Characterizing Customer Preferences: How the Doritos® Nachos Method Works for Electricity Service Plans

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ABSTRACT

Residential electricity customers typically pay the same rate all day every day for electricity. These customers get the caviar of on-peak electricity for the same price as the canned tuna off-peak electricity. Utilities are considering offering customers variations in rate structures, such as time-of-use pricing, to reduce on-peak electricity use. But how will utilities know how to design electricity service plans that customers will choose? EPRI researched approaches for determining stated preferences for hypothetical offerings and determined that discrete choice experimentation (DCE) would be more effective than market segmentation. Many commercial product manufacturers use DCE for product development. A classic case is the development of the addictive snack, Doritos® Nachos. To test the DCE approach, EPRI embarked on research with several utilities to develop discrete choice experiments for selected electricity service plans (time-of-use and fixed bill, compared to the status quo flat rate) and test them in utility territories. Surveys were developed with a well-tested informational piece to describe the different options. Over 1000 surveys were administered with an average uptake of 38%. The results were used to develop choice models, and then a market share model. The results are statistically significant and can be used to identify likely participants and how to market to them. The results may be used by utilities to design new offerings with confidence in participation by their customers. Results will be shared in this presentation as well as plans for expanding the method to preferences for customer technologies.

Introduction

There are over 3,000 utility retail electricity service providers in the United States serving over 120 million residential customers. For the last several decades, most of these customers have been charged a flat rate for the electricity they use, regardless of how much they use and when they use it. As of the end of 2014, about 96% of these customers were still paying a flat electricity rate[1]. The primary advantage of a flat rate system is that it is relatively simple and easy for customers to understand. Electricity rates are developed by utilities and approved by state regulators, who have for the most part supported flat rates due to concerns that a more complex rate structure could result in higher bills for some customers as well as potential confusion or annoyance.

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1 *Annual Electric Power Industry Report—Form EIA-861*, U.S. Energy Information Administration, August 11, 2015. Accessed online: http://www.eia.gov/electricity/data/eia861/index.html.

At the same time, the electricity landscape is dramatically changing with technologies at the distribution level, such as advanced metering infrastructure (AMI), distributed generation and energy storage, and customer devices such as smart thermostats and energy management systems. At the bulk power level, renewable energy continues to add to the mix driven by states' Renewable Portfolio Standards (24 states). State policies also drive Energy Efficiency Resource Standards (29 states).

These changes in the electricity landscape plus, for many utilities, keeping prices low to customers to maintain economic well-being and development, are driving utilities to consider offering customers electricity service plans that can meet customer needs as well as utility and societal needs. EPRI coined the term "electricity service plans" (ESPs) to broaden the concept of customer offerings to include more than rate structures, such as behavioral measures, customer technologies, and information on energy use. ESPs may be designed to induce changes in customer electricity usage for many reasons, including to avoid or defer building new infrastructure, to enable demand side management to support renewable energy integration, or to reduce the need to purchase power during peak periods. The idea of ESPs is to provide options for customers to meet their needs, for example, reduce their bills, and at the same time, meet these grid needs. But introducing ESPs also adds complexity to a utility's rate structure, which can bring its own set of challenges related to the approval process, designing and implementing the ESP and communicating the new options to customers.

While ESPs are not widely used today, two of the most popular are time-of-use (TOU) and fixed bill plans. In TOU plans, the price depends on when the service is used, following a posted price schedule that changes infrequently. Most consumers are familiar with the concept of TOU plans, although they don't use TOU terminology since TOUs are used in a variety of shopping and purchasing contexts. Many movie theatres, for instance, have tiered pricing structures based on time of day, with tickets being least expensive early in the day and most expensive in the evenings and on weekends when more customers go. Because so few electricity customers have been offered electricity TOU plans, they are unfamiliar and may be seen as complex and confusing. Fixed bill plans are simpler—customers pay a predetermined amount for electricity service for an entire year regardless of their actual electricity usage during that period.

Challenges of Electricity Service Plans

ESPs offer the potential to meet customer needs that have previously been unfulfilled or underserved and to anticipate new service needs in the wake of technology advances. The challenge is to align customer wants and needs with the physical nature of the electricity supply. Regulated utilities must also gain approval from their state regulators before they implement new ESPs. Other utilities often need internal and external approval. These interactions can often take several years and require input from multiple stakeholders. Utilities need to determine which plans have the greatest likelihood of being adopted before they commit resources to developing and offering ESPs and seek regulatory approval.

This requires a better understanding of customer preferences, which also requires gaining a more thorough understanding of customers themselves. Electricity customers vary widely: by age; gender; ethnic type; geographic location; income and education levels; and familiarity with technology such as smart meters and other devices to measure and control electricity usage. Utilities need a way to segment their customers that takes into account all of these differences as

well as how each group would respond to various ESPs. Having a better idea of customer preferences will help utilities target new offerings to the right customers and will also provide information about what marketing messages will most resonate with these customers.

Recognizing that utilities need an effective method for determining customer preferences for electricity service plans, EPRI researched methods for use with residential customers. The research considered discrete choice experimentation (DCE) and market segmentation. One of the key factors of the analysis is that electricity service plans are not familiar to customers; they are hypothetical. A challenge with determining preferences for hypothetical offerings is that the offering must be clearly described and understood to glean meaningful results. The outcome of the research was that DCE is an effective method for determining preferences for hypothetical offerings[2]. Once this result was determined, EPRI worked with member utilities to develop a research project to test the methodology. The goal of the project was to answer the following question: can DCE be used to characterize preferences for hypothetical electricity service plans? The results of the project were documented in an EPRI report[3] and are discussed throughout this paper.

Overview of Discrete Choice Experimentation

DCE is a methodology developed using behavioral sciences—economics, sociology, social psychology and market research, among others. DCE involves using specialized surveys to gather information about customer preferences by asking participants to make choices among alternatives. The alternatives are typically offered in combinations so that survey recipients have to make trade-offs in perceived value; for instance deciding their preferred time periods for paying higher and lower rates for electricity. Analyzing the choices quantifies the relative preferences to characterize how preferences change as product features vary. This approach yields information on "stated preferences" versus the "revealed preferences" which are the actual choices made by customers.

DCE is a powerful exploratory tool for understanding customer preferences for new product offerings in the absence of actual market transaction data. It has been widely and successfully used in the food industry to create snack foods that have been optimized for the perfect combination of variables—such as sweet, salty, crunchy, creamy—based on consumer survey responses. This approach is responsible for wildly popular products such as Doritos® Nachos, Cherry Vanilla Dr. Pepper and Kraft Foods' Lunchables products. According to *The New York Times Magazine* in a February 20, 2013 article, "Food engineers alter a litany of variables with the sole intent of finding the most perfect version (or versions) of a product. Ordinary consumers are paid to spend hours sitting in rooms where they touch, feel, sip, smell, swirl and taste whatever product is in question. Their opinions are dumped into a computer, and the data are sifted and sorted through a statistical model…which determines which features will be most attractive to consumers.[4]"

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2 *Methods for Characterizing Customer Preferences for Electric Service Plans*, EPRI, Palo Alto, CA: 2013. 1024401.

3 *Measuring Customer Preferences for Alternative Electricity Service Plans: An Application of a Discrete Choice Experiment*, EPRI, Palo Alto, CA: 2015. 3002005757.

California's Experience with Electricity Service Plans

California's experience with ESPs demonstrates that the process is time-consuming, complex and requires collaboration between utilities, regulators and customers. The three investor-owned utilities in California—Pacific Gas and Electric (PG&E), Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E)—have inclining block rates with four tiers for residential customers. All three utilities also offer TOU options[5] [6] [7].

The California Public Utilities Commission (CPUC) has been working with these utilities to design a new and less complex rate structure for residential customers. After three years that included numerous revisions and opportunities for public review and comment, CPUC has directed the three utilities to "…take the next steps in residential rate reform. This reform is intended to make rates more understandable to customers and more cost-based and to encourage residential customers to shift usage to times of day that support a cleaner more reliable grid.[8]" The required immediate actions include consolidating complicated pricing tier structures, outreach to educate some customers on no-cost and low-cost conservation measures, improving rate comparison tools and educational materials to help customers understand their energy bills, and designing time-of-use pilots. Over the next several years, the rate reform will require utilities to evaluate pilot TOU rates and file residential rate design documents by January 2018 for rate structures that will take effect in 2019, as well as providing the option for utilities to request a rate option with fixed monthly charges[9].

One of the steps taken by the three utilities was to conduct a study on customer preferences for time-of-use rates and other aspects of the rates discussion in California. The utilities used a conjoint study, similar to discrete choice experimentation, which used a choice-set survey to gather information on preferences and develop a choice model to estimate preferences. The results are providing insights to the rate reform process[10].

Using Discrete Choice Experimentation to Understand ESP Preferences

Oklahoma Gas and Electric (OG&E) has also used DCE to gauge customer preferences in order to inform decisions about what ESPs to offer to customers. OG&E conducted a study to

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4 "The Extraordinary Science of Addictive Junk Food," *The New York Times Magazine*, February 20, 2013. Accessed online: http://www.nytimes.com/2013/02/24/magazine/the-extraordinary-science-of-junk-food.html?_r=0.

5 PG&E website: http://www.pge.com/en/myhome/saveenergymoney/plans/tou/index.page?

6 SCE website: https://www.sce.com/wps/portal/home/residential/rates/residential-plan.

7 SDG&E website: http://www.sdge.com/whenergy/residential.php.

8 *Decision on Residential Rate Reform for Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company and Transition to Time-of-Use Rates*, California Public Utilities Commission, Rulemaking 12-06-013, July 3, 2015.

9 Ibid.

10 *Residential Rate OIR Customer Survey Research*, HINER & Partners, Inc., August 8, 2013.

better understand how residential customers would react to alternative service offerings. The survey included six alternative service plans: one fixed bill option and five variations of variable peak pricing (VPP), a hybrid of TOU peak and off-peak pricing. Almost 1,400 responses were received. Based on the survey responses, OG&E implemented a VPP pilot in which participants reduced their energy usage when high peak prices were posted. The pilot indicated that as many as 56,000 customers might enroll in a VPP plan. OG&E launched a VPP program in 2010 that now has over 100,000 participants[11].

EPRI's study used the DCE methodology to develop a survey to collect information about residential customer preferences and the customers themselves. The goal of the survey was to characterize consumer preferences for various TOU and fixed-bill options and then use that data to develop choice models to identify customers according to their preferences and to help design ESP offerings. To ensure the survey would be effective, it was tested extensively, initially with test subjects in one-on-one settings, then with a test group using commercial panels to make sure customers understood the hypothetical choices being offered.

Survey Design and Administration

Survey: The survey comprised an introduction, four sections, and an informational section. The introduction told participants that the survey would only take a few minutes to complete, that all answers were confidential, and that the survey goal was to gather opinions. Time required to complete a survey is a critical component of a well-designed survey to achieve a good response rate. This survey was designed to require 20 minutes or less to complete and as a result, the average response rate was excellent at 38%.

Section A of the survey collected general information on household characteristics and electricity use. The explanatory section came in the form of a leaflet that explained the concept behind electricity service plans and provided an overview of the three different ESP types that they were being asked to consider: flat rate plans representing the status quo, TOU plans and fixed bill plans.

Section B consisted of eight choices, each of which asked respondents to choose among three alternative ESPs. The first six questions focused on TOU. Each choice included a flat rate plan and two TOU options. The TOU options provided survey respondents with a range of weekday on- and off-peak electricity prices. Eleven of the 12 TOU options only offered summer rates, with the twelfth offering both summer and winter rates. In all cases the weekend rate was identical to the off-peak rate. An example of a choice question is shown in Figure 1. The next two questions focused on fixed bill alternatives, in which two fixed bill options were compared to the status quo, a flat rate plan. The reason for only including two fixed bill questions was primarily to control the length of the survey.

Section C ascertained respondents' interest in an ESP option in which their electricity provider would pay them to reduce their electricity use during peak periods. Finally, Section D collected demographic information, including gender, age, education level, household income, ethnic origin and employment status. In all, survey respondents answered 30 questions.

11 *Measuring Customer Preferences for Alternative Electricity Service Plans: An Application of a Discrete Choice Experiment*, EPRI, Palo Alto, CA: 2015. 3002005757.

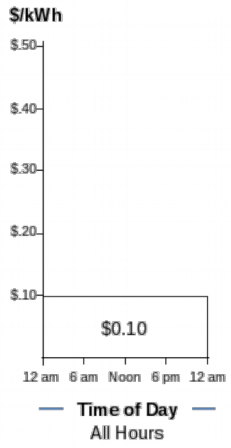
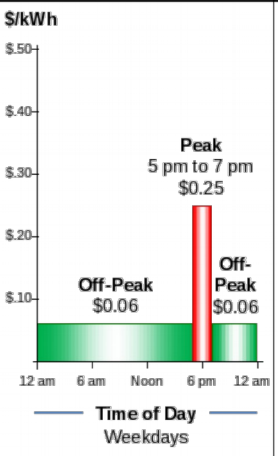
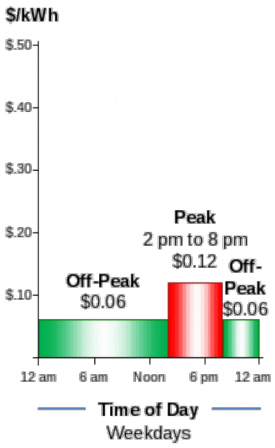
Attributes	Current Rate	Option A	Option B
Pricing Blocks		 All Weekend Hours $0.06/kWh	 All Weekend Hours $0.06/kWh
Season When This Rate Would Apply	Year-Round	Summer	Summer
Which option would you choose?	☐ I would choose this option.	☐ I would choose this option.	☐ I would choose this option.

Figure 1

The survey was designed to compare attributes of time-of-use rates and fixed bill plans. In this survey there were 24 sets of site profiles (eight choice questions for three blocks of respondents). Each choice question included specific levels of the following attributes:

- Off-peak Price ($/kilowatt hour).
- Peak Price ($/kilowatt hour).
- Peak Period (the hour the peak begins and the hour it ends).
- Peak Seasons (months when the TOU rate is applicable, all or some; in the case of the latter the implication is that the uniform rate applies).
- Fixed Bill Premium (percentage markup over the expected bill under the uniform rate).
- Fixed Bill Contract Length (years).

The survey was administered to residential customers of a mix of utility types: investor-owned, public power, and cooperatives. Residential customers included those with previous electricity rate education, urban customers and rural customers. US Postal Service (USPS) address lists for the sample frame population were acquired and random sampling determined to whom they were sent (addressed with the occupants' names). Seven hundred fifty sampled addresses were drawn from the USPS Delivery Sequence File, Second Generation (DSF^2) in anticipation of collecting 250 completed surveys. The DSF^2 database contains vacant, residential, business or seasonal address information that can be purchased from a DSF^2 Licensed Service Provider. EPRI also tested alternative ways of delivering the survey (regular and express USPS

and premium commercial delivery services) and alternative packaging and messaging, including a plain envelope, a sticker indicating a monetary incentive was inside, branding the material with the utility's logo and including a letter encouraging participation by the utility executive.

Survey Results

A total of 1,081 survey responses were received, with a very high average response rate of 38%. The eight questions with three alternatives per question provided a total of 25,944 total alternatives to survey respondents and resulted in 8,848 consumer choices. Test results were used to develop a choice model to associate TOU and fixed bill pricing to the likelihood that a customer would choose that ESP if it were offered. In addition, the choice model identified several customer demographic features that played a significant role in explaining ESP preferences.

The study showed that demographics were more important drivers than TOU features in establishing preferences, meaning that the success of a TOU depends on the characteristics of the customer it is offered to. Demographics were the key factor in 58% of the responses, while prices accounted for 11%, peak periods for 24% and peak seasons for only 4%. Figure 2 shows the negative or positive influence of the variables that influence consumer preferences for TOU.

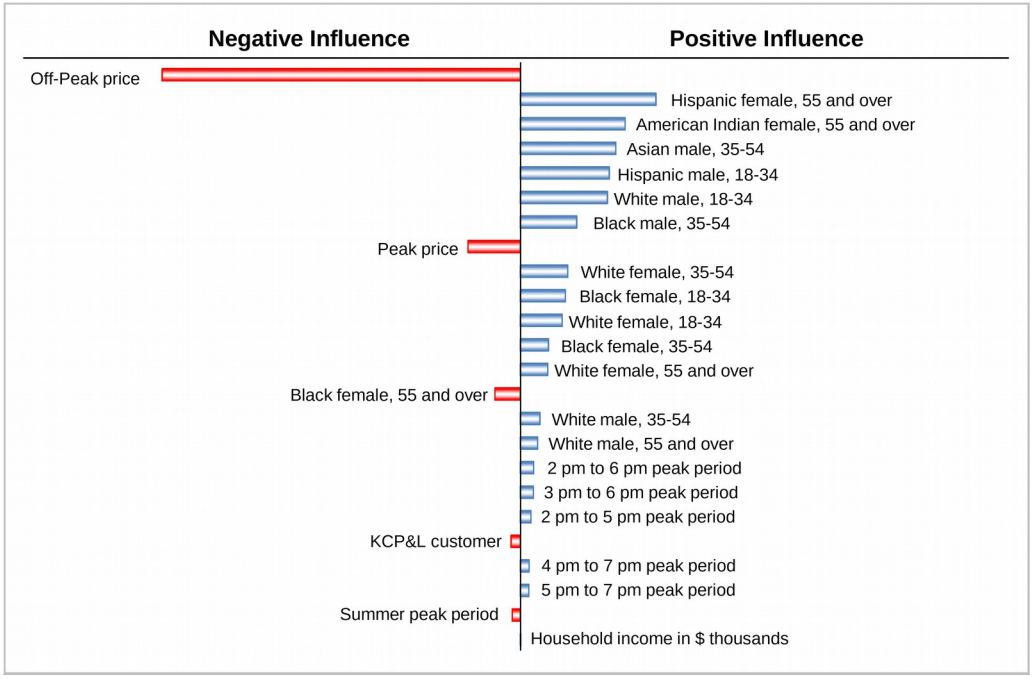


Figure 2

Overall, it was estimated that 29-33% of survey respondents preferred TOU rates over the status quo. The preference for TOU options varied more depending on attributes than the fixed-bill options. There were trade-offs between peak, off-peak and period length (number of hours), with a slight preference for a lower peak rate over the period length. Off-peak price, however, was the biggest driver of preference change. Fixed bill preferences were not influenced by design features such as contract length and risk premium, but this finding was most likely the

result of including only two fixed bill questions in the survey to keep the survey to the 20-minute time limit.

Another key finding was that although the surveys were completed by customers of different regions and utility types, their responses didn't vary significantly, although there were some slight varieties for customers of the central U.S. investor-owned utility.

The research also showed that the mailed survey proved to be more effective than using commercial panels, which tend to exclude or under-represent rural, low income and elderly populations. As discussed earlier, a variety of delivery methods were tested. Two delivery methods were particularly successful. Using USPS First Class delivery with an envelope stating that there was a $10 bill enclosed with the survey achieved a response rate of 75%. Branding the survey with LPC name and a letter to the occupant from the LPC top executive, increased the response rate by up to 50%. USPS address data aligns well with sampling from a utility's billing or customer information files, which provides an occupant name for each address (USPS provides only the mailing address). Results of the response rate research are shown in Figure 3.

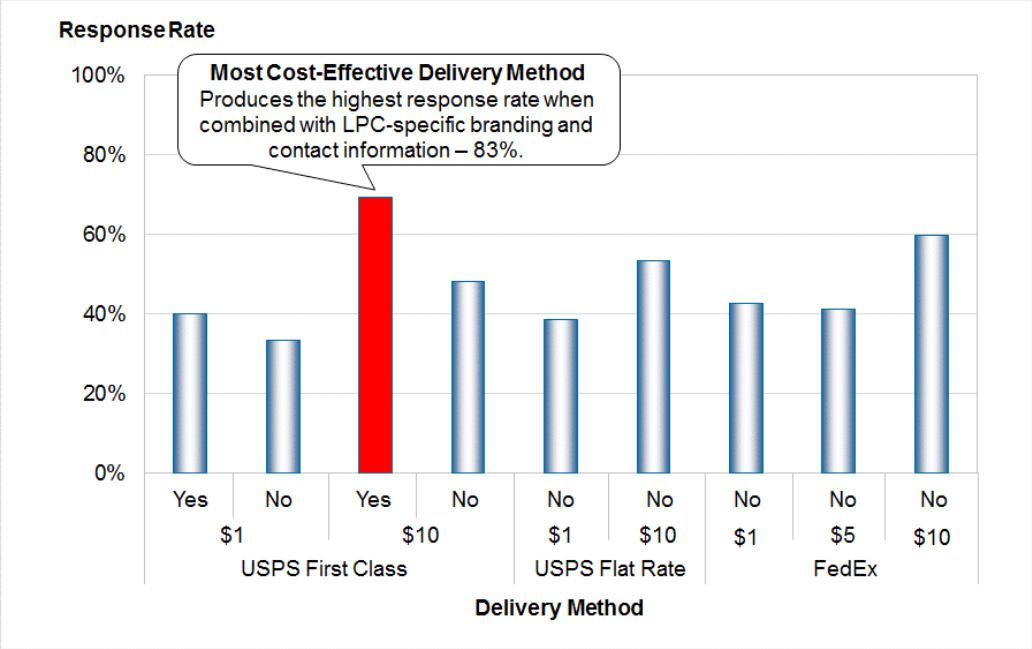


Figure 3

A market size model was developed that shows how many customers prefer TOU and, based on demographics results, where they live. Figure 4 shows how the choice model and demographics lead to market size estimates. The choice model and address data can be aligned with U.S. Census data to enable inferring results to the greater population. Furthermore, customers most likely to prefer TOU can be targeted with marketing materials to encourage them to participate in a TOU program.

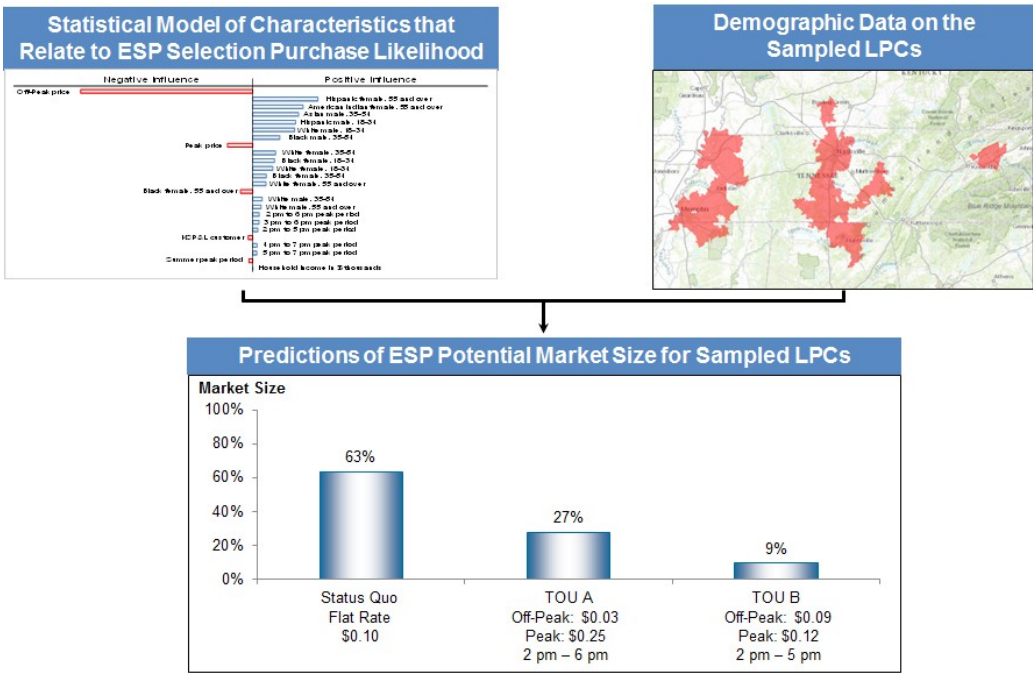


Figure 4

Lessons Learned

Overall, this study demonstrated that using DCE to measure customer preferences for various electricity service plans is a viable approach for electric utilities. DCE provides standardized and documented methods that can be implemented quickly and cost-effectively. The study showed that demographic data must be paired with ESP preferences to gain a complete picture of customer preferences and that direct mail is an effective way to solicit participation in surveys. Uptake is increased by a financial incentive and/or utility branding. Utilities can use the information gleaned from these studies to develop ESP offerings that are more likely to be adopted by enough customers to justify the time and expense required. They can also use these data to create effective education and marketing about ESPs targeted to customer demographics more likely to accept the offer.

Next Steps

Utilities can use DCE methodology to develop new ESPs or gain information about ESPs they are already considering. The methodology can also be applied to other types of customer choices that impact electric utilities, such as plug-in electric vehicles and rooftop solar photovoltaics.

Developing New ESPs

This research fits into a larger overall process that utilities can use when they are considering offering new ESPs to their customers. At a high level, this process involves five steps:

1. Developing a list of ESPs to consider and then screening them to see how they align with the company's strategic goals.

2. Determining customer preferences through surveys, market data, or tools such as the ESP Preferences Estimator developed using results of this research.
3. Designing preliminary ESPs and then evaluating their impact on the utility's load, revenue and other financial measures and infrastructure requirements.
4. Launching new ESPs that include marketing plans, education and outreach and performance goals.
5. Monitoring and tracking the performance of the ESPs.

Applications to Other Consumer Choice Decisions

The DCE methodology could also be used by utilities to gauge customer interest in customer technologies that interact with the electric system. Plug-in electric vehicles (PEVs) are gradually becoming more widely used. PEV customers need charging facilities at home and away from home, which will expand the amount of electricity these customers use and how they use it. Utilities need to be able to estimate adoption rates and locations for PEVs to ensure they can meet this growing demand and to offer services that support customer needs as well as encourage adoption of PEVs. Rooftop photovoltaics (PV) alter the relationship between the customer and the utility as customers shift to being both consumers of and providers of electricity. Knowing which customers are likely to install PV and where they are located will help utility distribution planning and resource allocation. In both cases there is a scarcity of market data to predict detailed adoption rates and locations for these technologies and a DCE study could provide valuable information about customer preferences.

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- Tennessee Valley Authority.
- Tennessee Valley Public Power Association.
- Tullahoma Board of Public Utilities.