U.S. DEPARTMENT OF ENERGY | Electricity Delivery & Energy Reliability

OG&E Uses Time-Based Rate Program to Reduce Peak Demand

As part of its Smart Grid Investment Grant (SGIG) project for the U.S. Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability (OE), Oklahoma Gas and Electric Company (OG&E) has successfully tested over a two-year period a new time-based rate, which provided about 4,670 participating customers with pric
es that varied daily in order to induce a change in their patterns of electricity consumption and a reduction in peak demand.

According to OG&E's Mike Farrell, "Customers are being provided time-differentiated pricing so that they can choose the appropriate balance between cost and comfort." As a result of the pilot's customers' response to the time-based rate program and modification of their electricity usage, OG&E is rolling out the rate to about 20% of their customers (120,000) by 2016 with the aim of deferring investment in about 170 MW of power plant capacity.

OG&E's SGIG project is multi-faceted and includes activities for automating distribution systems, installing smart meters, and evaluating time-based rates and customer systems such as in-home displays (IHD), programmable communicating thermostats (PCT), and web portals. OG&E's evaluation of time-based rates is part of DOE-OE's SGIG consumer behavior study (CBS) effort.

The CBS effort includes nine SGIG projects that, including OG&E, are deploying smart meters, time-based rates, and various forms of customer systems (e.g., IHDs, PCTs, and/or web portals) to achieve demand-side objectives such as peak demand reduction and/or electricity conservation. The nine projects are applying controlled experimental design methods, including random selection and random sampling for treatment and control groups, to help obtain results that have higher levels of statistical precision and validity than those that do not employ such methods.[1] These techniques also allow for a greater ability to extrapolate results to comparable utilities and customer groups in the United States.

[1] For more information see http://www.smartgrid.gov/recovery_act/consumer_behavior_studies.

OG&E's Treatment and Control Groups

The table below summarizes the results of the randomized assignment of OG&E customers to rate and technology/information treatments and control groups. Rate treatments included variable peak pricing (VPP), which combines a time-of-use design (i.e., prices cover peak and off-peak periods) with real-time pricing (i.e., prices change frequently). The VPP rates during the five-hour peak period vary daily depending on the cost of electricity. The VPP also includes a critical peak price (CPP) component that is applicable year-round when OG&E forecasts a "critical peak event" and needs a reduction in system peak demand. In addition, OG&E also offered a time-of-use (TOU) rate with a CPP component in its pilot test. OG&E provided customers with at least two hours of notice of critical peak events, and each event can last up to eight hours.

The technology/information treatments included IHDs, PCTs, and access to web portals. These were deployed to enable customers to better manage their electricity consumption and costs through improved understanding of their usage patterns.

Total Number of OG&E Customers in Treatment and Control Groups in 2010 and 2011

Treatment/Control Groups	TOU - CPP	VPP - CPP	Total
Web Portal Only	528	559	1,087
IHD and Web Portal	440	442	882
PCT and Web Portal	412	427	839
IHD, PCT, and Web Portal	430	433	863
Control	-	-	999
Total	**1,810**	**1,861**	**4,670**

OG&E's Time-Based Rate Offerings

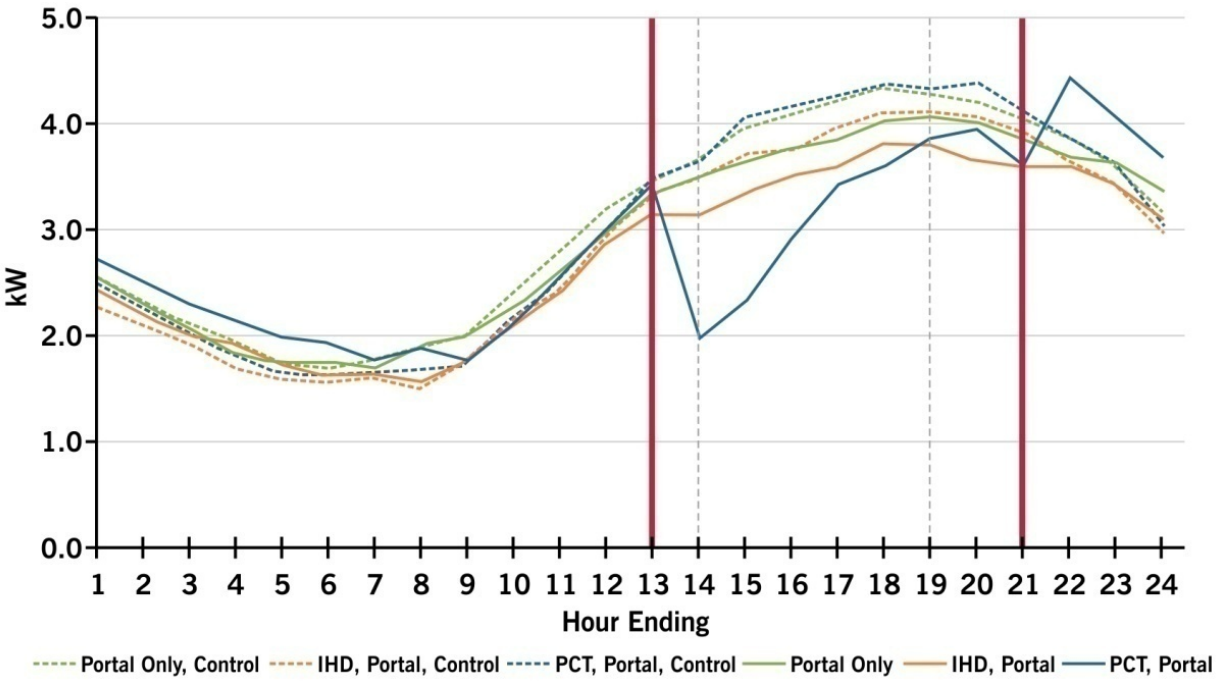
The next table summarizes the time-based rate offerings and the number of days in the summer of 2011 that participants were exposed to the various price levels. The rate is in effect for June to September. On-peak price levels were communicated to customers by 5 p.m. on the previous day. As shown in the table, there were four on-peak price levels: Low (which also corresponded to the off-peak price level), Standard, High, and Critical. As such, each day was

identified by one of the four on-peak price levels. Customers in the control group received the standard rate.

2011 Rate Offerings in OG&E's Consumer Behavior Study			
Price Level	**Residential VPP-CPP**	**Residential TOU-CPP**	**Number of days in summer 2011 at each price level**
Off-peak	4.5¢/kWh	4.2¢ per kWh	122
Low	4.5¢/kWh	4.2¢ per kWh	63
Standard	11.3¢/kWh	23.0¢/kWh	25
High	23.0¢/kWh		28
Critical	46.0¢/kWh		6
Critical Peak Event	46.0¢/kWh	46.0¢/kWh	7 (included in the above)

Demand Response to Time-Based Rates

The figure below shows 24-hour load profiles for the average customer in the OG&E study's VPP-CP treatment and control groups on one of the seven critical peak event days in 2011 (July 15). The vertical red lines indicate the hours of the critical peak event, while the dotted grey lines indicate the hours of the daily peak period. Each of the treatments showed demand reductions during the peak period, relative to the control group. The largest reductions were observed for the customers with PCTs (about 30%), while these also involved a "rebound effect" after the event as air conditioners switched back on to cool homes after the critical peak events were over. Although not shown in the figure, a maximum peak demand reduction of 1.8 kW per customer was observed during critical events, compared to an average reduction of about 1.3 kW per customer observed during non-event peak periods.



OG&E reports that customer acceptance was generally favorable and customer complaint and drop-out levels were relatively low. This may be due, in part, to the fact that most of the participating customers experienced reductions in their summer electricity bills. The average bill reduction over the summer periods was over $150/customer.

Observations

OG&E customers with PCTs appeared to have utilized the greatest control over their electricity usage, both in the peak period (as already mentioned) but also in the off-peak period. As the figure above illustrates, customers with PCTs appeared to increase consumption in overnight off-peak hours relative to the control group, especially those in the VPP-CP rate group. This data suggests that these customers were taking advantage of less expense off-peak electricity prices to increase cooling loads overnight for comfort purposes and/or to pre-cool their homes in anticipation of the event. This effect warrants further study to assess whether customers will more generally increase off-peak consumption when migrating to time-based rates, especially if they have controllable loads such as air conditioning that may be more readily consumed during the off-peak period when prices are lower.

Customers with IHDs appeared to have the largest overall electricity conservation effect in the first year of the study, regardless of the rate design, but in the second year the effect was no greater than those with web portals alone. This observation also warrants further study but suggests that IHDs may, in the short run, enable customers to identify and change behaviors

that reduce wasteful energy use; but that over the longer term, the IHDs may not be any better than web portals at achieving and maintaining electricity conservation effects.

OG&E reports that not all of the customer equipment installations went as planned. In a few cases, due to mix ups, customers received equipment they were not expecting. Demand-side projects involving thousands of customers who receive some form of customer systems may involve needs for record keeping that can be more complicated than expected. Thus there is a need in "customer-facing" programs for continual process improvement to ensure that customers are adequately screened for eligibility to receive certain pieces of equipment, utility contractors install the correct equipment, and information about both the equipment that was supposed to be installed, as well as the equipment that was actually installed, are documented properly. Steps taken with customers to build confidence in program marketing and implementation will help on-going and future recruitment demand response efforts.

Path Forward

The reductions in peak demand, along with the generally favorable levels of customer acceptance, met OG&E's corporate objectives for the project and enabled the decision to roll-out the rate and technology options to more customers to defer capacity expansion projects. As has been found in other pilots around the country, OG&E's results suggest that customer systems such as PCTs, IHDs, and web portals can help customers respond to time-based rates. However, these systems are in the early stages of development and OG&E reports that there are challenges to address, including accomplishing installations inside customer premises, and integrating the devices with AMI, communications, and back-office systems.

Valuable experiences have been gained by OG&E and other SGIG CBS projects related to customer motivation, engagement, recruitment, marketing, and education strategies. For example, the motivations reported to the SGIG CBS projects for customer participation include having the opportunity to save money, doing something positive for the environment, having greater control over consumption and costs, and finding enjoyment in the experience. However, it seems that saving money has been the primary motivator for customers to join time-based rate programs or have interest in acquiring customer equipment.

Learn More

The American Recovery and Reinvestment Act of 2009 provided DOE with $4.5 billion to fund projects that modernize the Nation's electricity infrastructure. For more information visit

www.smartgrid.gov or www.oe.energy.gov. There are five recent reports available for download:

- *Smart Grid Investment Grant Progress Report*, July 2012
- *Demand Reductions from the Application of Advanced Metering Infrastructure, Time-Based Rates, and Customer Systems – Initial Results*, December 2012
- *Operations and Maintenance Savings from the Application of Advanced Metering Infrastructure – Initial Results*, December 2012
- *Reliability Improvements from the Application of Distribution Automation Technologies and Systems – Initial Results*, December 2012
- *Application of Automated Controls for Voltage and Reactive Power Management – Initial Results*, December 2012