DYNAMIC PRICING FOR RELIABLY SHAPING OF ELECTRICITY DEMAND

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We propose two dynamic pricing schemes to address these challenges in retail electricity setting, i.e., non-differential and differential (customized) dynamic pricing. For the non-differential dynamic pricing, all the residential customers are offered with the same incentive at each period, and the incentive is time-varying; For the customized dynamic pricing, each customer is offered with an incentive price depending on their demand variability and reliability of their responsive load. The goal is to determine the aggregate electricity demand reduction with high reliability (low risk) that maximizes the utility companys long-term average revenue. Both dynamic incentive pricing schemes improve the utility companys revenue by utilizing virtual generation, i.e., demand reduction, and achieve improvements in both total systemic costs and load reduction over existing schemes. In addition, customized pricing proves to be superior to the non-differential pricing in the sense of reliable aggregate demand shift and improved long-term average revenue, since it is based on the customer segmentation according to their reduction reliability and achieves an improved incentive resource allocation among all the customers. The residential customers real-time price elasticity is estimated from the smart metering data of the OlyPen project. Extensive simulation experiments show that for each single period, customers with higher elasticity and lower variance should be paid with higher incentive rates; and along multiple periods, customers with smaller likelihood of shifting their load and greater inclination to consume less over the entire horizon should be given higher rebates. The proposed dynamic pricing mechanism also improves the social welfare for both electricity suppliers and buyers.