Demand Impact of a Critical Peak Pricing Program: Opt-in and Opt-out Options, Green Attitudes and Other Customer Characteristics

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Electricity is a non-storable product whose cost varies across time while utility rates often do not. Dynamic or time-varying pricing allows better alignment between the price and cost of electricity. For instance, the cost of generating and delivering electricity during periods of high demand, such as hot summer days when air conditioner use is extensive, is higher than during other periods. Dynamic pricing makes it possible to charge higher prices during such periods. One result of such price variation is the shifting of power demand from higher to lower priced periods. Power industry stakeholders including utilities have great interest in this effect. It permits, among other things, the provision of cost efficient power by helping utilities avoid the addition of generation and delivery capacity to meet high peak demand.

Three types of time-varying pricing are currently in use. The most static of these is time-of-use (TOU) pricing that varies across blocks of time, such as peak, off-peak and shoulder months, but does not vary within these blocks. The second is critical peak pricing (CPP), which overcomes the short-comings of TOU by incorporating higher charges at critical system peaks that often happen within blocks of pricing months covered by TOU. The third is real time pricing (RTP) and reflects real time market demand and supply conditions. All three time-varying prices

are attempts at improvement over static prices that do not consider the time-varying cost of the production and delivery of power.

In this paper, we explore the demand effect of a CPP pilot undertaken by Sioux Valley Energy, a cooperative serving 21,000 electric customers in Minnesota and South Dakota. The utility used a Smart Grid Investment Grant to install a system-wide advanced metering infrastructure (AMI), which was used for the pilot. The pilot ran from June 1, 2011 through August 31, 2011 and involved 13 event dates when the price of electricity jumped from an average of $0.09/kWh to $0.50/kWh between the hours of 4 pm – 8 pm. The utility notified participating customers a day-ahead of an event day via email, text message, phone call or in-home displays. The pilot involved three types of test groups from the utility's two residential rate class customers. These are opt-in, opt-out, and tech only customers. Opt-in customers are those that volunteered to be on the CPP rate in response to solicitations from the utility. Opt-out customers are those randomly chosen to be on the CPP rate, but had the option of opting out of the program. They also enjoyed bill protection since their bills reflected the lesser of the CPP or default rate. Tech-only customers are those that stayed on the default rate, but received in-home displays that alerted them of critical peak events.

In the paper, we use two different modeling strategies to estimate the demand response of the three groups. The first model estimates the effect of price on demand and the extent of the substitution of demand from peak to off-peak period. The second model looks at the difference between power demand during event and non-event hours for each group to determine the demand effect of the CPP pilot. The pilot also involved a survey that was used to gather information on customer characteristics from a representative sample of each test group. In particular, the survey gauged "green attitudes" of participants (the extent of their concerns about

environmental issues and actions they take to conserve energy based on these concerns) and their appliance ownership. We used the survey information to understand the customer characteristics that drive program response.

We find that a 1 percent increase in price results in demand reduction of 14 percent while the substitution of demand from peak to off-peak period ranges from 12 to 18 percent. Further, average demand reduction is 1.04 kW (27 percent) for the opt-in group; 0.27 kW (7 percent) for the opt-out group; and 0.16 kW (4 percent) for the tech-only group. Other studies in the industry involving experiments and programs with opt-out customers have registered demand reductions of 25% (about 1 kW) or more. The current pilot's results are thus about a third of what is typically seen in the industry from CPP programs. Based on this, we conclude that offering CPP rates on an opt-out basis with bill protection leads to significantly lower per-participant peak demand reduction. We also find that green attitude, and not electric appliance presence, is the greatest driver of reduction in household energy use during peak events. We note, however, that such attitudes do not appear to lead to extra demand reduction for the opt-in customers that self-select into the program. Therefore, we recommend exploring the effect of offering CPP rates on an opt-out basis without bill protection to fully understand the demand changes that are possible under this pricing scheme.