europe [4-7]. Most of these programs offer payments to large customers in exchange of load reductions calculated from an expected consumption called Baseline Consumption Level (BCL). With this method, participants are paid for selling load reductions when they have not previously bought the load. This fact introduces clear market inefficiency because they are paid for something they do not own [8].

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Recommended by Prof. Alexander Damićan  
(paper no. 209-1096)

To avoid such problem, large electricity customers and energy traders may participate buying energy through demand bids in forward markets (Day Ahead and/or Intra-Daily). After this energy transaction is somehow firm, they may participate in short term markets just as generators do, selling some of the energy previously bought by offering reductions in Balance or other Ancillary Services markets. For practical reasons, small and residential consumers are usually not allowed to participate directly in markets [9], but could participate by managed aggregators in a similar way.

The authors have proposed in a previous paper [1] a way to organize, based on the physical processes involved in electricity consumption, the customer demand according to the relevant parameters in this consumption (size, service provided, flexibility, etc.). The paper described a methodology developed for the characterization of a large customer' peak demand in winter and summer.

The objective of the present paper is to extend the proposed concepts to investigate the use of the previously proposed methodology to estimate the potential participation of a large customers in Electric Energy Markets (Day Ahead, Intra-Daily and Balancing). For doing so, the methodology of customer peak demand organization of [1] is extended to all day long demand organization and a simulation of the participation in the Spanish market of a specific customer (a university) is performed to describe a detailed economic balance of the energy purchases and sales in a real environment.

The paper is organized as follows: The methodology proposed by the authors to organize the customer demand is first used, in Section 2.1, and applied to settle the basis for the demand description. These concepts are extended and the methodology is used in Section 2.2, to compute, for the same customer and over a trading period of 24 h, an hourly set of bids and offers suited for participation in electricity markets. After that, Section 3 is devoted to review the more relevant market characteristics in the possible target markets in Spain. Finally, Section 4 is devoted to use the customer demand organization for simulating the participation in the markets, described in the previous section, and an estimation of the possible benefits for the customer is hinted. Finally, some conclusions are drawn in