Residential end-use electricity demand: Implications for real-time pricing in Sweden

Efficient pricing of electricity is topic important from a policy perspective since efficiently priced electricity can lead to many benefits, including reducing system cost and allowing lower cost integration of variable sources of energy like wind. Despite much research on different pricing mechanisms, in most countries household retail prices have been varying only at a monthly level. Recently, there has been a serious reconsideration of earlier ideas regarding “real time” pricing (RTP) i.e. allowing the retail price of electricity to be determined by the wholesale (spot market) price.

Our study considers the case of Sweden in the context of efficient pricing, where the government and regulators have been quite positive about the potential for real time pricing to alter household demand behaviour. Nonetheless, there is little empirical evidence about the practicability of such schemes, and virtually none for Sweden. In understanding the potential for real time pricing to shift demand over the day, it is important to have a clear idea of two factors: how consumers currently consume electricity at the hourly level; and what the potential benefit to the consumers and retailers is, of different shifts of the daily load profile. Ours is the first empirical study to answer these questions for Sweden. In other words, our study provides an idea of how consumers currently use electricity, at the hourly end-use level, and what are the likely benefits of a variety of load shifts, plausible or not. The perspective taken in this study is, essentially, of a thought experiment in a counter-factual world wherein system prices are exogenously determined and load shifts are feasible.

Using unique data from a study carried out by Sweden’s Energy Agency– in which many households were metered at the appliance-level at 10-minute intervals–, our study estimates hourly end-use load profiles, conditional on household characteristics. These load profiles are in themselves important, since they indicate to the retailer and regulator how consumers actually use electricity during the day. They also provide an opportunity to understand the potential for RTP, in that when used with the (Nord pool) spot price data—upon which any real-time price will likely be based—and specified shifts of the load profile (e.g. shifts of the entire daily load profile two hours ahead), it is possible to compute potential cost savings for both retailers and consumers. Our study indicates relatively intuitive facts about the daily load profile: heating is the largest part of load in winter, and there are two peaks in demand corresponding respectively to the pre-office hours in the morning and the post-return-to-home hours in the evening. Our main results are that the daily cost savings to consumers and retailers is not large; even with maximum variation in price, daily cost reductions for the average consumer are smaller than 5% for a very unlikely five-hour-ahead shift in the daily load profile.

Overall, our results indicate that, in the short-run, when technology is fixed, and with domestic load being only a small part of total system load, the direct economic benefits of RTP in reality are likely to

be rather small (as also found in a few other studies of RTP schemes for other countries). Our results are also consistent with the general lack of interest shown by Swedish retailers in offering, and consumers in wanting, real-time contracts which are available by law in Sweden. Taken together, our results and the lack of market activity for RTP contracts call for a careful re-evaluation of the Swedish government's thrust on RTP, and demand flexibility in general, to bear a share of the task of balancing load variability in load.

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