AN ASSESSMENT OF THE ECONOMIC POTENTIAL OF LARGE-SCALE DEMAND RESPONSE: IS THERE A BUSINESS OPPORTUNITY IN FRANCE ?

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Overview

Demand Response is often seen as an appealing option to ensure the equilibrium of electricity markets in case of high penetration of intermittent renewable energy sources. The European power sector could therefore greatly benefit from large-scale deployment of Demand Response, both in terms of cost and enhanced security of supply. However, despite an important amount of available flexible loads, the potential of Demand Response in Europe is far from being tapped. One fundamental reason is the uncertainty around the economic viability of the enabling technologies needed to trigger Demand Response. We tackle the business case of a Demand Response provider by quantifying its expected annual revenues from a real-time energy market. Our contribution is twofold. First, we explicitly include technical and customer-based constraints that might limit the activation of Demand Response, such as maximum number of Demand Response events and their duration. Second, we take into account the uncertainty arising from the total residual demand, highlighting the intertemporal opportunity cost for the Demand Response provider to trigger an event at a certain point in time.

Our paper is structured as follows. The first section explains how Demand Response is modelled. In particular, we motivate the approach of modelling Demand Response as a storage unit, while paying a special attention to what differentiate Demand Response from a standard electricity storage. A customer segmentation is also presented. In the second section, we present the electricity market model we use to carry out our study and we introduce the dedicated resolution method, namely the Stochastic Dual Dynamic Programming algorithm. Section 3 presents a case study on the french power system. Two scenarios are analysed: one based on the current electricity mix, one based on a 2030 electricity mix/demand projection. Annual market revenues are estimated and compared with the annual fixed costs of enabling technologies. The last section concludes and proposes some political implications.

Methods

Electricity market modelling

Optimization under uncertainty

Stochastic Dual Dynamic Programming

Results

A first quantitative estimation shows that a Demand Response provider in France would have been a viable business by now. In the 2030 scenario, the business case is better.

Those results stand when one single agent owns a 100% market share. If several Demand Response providers have to share the market (e.g. segmented according to residential, commercial, and indutrial customers), business viabilities are not always guaranteed.

Moreover, a sensitivity analysis points out that the variable costs of Demand Response activation are fundamental drivers of the viability of the project, since Demand Response competes with other generating units.

Conclusions

Demand Response presents a fairly good business opportunity in France. However conclusions about the economic potential of Demand Response should be taken with care. First, results obtained are very sensitive to assumptions made about the variable costs of activation, which are rather difficult to estimate since they depend on consumers willingness to participate. Second, the market of Demand Response might be limited to a small number of providers.

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