

A Business Model for Retail Aggregation of Responsive Load to Produce Wholesale Demand Side Resources

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Objectives

The project seeks to develop methods for assembling, managing, and valuing complementary portfolios of variable or intermittent power sources and applications, such as load curtailment, load shifting, renewable resources (wind, solar) and distributed storage (e.g., EV and PHEV batteries, UPS devices etc.). Aggregators can assemble portfolios of such resources to obtain wholesale resources that can be offered in the various ISO markets and exploit the complimentary aspects of these resources through portfolio structuring and dispatch strategies to mitigate the intermittent nature of load response and renewables. Variability can be further reduced by pooling uncertain retail level load response and distributed renewable and organizing the pool through product differentiation according to dispatch priorities. This approach will draw on theoretical developments in the economics of efficient rationing and priority service pricing and on recent advances in the financial theory of collateralized debt obligations (CDOs). Specifically, we will exploit the analogy between the pooling of uncertain debt obligation into collateralized debt tranches and the pooling of uncertain demand and renewable energy resources into firm wholesale energy and reserves that can be offered into the ISO markets.

Expected technical accomplishments by the end of the year

The first step we expect to complete and development of an illustrative example that will illustrate the development of a pricing scheme on the retail side that will incentivize load participation and induce self-selection of interruptible service contracts. The aggregation of service contracts by retail customers will create a profile of load response that can be offered into the wholesale market. We plan to develop a theoretical framework and illustrative example for optimizing that profile which will be characterized in terms of a cumulative distribution of curtailable load. We also plan to explore the financial literature on collateralized default obligation (CDO) and debt tranching and in particular the use of Copula distributions to capture the statistical properties of correlated unreliable sources that can be pooled and trunched into priority service classes.

Deliverable and schedule

Since the funding was received at the end of May 2012 we plan to use the FY2012 over the period of June 1, 2012 until May 30, 2012. The first deliverable of the project is a paper submitted to HICSS46 which illustrates the proposed methodology and potential gains. We expect a follow-up paper to be developed by May 30, 2012 and hope to continue the work after that with FY2013 funding.

Risk factors

We do not expect any major obstacles to performing the work described above but the late start due to funding delay caused a delay in recruitment of a grad student that will be working on the project and to some uncertainty regarding how fast he will be able to ramp up to the task.

Early thoughts on follow-On work for FY 2013.

The work this year will focus on pricing of differentiated service level and aggregation of interruptible service contracts into a whole sale product. The follow-up work will explore in more details the complementarity between such a differentiated service and specific distributed resources or loads such as PV panels, EV charging and HVAC type loads that can be shifted in time rather than being interrupted. We are interested in exploring the complementarities and optimizing the mix of such localized supply and demand resources. A promising approach which we plan to explore is to think of such portfolio optimization in terms of financial analogs and to explore operational hedging strategies.