The Effect of Information on TOU Electricity Use: an Irish residential study

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Executive summary

Feedback on electricity use has been found to be an effective mechanism in improving supplier efficiency and encouraging the reduction of residential energy consumption (Fischer 2008, Ehrhardt-Martinez et al. 2010). This information can allow the consumer to learn about how their energy habits impacts their overall usage and bill to encourage conservation practices.

Utilities often use energy efficiency and demand side management programs, such as time-of-use (TOU) pricing, to reduce electricity demand and shift peak usage. These pricing schemes allow the price of electricity to reflect the cost of generation at varying efficiency rates of fuel powered generation and fuel prices during times of high and low demand (Faruqui et al. 2010a, CER 2011). The ideal result is a shifting of usage away from periods of higher energy costs to periods of lower energy cost and consequently a reduction of greenhouse gas emissions. Other benefits of time-of-use pricing include reducing peak congestion and susceptibility to outages by spreading out electricity demand to other periods (Faruqui et al. 2010a, Newsham and Bowker 2010).

Determining how TOU and feedback information are adapted into the household and how households adjust their consumption over time would provide evidence about the effectiveness of continuous information provision. To determine whether these feedback technologies are cost-effective, it is necessary to assess if their effect is sustained over time. The aim of this paper is to analyze the change in usage with different methods of information feedback coupled with a TOU pricing scheme using data from the Ireland Behavior Trial. I take advantage of this unique panel with information about household electricity consumption to answer three main questions on the effectiveness of an in-home display compared to the conventional methods of billing.

First, how persistent are the effects of information provision in a TOU setting? One potential interpretation is that the increased stock of information treatment allows households to learn about their usage patterns and adapt their usage around peak periods to increase savings. This learning occurs through consumer experimentation by altering daily habits such as turning off lights, unplugging electronic devices, and waiting until off peak times to start running appliances. Households can determine which actions impact their electricity bill the most and optimize their usage.

Second, how do households with in-home displays compare in terms of peak energy savings to those on monthly or bi-monthly billing in the beginning and the later months of the trial? In other words, what the benefits are from additional information. On average, a household with an IHD is expected to have a larger response than a household with conventional billing as they have more complete information sets.

And third, what are the overall savings from households with in-home displays compared to conventional billing? This question is tied to the previous question in that households with more information are expected to make larger changes to their energy use. However, it may be possible

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that households with extremely low usage may increase their usage overall when provided with more information (Fischer 2008).

Previous studies have analyzed the effects of information with pricing policies but none have yet compared the billing frequency with information technology with a policy designed to curtail usage during specific times. I find that households with in-home displays reduce their peak energy consumption more than households in the monthly and bi-monthly billing treatment groups during the earlier months of the trial. However, IHD effects lessen over time as households become accustomed to the IHD. This suggests that effectiveness of information wanes as households get used to the presence of the display. On the other hand, monthly and bi-monthly treatment groups show gradual reductions over the course of the trial, suggesting a slower learning rate as households develop a new habit stock.

From a conservation perspective, IHDs appear to have a larger impact on reducing overall energy usage but most of these gains come from the beginning of the trial. When analyzing effects from the latter half of the trial, households on monthly billing are able to reduce their overall consumption more than IHD households. While real time information is effective in reducing initial consumption, in the long run it may be less effective in encouraging conservation practices than conventional billing methods. Overall, I find that monthly billing is more cost effective than providing IHDs (based on a 10-year lifespan).

One suggestion to maintain the strength of the effects is to increase the frequency of bills for households with IHDs. Households are reminded more frequently through the "shock" of receiving their bill to reduce their consumption. Additionally, to prevent IHDs from falling into the "background" of household routines, utilities can change time-of-use rates on a quarterly basis and allow households to adjust their consumption with a more flexible pricing structure to reflect the cost of electricity generation and demand for different seasons.

Overall, the provision of information with TOU pricing has strong initial effects but similar to the suggestions of Torriti (2012), IHD may not be as effective with TOU pricing as it is in cases where the price of electricity changes more frequently such as with dynamic pricing. More research will be needed to determine the benefits drawn from IHDs versus billing frequency with different pricing schemes.

Keywords TOU pricing, information, feedback, energy efficiency, residential electricity