

Optimal electricity demand response contracting with responsiveness incentives

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Demand response programmes in retail electricity markets are very popular. However, despite their success in reducing average consumption, the random responsiveness of consumers to price event makes their efficiency questionable to achieve the flexibility needed for electric systems with a large share of renewable energy. This paper aims at designing demand response contracts which allow to act on both the average consumption and its variance. The interaction between a risk-averse producer and a risk-averse consumer is modelled as a Principal-Agent problem, thus accounting for the moral hazard underlying demand response contracts. The producer, facing the limited flexibility of production, pays an appropriate incentive compensation to encourage the consumer to reduce his average consumption and to enhance his responsiveness. We provide closed-form solution for the optimal contract in the linear case. We show that the optimal contract has a rebate form where the initial condition of the consumption serves as a baseline and where the consumer is charged a price for energy and a price for volatility. We illustrate the potential benefits issued from the implementation of an incentive mechanism on the responsiveness of the consumer by calibrating our model with publicly available data.