

# Changing How People Think About Energy

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## ABSTRACT

What happens when people pay for electricity using market-based prices that vary hour-by-hour and day-by-day? What behavior does hourly energy pricing elicit? What opinions drive these behaviors? How does energy efficiency factor into investments and decision-making? Three years of hourly consumption and qualitative survey data on over 1400 participants in the Energy-Smart Pricing Plan<sup>SM</sup> (ESPP) were analyzed to answer these questions.

The Community Energy Cooperative developed and has managed the ESPP program for three years. An essential component of administering ESPP is educating participants to adopt energy efficient technologies and behavior. The process of communicating these concepts and how participants responded is discussed. This experiment included two years of relatively cool summer weather and one year of atypically high temperatures and high electricity prices. Participants' energy use fluctuated as well. While only minimal behavioral responses in the first two years resulted in net savings on energy bills, more effort and conservation behavior was required to be successful in saving money in the third year. Changes in levels of satisfaction and success in reducing electricity use between the two time periods are explored.

ESPP represents an alternative electricity rate for mass market residential consumers, regardless of their electricity provider. Therefore, the lessons learned here are relevant to those electricity providers who are considering providing new pricing choices to their customers.

## Introduction

Over 1,400 households in the Chicago area have chosen to pay for their electricity in a new way, with real-time prices that vary hour-by-hour and day-by-day. The Community Energy Cooperative has been managing the Energy-Smart Pricing Plan<sup>SM</sup> (ESPP), a market-based pricing program, since 2003. ESPP gives residential consumers the opportunity to share in the benefits of market development by providing direct access to hourly market-based electricity prices. ESPP participants save money from changes in electrical usage during on-peak and high price periods, and by paying lower off-peak electricity prices. Real-time pricing (RTP) can also capture system-related values such as increased reliability of electricity service as a result of better management of scarce and expensive peak electricity supplies. If significant numbers of consumers reduce demand during high price hours, RTP has the additional potential to benefit all customers through improved reliability, deferred need for transmission and distribution investments, and lower energy procurement costs overall (DOE 2006, 30).

The Cooperative's work has shown that real-time pricing is a viable option for residential electricity consumers. The ESPP program has changed the way participants use and think about energy. Their responses vary according to environmental and behavioral factors, but three years of impact evaluations have demonstrated consistent reductions in peak load and a conservation effect – participants are not just shifting their time of use, they're using less electricity.

Education is a key factor in influencing this change, and the potential for lowering household electricity bills provides the incentive for changes in behavior.

This paper describes how the Energy-Smart Pricing Plan works, who participates in the program, and how these participants manage real-time pricing. A quantitative analysis of ESPP participants' energy use is discussed in a companion paper, "Real-Time Pricing is the Real Deal: An analysis of the Energy Impacts of Residential Real-Time Pricing" (Star et al. 2006).

## **Background**

The Community Energy Cooperative is a Chicago-based nonprofit membership organization that was founded by the Center for Neighborhood Technology (CNT) in 2000. CNT combines research, advocacy, policy analysis and program implementation in the areas of energy, transportation, green infrastructure and community information. The Cooperative grew out of CNT's work with the local electric utility ComEd. The Cooperative saw the potential for community-based energy efficiency and demand reduction programs to capture the value of avoided infrastructure costs and to help consumers and communities control energy costs and reduce energy use.

An important challenge facing electricity markets is the lack of rational pricing of retail electricity. While the costs of electricity in wholesale markets can vary dramatically, retail pricing, especially for residential consumers, is generally based on a fixed price. These fixed standard rates mean that consumers pay the same price for electricity at all times and are insulated from the real costs of this commodity which, in wholesale markets, are high during times of high demand, and lower at times of lower demand. In addition, the need to mitigate risk in the fixed rates, given uncertainties of energy use, weather, and peak price, adds additional costs to consumers' rates.

The Energy-Smart Pricing Plan was developed from the Cooperative's analysis of historical energy prices in the northern Illinois (ComEd) service area. Three years (1999-2001) of usage data from residential consumers were studied and costs were calculated using actual wholesale market prices of electricity from the same period. The Cooperative analysis verified that, instead of being random and unpredictable, market prices for electricity followed a pattern. Prices for the majority of the hours of the day were lower than the standard rate, and the number of high priced hours was relatively small, occurred infrequently and most often at predictable times. The Cooperative's analysis showed that even if participants did nothing to change their energy use, the lower prices for the majority of hours could yield energy savings of 10%. If participants were aware of high price periods, educated about how to reduce their electrical usage, and responded by conserving, the impact of the high electricity prices could be further reduced.

In 2002 the Cooperative brought a proposal for a pilot residential real-time pricing program to ComEd. Working with ComEd, the Cooperative developed a three-year pilot program that took advantage of the Cooperative's experience as a community-based implementer of energy programs, its ability to provide consumer education, and its ability to promote the program (ComEd is restricted under state rules governing deregulation from promoting its rates or products). This created a partnership between a utility and a group focused on consumer and

environmental benefits to test and evaluate this approach. ESPP was approved by the Illinois Commerce Commission as a pilot program and was launched in January 2003<sup>1</sup>.

### **How the ESPP Program Works**

The ESPP program is a “pure” market-based pricing rate. Participants pay hourly electricity prices based directly on the day-ahead wholesale market. Distribution, transmission and other ancillary costs are either a fixed charge or set at a standard per kilowatt hour charge. Participants receive educational information on overall price variability and expected price patterns, along with suggestions for energy efficiency and reducing usage during peak times, designed to enable them to make informed decisions about energy use. Each day’s hourly prices are available for reference beginning the previous evening on the Cooperative’s website, or by calling a toll-free number. However, for most hours of most days, energy prices are both relatively low and predictable and ongoing monitoring is not necessary. When any hourly energy price is above 10¢/kWh<sup>2</sup>, participants are notified the evening before by a “high price alert,” conveyed by either an automated phone call or email message which details the high price hours and prices. Participants can respond by shifting the times they use electricity or reducing their loads.

Upon enrollment in the program, new participants have their standard kWh electrical meters (which record only the total amount of electricity used) replaced with new interval recording meters that record their electrical use in hourly increments<sup>3</sup>. These meters do not provide real-time feedback to participants on energy use, but the deployment of this relatively inexpensive equipment keeps the operating costs of the program lower than it would have been with other more sophisticated metering options. By contrast, other time-of-use or critical peak pricing programs utilize significantly more expensive technologies (Wood et al. 2004).

Participant education is a key feature of ESPP, and informational material is provided on an ongoing basis. In addition to a quarterly newsletter covering general energy information, participants receive several separately mailed “ESPP Updates” which cover topics such as summer/winter price patterns and individual participants’ bill summaries and energy use. The recommendation to invest in energy-efficiency technologies in order to reduce load overall, not just shift load to lower-price periods, is constantly reinforced. The Cooperative also paid for and installed 221 programmable thermostats for participants with central air conditioners.

Avoiding the load increases from summer air conditioner use is a particularly important component of ESPP. Participants receive an annual “Summer Readiness Kit”, which includes tips for managing high price hours. In 2003 and 2004 the Kit contained postage-prepaid survey cards, which the Cooperative provides to solicit feedback on how participants react during high price alerts. To encourage responses, participants who return the survey cards are entered into a drawing for cash or other prizes.

Participants sign a one-year renewable contract to participate in the program and to authorize the ongoing release of their energy usage and two years of historical data to the

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<sup>1</sup> Funding for the Energy-Smart Pricing Plan pilot was provided by Commonwealth Edison and the Illinois Department of Commerce and Economic Opportunity.

<sup>2</sup> \$0.10/kWh is the price for energy alone, distribution and other charges are not included. The standard rate (blended summer-winter) for residential ComEd customers is \$7.781/kWh., including distribution costs.

<sup>3</sup> Meters are manually read (with electronic handhelds) by ComEd meter readers on their normal meter reading routes.

Cooperative. This data is available to individual participants on the Cooperative's website by means of password-protected accounts and are also used by the Cooperative for research purposes. The downloadable data is summarized by month, day, and by hour, in table and graphical formats, along with calculated comparisons of costs under the ESPP rates and the standard rate. For participants who are not computer users, the data are summarized and reported in a report mailed twice a year, or upon request.

## **Marketing and Participants**

The Cooperative initially marketed the ESPP program to its membership base of 7,000 households. These members represented a constituency that had some previous exposure to energy-related programs, such as air conditioner exchanges and a natural gas insurance program. Cooperative members had previously received compact fluorescent light bulbs and the Cooperative's quarterly newsletter. The Cooperative anticipated that members, given their established relationship, would be more receptive than the general public to an unfamiliar concept such as RTP. The ESPP program was well publicized to members prior to launch in the fall of 2002. The sign-up brochure described "choice, control, and cash" and "become(ing) part of something new...unique opportunity, unique rewards."

This solicitation resulted in the enrollment of 768 participants<sup>4</sup>, approximately 11% of the membership. Enrollment was then opened to non-members. Almost half of the participants who enrolled in ESPP in 2003 and 2004 were from these new contacts that had no prior relationship to the Cooperative. They learned about ESPP through word-of-mouth and media publicity. This enrollment pattern provided a valuable insight into consumer receptiveness – although the size of the market for RTP could not be evaluated, significant consumer interest did exist.

## **Program Results in 2003 and 2004**

The ESPP program began January 1, 2003. Operations were just underway when an unexpected price spike occurred in February, a side effect of a world energy market price spike, resulting in the first high price alert. The timing of this event was a challenge to the Cooperative's careful explanations of how real-time pricing worked – i.e., energy costs that were lower in winter and higher during summer. To address the issue proactively, the Cooperative contacted participants immediately with a letter explaining the reason for this anomaly, and the high price notifications were of short duration (10 days with high price alerts total). The remainder of 2003 proceeded without unexpected variations. A cooler-than-normal summer, described in more detail below, resulted in a relatively small number of high price notifications (see Table 1, below).

ESPP 2003 was assessed by an outside evaluator. This consultant completed an impact analysis of the response to high price alerts by participants, where price elasticity was calculated

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<sup>4</sup> 103 participants were randomly assigned to the control subset in 2003. This control group received new meters so their hourly energy use could be monitored by the Cooperative, but they did not receive any of the energy pricing or other information. To compensate for not having the opportunity to lower their bills using real-time prices, each control group household received three \$15 gift certificates. All control group participants were eligible for Rate RHEP after one year. A discussion of the data from this group is included in the 2003 ESPP evaluation (SBC 2004).

as  $-0.042^5$ . In some cases, the response to high price alerts included consumption decreases of more than 25% in the first hour (Summit Blue Consulting 2004).

ESPP participants overwhelmingly reported their experience with the program as positive. One participant's comment on the year-end survey "convenient, affordable, reliable, and effective", summarized other verbatim comments from respondents. Only one participant did not renew his contract for 2004<sup>6</sup>. The primary motivation for trying ESPP was to save money, and the average overall bill savings was 20.1% compared to the standard rate. Lower income households (and larger families) were more likely to do more to change their energy use during the high priced days.

The key finding from this first year was that participants were apparently willing to significantly change their behavior to respond to high peak prices. The one caveat to the very positive evaluation was that the summer of 2003 was fairly mild, with some moderately hot spells, but overall relatively cool temperatures and low energy prices. Consequently, participants were not required to expend extraordinary effort to achieve significant savings. In their overall conclusions, the evaluator noted "much additional information will be obtained in the second and third year of the program ... when program participants experience a wider range of weather and energy prices" (Summit Blue Consulting 2004, S-9).

In 2004, enrollment increased to a total of 1,237. A new study subset was established, 57 participants with central air conditioners were enrolled in an automatic cycling program. Their compressors were remotely cycled on and off for 15 minutes at a time during high price hours (when hourly energy prices exceeded 10¢/kWh)<sup>7</sup>. However, this summer was also unusually cool, with mild weather patterns, no heat waves and low, relatively non-volatile energy prices.

The 2004 assessment verified the previous year's results, which were driven by the unusually mild summer. Residential customers responded to hourly prices with a price elasticity of  $-0.08$ . New participants responded similarly to 2003 enrollees, suggesting that response fatigue, or non-responsiveness over time, was not a factor (Summit Blue Consulting 2005).

At contract renewal time in December 2004, only four participants withdrew from the program due to dissatisfaction. While there was value in the continued satisfaction of participants and the replication of 2003 results, a summer of more characteristic Chicago weather was necessary for a comprehensive analysis of the program. 2005 provided that context.

## ESPP in 2005

In 2005, the Cooperative received funding to expand ESPP by recruiting participants in a suburban area of the Chicago region. Kane County is one of the fastest growing areas in the Chicago region. The new homes tend to be quite large; research by the Cooperative suggested that as many as 20% of them required two air conditioning systems for cooling. Kane County is also an area where managing the growth of peak demand is a recognized public concern.

A direct mail solicitation was used to market ESPP in Kane County. A single 80,000 piece mailing yielded 1,467 interest forms (a 1.83% response rate). The marketing materials consisted of a letter and a tri-fold informational brochure that differed from earlier marketing

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<sup>5</sup> In other words, a doubling of electricity prices results in a decrease in hourly energy use of nearly 5%

<sup>6</sup> This participant was part of the Control group. Their new interval meter was malfunctioning and generated overcharges. The participant could not be dissuaded of his distrust of the technology.

<sup>7</sup> The hardware for this program was the same technology used by ComEd for their Nature First cycling program, a direct control load program which is initiated at times of peak demand.

materials by reporting actual, not expected, savings of participants. The Cooperative met the recruitment goal of 500 participants (which resulted in a total of 1,471 participants) and the challenges that would provide a more fertile testing ground for ESPP materialized.

Summer 2005 was extremely hot in Chicago. The exceptionally warm weather resulted in cooling needs 33% above normal and the highest cooling degree-day total since 1995. The June/July period was Chicago's sixth warmest on record, followed by the tenth warmest September. At the same time, hourly energy prices were significantly higher and blocks of high priced hours extended for longer periods than those of previous years. See Table 1 for a comparison of the number of days with high price notifications and the number of hours with prices greater than 10¢/kWh, from 2003 to 2005.

**Table 1. Number and Distribution of High Price Notification Days**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total # days with High Price Notifications	Total # hours with prices >10¢/kWh	non-weighted average prices (cents/kWh)
<b>2003</b>		X	X			X	X	X					20	77	3.217
<b>2004</b>						X	X	X					7	19	3.837
<b>2005</b>						X	X	X	X	X	X	X	140	876	5.705

Hourly energy prices exceeded 20¢/kWh for the first time during the pilot, and a new bi-modal price pattern, with both morning and late afternoon price peaks, emerged. This price pattern complicated participants' attempts to shift loads. Participants received almost daily reminders that their energy prices were higher than the standard rate, and high price notifications continued through December.

The Cooperative sent two unscheduled communications to all participants, in order to proactively address the unusual circumstances. The first, sent in April, acknowledged that there had been no savings in 2005 so far for approximately half the participants, and that on average, ESPP bills had been 3% higher than the standard rate. The Cooperative's prediction at this time was that prices would stabilize in the near future. A second letter, sent in September, explained the "perfect storm" of events that were causing continued high prices. Hot weather, impact of higher natural gas prices on running peaker plants, the cost of coal, and the devastation of Hurricane Katrina all contributed to the impact.

Participants responded with concerned questions and some complaints. The new 2005 recruits, who had neither previous experience with ESPP, nor accumulated savings from earlier years to offset 2005's higher hourly energy prices, were disproportionately affected. Many of these new participants own larger homes that used more electricity, and the higher rates made a bigger impact on their bills.

## Program Results

Although the hot weather, high energy prices, and extended length of the notification periods provided significantly different conditions relative to the summers of 2003 and 2004, overall ESPP participants continued to respond to hourly electricity prices in a manner similar to prior years. The 2005 evaluation showed an overall price elasticity of -0.047. This level of response is strong and is comparable to those found in other programs that use price signals to motivate changes in consumer behavior (DOE 2006). Participants continued to show a significant response to the high price notifications.

The impact of the increased number of notifications and the possibility of a “response-fatigue” factor, or deterioration in the elasticity of response after an extended period of high price notifications, was analyzed. Participant responses to high price notifications declined somewhat as the number of notifications during the summer and the length of a given high price period increased. However, as the time between high price periods increased, their response to price notification “regenerated”. Overall, participants continued to respond to high price notifications throughout the entire summer of 2005. In fact, the estimated decline in response was actually less than was observed in 2003.

Participants with central air conditioners were less sensitive to high price notifications relative to other participants. This may be because they have permanently programmed their thermostats to be at a higher temperature, especially when not home. The response of participants in the automatic cycling program showed an added increase in response during high price periods by as much as  $-0.022$ , for a total price response of  $0.069$ .

Analysis of demographic characteristics showed there are no differences between the elasticities of single family and multifamily homes, despite a general trend for multifamily homes to be lower overall consumers of power. Neighborhood income also has little effect on price responses; lower income participants were as demand responsive as higher income participants. However, participants who enrolled in 2005 tended to have lower price elasticity relative to other participants.

The analysis of all participants’ overall summer energy use shows that ESPP participants consumed 35.2 kWh less per month during the summer months under ESPP compared to their usage rates (weather normalized) prior to their enrollment in ESPP. This represents a savings of 3-4% of summer electricity usage. Therefore, participation in the RTP program results in a net decrease in energy consumption, or a conservation effect (Summit Blue Consulting 2006).

2005 was the official end of the ESPP experiment under the original experimental rate. The high price alerts continued through December and rates for all hours were significantly higher than the frozen residential rates; prompting consideration of whether ESPP should be extended for another year. The Cooperative and ComEd decided to continue the program for one more year through 2006, when the current rate freeze would expire and new prices would be procured by auction.

The year-end 2005 ESPP Update included the usual analysis of savings and opt-out instructions. In addition, each mailing also included a letter with specific recommendations about whether or not the participant should continue in the ESPP program. Unlike previous years, where the Cooperative endorsed remaining in ESPP, participants received the instructions: “You should review your bill details in the enclosed ESPP Update to determine whether these recommendations are right for you.” To facilitate this review, the Update contained customized charts documenting the participants’ monthly and yearly energy usage and bills, with comparisons to the combined averages of all participants.

The number of withdrawing participants (169) in 2005 was far greater than in previous years, but lower than the Cooperative staff expected. The most recently enrolled Kane County participants had the largest proportion of withdrawals (see Table 2). Since saving money on electric bills is the primary motivation for participation in ESPP, the Cooperative anticipated this would be a primary factor determining whether or not participants re-enrolled in the program. Failure to save money was influential, but some participants who saved money on ESPP did not re-enroll, and other participants who did not save money continued with the program.

**Table 2. Numbers of Participants That Did Not Re-Enroll in ESPP**

	2003	2004	2005	# that had saved money on ESPP	# that had not saved money on ESPP	% of all ESPP participants	% of that geographic area
Withdrawals							
All other geographic areas	1*	4*	59	45	17	4.62%	6.49%
Kane County	-	-	110	13	97	7.95%	27.64%
Total # of non-renewals	1	4	169	58	114	12.57%	

Numbers do not include participants who left the program due to moving (re-enrollment at new addresses was not always possible)

\* Includes one control group participant that was not on the ESPP rate, these two participants neither saved nor lost money.

## Lessons Learned

Three years of the Energy-Smart Pricing Plan operations has shown that a real-time pricing program can be successfully utilized by residential consumers, and their actions result in significant reductions in peak demand. However, questions still remain to be answered. How many consumers would choose to participate in a large-scale real-time pricing program? What are the characteristic of households that are most likely to benefit from RTP? What educational tools will effectively influence behavioral changes? And what impact can these residential electricity users have on the electrical system?

These three years of program operations have produced a wealth of data. Quantitative data from participants' interval meters as well as pre-ESPP historical usage are available for analysis. In addition to actual energy use, extensive documentation of behavior was collected in multiple surveys, participants' reporting of specific responses to high price alerts, and ongoing conversations with members; these data provide insight into the thoughts and motivations of participants. An analysis of these findings is summarized below.

**1. The time is right for consumers to think about energy.** Americans are increasingly aware of the importance of energy in their lives. Meanwhile, the “energy IQ” of Americans is low. An annual survey by the National Environmental Education & Training Foundation (2002) found that many respondents have little understanding of where electricity comes from, much less knowledge of how electricity markets work, or even the amount of electricity used in their households. At the same time, 91% of these respondents believe that “energy conservation will play an increasingly important role the nation’s economic future”. They also report performing energy conservation behaviors voluntarily. But a lack of knowledge stands in the way of consumers making informed and effective energy decisions.

However, consumers have shown that, with effective public education, they can significantly reduce the amount of energy they use. California residents did so during the 2000-2001 electricity crisis (Kunkle et al. 2004). And while the concept of real-time pricing is unfamiliar to most Illinois residents, enrollment in the ESPP program shows consumers are interested in energy options.

Real-time pricing gives consumers an opportunity to be actively engaged in their energy use and choices, instead of electricity being just another bill to pay. Following the relatively challenging circumstances of summer 2005, the Cooperative provided an opt-out reply postcard for participants. 104 participants ignored the instructions to “do nothing” if they wanted to renew their contract, and returned their postcards with affirmations of their appreciation of the



ESPP program. In addition to the tangible reasons for satisfaction (“ESPP is saving me a lot of money!”), participants wrote “thank you for the information on issues” and “This is important”.

**2. Saving money is the primary reason people join ESPP, but not the sole reason the program provides customers value.** “Save money on my electric bill” was repeatedly cited in surveys as the number one reason for participating in ESPP. But an analysis of non-energy benefits found that “ability to control”, “increased awareness/knowledge”, and “understanding about energy use” all factored into participants’ levels of satisfaction. ESPP participants were either satisfied (53%) or very satisfied (41%) with “how ESPP helped them understand how they use and can save energy”. Participants who did not save money on the RTP rate acknowledged that the program had caused them to be more energy-efficient, and understood that this knowledge and change in behavior would have long-term benefits. California’s Statewide Pricing Pilot participants also agreed that the SPP was “worth it for reasons not associated with costs savings” (Schultz & Lineweber 2006). But while ESPP’s “environmental benefits” were recognized and valued by participants, 25% of respondents did not cite this factor as a reason for participation.

The 2004 evaluation showed that participants narrowed their expectations for savings, with replies from respondents who joined ESPP in 2003 showing a downward adjustment appropriate to their experience with the program. Fewer respondents expected extremely high savings, perhaps a reflection of the more realistic understanding of the program, their bills, and energy costs.

The participants who did not renew for 2006 both saved and lost money on the ESPP rate relative to the standard rate (see Table 2). Anecdotal comments from the 58 participants who saved money but did not renew included concerns that the pattern of high prices would persist and future savings would not occur, and complaints about notifications being disruptive.

**3. Sophisticated IT systems are not essential to create behavior change.** The relationship between participants’ use of technologies and their success as real-time pricing participants is complex. The Cooperative used standard interval recording meters with no enabling technologies (e.g., two-way communications, control of HVAC systems), which kept program costs low, but also precludes real-time feedback to participants on their energy use. The Cooperative tested two hardware technologies: programmable thermostats and remotely controlled central air conditioning cycling switches.

In 2003, the Cooperative paid for and installed programmable thermostats for 221 participants with central air conditioners. This ensured that the participants had the ability to adjust their usage (in particular the ability to easily change their programming on a high priced day), and also that the uniform thermostat choice made it easier to provide instructions about how to manage use during the summer. According to survey responses, programmable thermostats had value as a program benefit, but ranked lower than other intangible benefits (e.g. ability to control electric bills and the environmental effects of energy use). There were no statistically significant correlations between elasticity and the use of the programmable thermostats provided.

The Cooperative offered a direct load control option to participants with central air conditioners in 2004. Central air conditioner compressors (CACs) are automatically cycled when hourly energy prices exceeded 10¢/kWh. Response to this option was strong; the 50 available slots were filled in less than a week. Cycling participants reported high levels of satisfaction with

the system, even after the summer of 2005, which 24% reported no change in comfort level, 62% had a decreased comfort level but were satisfied with this status. Cycling CACs correlated to an additional elasticity of  $-0.04$  during the day and  $-0.02$  during the evening on high price days.

Owning or using a computer is specifically not required in the ESPP program design. This factor allows for a broader group of eligible participants, since older and less affluent households are less likely to be computer owners. However, ESPP operations do utilize electronic technology, and correlations were observed between computer access and elasticity. For example, participants who receive e-mail high price alert notification had an additional elasticity of  $-0.02$  during high price periods than participants who receive notification via telephone. Participants with a computer in the home are more responsive to high price notifications, over and above the increase associated with email notification.

A website that provides complete hourly data to ESPP participants, following the monthly meter reading, is available. Of the 70% of participants who have home internet access, only 220 of all participants have logged into the Energy-Smart website, for a total of 696 visits<sup>8</sup>. A distribution of the usage by these participants is summarized in Table 3. There is no statistically significant correlation between website usage and high elasticity of demand, and the participants who logged into the website most frequently were more likely to withdraw from the ESPP program, though this relationship was not statistically significant.

**Table 3. Use of ESPP Usage Analysis website by participants**

# of times participants used website	1	2	3	4	5	6	7	8	9	10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 40	41 to 50	77
Number of participants	80	31	18	13	6	7	8	1	4	6	12	12	7	5	6	3	1

Survey research is currently underway to investigate why relatively few participants use the website, and how it could be improved. The correlation between computer access (although not necessarily analyzing usage information on the website) and increased elasticity is also being studied. As a program design factor, electronic communications are less expensive and more reliable than phone notifications, so requiring email access makes sense. But this restriction would also disenfranchise older and less affluent customers. Determining if and how the non-IT-connected participants can utilize RTP successfully is another subject for further investigation.

**4. Energy efficiency and demand reduction are working together.** Demand response programs are often characterized as shifting, but not necessarily reducing, electricity use. Writing on demand response and energy efficiency, York and Kushler (2005) note that “while there is clearly a relationship between demand and usage, little research has been done to test and analyze this area”. The 2005 ESPP impact evaluation analyzed the monthly kWh consumption of participants before and after they had been on the ESPP rate. A net reduction in usage of 3% to 4% during the summer months was found. This reduction occurred in an unusually hot summer and in the context of a program design that does not emphasize energy conservation as a necessary behavior.

<sup>8</sup> Usage data about which participants register to view their energy data and when they do so is recorded and available to the Cooperative staff.

Respondents to ESPP surveys consistently reported that participation in ESPP has encouraged them to adopt energy efficiency as part of their everyday lifestyle. When purchasing new appliances, ESPP participants reported buying energy-efficient models at high rates, ranging from 75% to 100%. A majority of participants (78% in autumn 2005) reported that they had turned their air conditioners down or off much of the time, and performed activities such as turning off lights, using fans, and closing shades. While self-reported actions are subject to the respondents' tendency to inflate positive behaviors, the varied behaviors reported by ESPP participants are consistent with the other researchers' observations that "energy conservation behaviors in households are widespread and evolving" (Kunkle et al. 2004, 7-175).

**5. High Price Notifications help keep energy use "top of mind".** The 2005 impact evaluation utilized new analytical models that provided a more nuanced understanding of individual price elasticities (Quantum Consulting 2004). Participants respond to hourly electricity prices with elasticities that vary from  $-0.015$  during the day to  $-0.048$  during evening high price hours. Average responses are doubled when participants report receiving notification of high price periods, and the success in notifying participants increases participants' price responsiveness on non-high priced hours as well (Summit Blue Consulting 2006).

The high price notifications consist of an announcement identifying the call or email as a high price alert for the upcoming day and a listing of the relevant hours and energy prices. Participants were surveyed regarding the usefulness of the high price alerts. The majority of respondents reported finding the alerts useful as reminders (see Table 4). A decline in percentages from June to October may be related to the almost daily continuation of high price alerts into the cool autumn months, when the most significant load reduction option (cutting back on air conditioner use) was not a relevant option.

**Table 4. Responses to the Survey Question:  
"Did You Find the High Price Notifications Useful for Managing your Energy Use?"**

Responses	June 2005	October 2005
Yes, extremely useful	52%	43%
Yes, somewhat useful	39%	42%
No, not at all useful	4%	10%
Not sure	5%	5%

Given the importance of the notification feature, the Cooperative worked hard to maximize the usefulness of the alerts. But for each notification event, approximately 8% of participants were unreachable by phone or email. The unreachable participants were not a consistent group; different individuals did not receive messages at different times due to a variety of constantly changing factors, including busy or disconnected phone lines and undelivered emails.

In response to complaints by some that the telephone messages were too long and by others that they were not detailed enough, participants were surveyed about the amount of information provided in the notifications. Most respondents (73%) said the notifications contained "the right amount of information". The remainder of the respondents were divided in their opinions, replying there was "too much information" (11%), "too little information" (4%), or they were "not sure" (12%). Respondents also provided suggestions about how the notifications could be changed to be more useful; these responses are currently being evaluated.

**6. Hard-to-reach populations represent particular costs and benefits.** Savings on electricity bills have a relatively greater impact on lower income consumers, so there are benefits to facilitating these consumers' successful participation in real-time pricing program. But regulators also cite concerns that consumers should be protected from possible losses. One of the lessons of the Puget Sound Energy time-of-use program was that "any program should make a majority of customers better off, or it should not be offered" (Faruqui & George 2003). The Sacramento Municipality Utility District Power Choice program was also available only to those "most likely to benefit during the summer under the rate alone without changing energy use behavior and patterns" (Wood et al. 2004). ESPP participants are not evaluated for savings potential prior to enrollment and accept the exposure to market volatility inherent in real-time. The only protection for participants is a price cap, which provides reimbursement for electricity costs if energy prices increase above 50¢/kWh. Since the highest hourly energy price so far has been 20¢/kWh, this safeguard has not been utilized.

ESPP participants include lower-income African-American and Latino residents who are successful in utilizing the RTP rate. Specific recruitment strategies were necessary to reach these groups. The direct mail marketing for ESPP yielded few responses from these populations. Instead, the Cooperative recruited participants through community outreach, collaborating with existing organizations when possible. Examples of partnerships included coordinating with community agencies that provided LIHEAP intake and meeting with local clergy to gain access to church congregations. All of the Cooperative's materials are translated into Spanish, and Spanish-speaking staff members are essential.

Real-time pricing also proved to be a mechanism for introducing energy awareness to minority and lower-income participants. An anecdote which illustrates this process concerns a participant whose electrical costs increased with ESPP due to the use of portable space heaters. The Cooperative recommended weatherproofing improvements and suggested she withdraw from ESPP. She refused, citing her satisfaction with the experience if not the savings – "no one has ever talked to me like this about these things before." When surveyed, respondents from this group also cite high levels of satisfaction with ESPP. In response to the question "In addition to saving money, ESPP was designed to help participants understand how they use and can save energy. How satisfied are you with this aspect of ESPP?"; these respondents gave had the highest percentages of "very satisfied" responses.

**7. Education is necessary, but not sufficient.** Although a real-time pricing rate alone, without behavior changes, can reduce electricity costs; participants who understand the rate structure and how to use energy efficiently have more opportunities to save. The Cooperative provides comprehensive educational resources, including workshops, but consumers vary considerably in how much time they are willing to invest in studying these materials. Communication opportunities typically occur when a participant identifies a problem and seeks advice on solving it – an effective but inefficient learning process. The Cooperative is currently studying participants with relatively high and low elasticities to better understand the role of education on their behavior.

## Conclusions

ESPP participants are a diverse group - they live in single family homes and multi-unit buildings in the city and suburbs, and have distinct load shapes. The persistence of their response

to high price alerts demonstrates that these participants are capable of and willing to respond to the challenges of a real-time pricing rate. In addition, the net decrease in these participants' energy use during summer demonstrates that lasting behavioral changes have occurred. Even following 2005's summer of high temperatures and electricity prices, a majority of survey respondents (75%) continued to categorize participating in ESPP as "quick and easy". Their process of adjusting their energy use to the economic realities of real-time pricing is a viable model for extending real-time pricing, for the benefits of consumers and the electrical system.

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