

Understanding Electric Utility Customers - Program 182

Program Overview

Program Description

Electric utilities increasingly realize that they need to better understand and engage with customers. Overall customer satisfaction is a key measure of how well a utility is meeting its customers' needs and expectations. However, engagement is taking on a new dimension. Technology advances along with the success of new electric service options, as demonstrated in pilots, make offering customers choices for how they buy electricity possible in almost any electricity market. Choices require more engagement because customers need confidence in the information that will help them make the right choice. Mutually beneficial results are the expectation, but are realized only if the choices offered customers jointly meet their needs and contribute to the utility fulfilling its obligation to provide reliable and affordable power.

The choices this program addresses involve offering electric services that embody different inducements to alter the level or profile of electricity usage. Since customers have diverse electricity demands, it follows that a single service offering leaves some of those demands unfulfilled. Diversity of demands is advantageous because electricity supply is subject to temporal and spatial supply cost differences that are best managed if there are complementary demands. Some customers will use less when prices are high and more when they are low. Information about when they use electricity helps customers better allocate their budget to meet all their needs. This program focuses on three categories of behavioral inducements: pricing structures, information provision (feedback), and control technologies.

Other industries have developed detailed knowledge of their customers' preferences and behaviors for decades, driven to do so by competition. Obtaining customer intelligence has been an important element of single-provider utility operations as well, but the focus has been more directed to measuring customer satisfaction rather than developing an in-depth understanding of when and how they use electricity. Utilities are grappling with the knowledge that customers will play a pivotal role in seeing that technology deployments and the investment benefits are fully realized, but their level of understanding of these needs and wants is insufficient to meet the task at hand.

With new technologies being added to the grid to enable greater consumer participation in how they manage their electricity usage, there is an opportunity for the electric utility industry to get customers actively and sustainably involved in electricity usage decisions. However, fundamental research is required first to identify the root drivers of utility customer behavior. Such drivers include the effects of rate structure, feedback, and control technologies on customer response, response variation by customer segment, and other pertinent research questions. Subsequent field tests are necessary to verify behavioral models and quantify their impact over a range of customer and market circumstances.

Research Value

This program employs two parallel and coordinated initiatives—original research and utilizing the research of others—to fill important knowledge gaps about how consumers and businesses use and value electricity. The Electric Power Research Institute (EPRI) has established a foundation for addressing the most critical gaps in its recent research findings synthesis (see the EPRI report *Understanding Electric Utility Customers* (1023562)). Transparency and research rigor are bolstered by EPRI making research findings available to a wider research audience—a practice not typically followed in the industry (for example, the EPRI report *Guidelines for Designing Effective Energy Information Feedback Pilots: Research Protocols* (1020855), which specifies research protocols that are now widely referenced and used). EPRI's collaborative research model is uniquely qualified to capitalize on these opportunities where collaboration best serves the needs of individual utilities and the collective needs of all utilities.

Approach

Understanding customers requires a commitment to asking the right questions, listening to what customers say, interpreting what they say systematically and objectively, and using the findings to create services that fulfill expressed needs. At the heart of this research is finding ways to incorporate behavioral modification inducements into electric service plans. An electric service plan (ESP) is defined as an offering that extends traditional rate structures to incorporate dynamic pricing, information, and control technology to the benefit of all customers.

If customers are not satisfied with current rates, then utilities need to find services that do satisfy customers. If current rates do not elicit electricity usage behavior that meets utility and society goals, then new services that do elicit such behavior need to be developed and made available. Both want to adopt new electricity consumption behaviors. Services and ESPs that accomplish that, therefore, induce a change in electricity usage behavior. Understanding customers requires understanding behavioral cause and effect relationships and using them to design more effective and mutually beneficial ESPs.

Program 182 endeavors to provide members with information about behavioral change mechanisms through the following activities:

- Designing effective electric service plans employing a rate structure design that combines conceptual guidance from the disciplines of finance and economics with real-world experience about how customers respond to different rate structures.
- Adapting conceptual models of behavior changes to utility circumstances to modify electricity usage.
- Constructing a framework for incorporating price demand response into wholesale and retail markets to improve their performance and enhance customer engagement.
- Using behavioral programs to tap into new sources of savings potential using non-monetary inducements such as feedback and control technology.
- Developing and testing new approaches for understanding customer diversity by developing robust, reliable methods for building actionable customer groupings and associations.
- Responding to the need to revise how electric service plans are designed and managed, to ensure that costs are efficiently and equitably allocated where electric service plan choices are available to customers.
- Anticipating and resolving barriers to enable demand response activities.

Accomplishments

The EPRI report *Methods for Characterizing Customer Preferences for Electric Service Plans* (1024401) reviews methods for eliciting and interpreting residential customer preferences.

Understanding Electric Utility Customers: What we Know, and What We Need to Know synthesizes the results of pilots and field trial involving ESPs. Two versions were released:

- Public Report 1025856
- Members-only (detailed) Report 1024402.

Electric Service Plan Portfolio Management: Approaches and Potential Applications compares methods for segmenting and categorizing customer preferences for services and recommends methods that are most applicable to estimating electric service plan market shares.

Complementary customer behavioral research, completed or ongoing, comes from or is conducted jointly with Program 170 (Energy Efficiency and Demand Response), Program 18 (Electric Transportation), and the Smart Grid Demonstration Project. This body of work includes:

- Development of feedback research design protocols that can and are being used to design research programs that will add to the useful body of knowledge of customer behavior
- A system to clarify the role and impact of alternative pricing structures
- Plug-in hybrid electric vehicle (PHEV) customer preference surveys

Current Year Activities

The 2014 program has two main elements. Project Set 182A continues the application of behavioral sciences to characterize customer preferences for and responses to behavioral inducements. Research results from 2013 enable building a system for managing electric service plans to maximize utility goals and the continuation of the synthesis and interpretation of the body of empirical research on the impacts of electric service plans. A new initiative seeks to clarify the conceptual foundation for how feedback induces electricity usage behavior to help utilities compare alternative ways to use whole-premise data.

Project Set 182B develops and tests, under realistic market conditions, a model to quantify the benefits of price and demand response.

Estimated 2014 Program Funding

\$2.0M

Program Manager

Ellen Petrill, 650-855-8939, epetrill@epri.com

Summary of Projects

PS182A Behavioral Programs (073565)

Project Set Description

A complete understanding of electricity customers' wants and needs requires characterization of how they respond to behavioral change inducements, either as individual interventions or in combinations. This research initiative focuses on three categories of behavioral inducements: pricing structures, feedback, and control technologies. The research will focus on all customers in all customer classes in all electricity market circumstances, both fully and partially integrated and competitive choice.

The project set is composed of three research initiatives:

- **Behavioral Program Readiness Scorecard:** A thorough and contemporary synthesis of the extent to which research has resolved key program performance uncertainties.
- **Electric Service Plan Design and Portfolio Management:** How to integrate choice among electric service plans that differ fundamentally from those with conventional rates into electric utility financial and commercial operations.
- **Technologies to Enable Changing Electricity Usage Behavior:** Categorizing customer-facing technologies according to how they purport to enable behavior change, and summarizing and synthesizing research to establish that capability.

Project Number	Project Title	Description
P182.002	Impacts of Electric Service Plans: Evidence Review and Behavioral Program M&V	A concise and current summary of the state of knowledge regarding electric service plan impacts framed in terms of participation (what we know about customer uptake of these programs), performance (energy and customer satisfaction impacts), and persistence (how long impacts last); a forum to discuss behavioral program M&V with utilities and evaluation experts, and what it would take to bring it to the mainstream.
P182.003	Development and Demonstration of an ESP Portfolio Management Model	Offering customers choices in how they purchase electricity can improve electricity system performance substantially. It also establishes a foundation for customer engagement that can be employed for a variety of purposes. However, offering choices responsibly, so that both customer and demand and system supply circumstances are balanced, requires departing from conventional ratemaking and administration practices. This project intends to develop and test a prototype ESP portfolio management model, under realistic circumstances, to verify that a diverse set of services can be coordinated and implemented to maximize utility and societal objectives.
P182.007	Foundation for Providing Effective Premise-level Feedback	First applications, conducted under experimental protocols, indicate that whole-premise feedback, provided routinely, can reduce consumption modestly but possibly cost-effectively. This project intends to clarify the underlying mechanisms that are thought to induce this behavioral change and evaluate how well they work in practice to help members quantify the potential benefits, determine if they should use feedback as a foundation for customer engagement, and decide if they should outsource its provision or integrate it into their enterprise systems.

Project Number	Project Title	Description
P182.008	Customer Engagement and Electric Service Plans	As utilities diversify their retail service offerings to provide customers with choices, they will need to develop new ways to communicate with customers and convey information in a timely and reliable manner. The engagement channels that result provide a opportunity to expand the dialogue with customers to serve a variety of purposes. This project intends to map out robust engagement strategies and portray how they can be used to develop strong partnerships with customers.

P182.002 Impacts of Electric Service Plans: Evidence Review and Behavioral Program M&V (072118)

Description

Many utilities are tasked with achieving goals of reducing peak loads, achieving energy efficiency targets, and improving customer satisfaction, and they are seeking new ways of doing this, particularly as benefits from traditional technology-oriented measures are diminishing (e.g., CFLs and other lighting measures). Utilities are wondering whether offering new electric service plans involving alternative rate structures, improved information provision (also known as feedback), and customer-facing control technologies may help them achieve their goals. To answer this question, they need a concise statement about what is known about the customer acceptance of such programs, their impacts in terms of demand and energy reductions, and how long these impacts may last. They also need guidance on how they should measure and verify (M&V) program impacts to have the same level of confidence as they would for technology measures.

This project aims to address this need by answering two key research questions:

- How do customers respond to various pricing, feedback, and control technology inducements (or combinations thereof)?
- What options exist for performing M&V on these types of programs?

Approach

The Evidence Review, ongoing since 2011, will be continued in 2014 to capture new empirical findings on electric service plan impacts (i.e., pricing structures, feedback, and control technologies). This process involves searching for new evaluations, screening them for design rigor, adding findings into the existing body of evidence, and finally, concisely summarizing knowledge about electric service plan impacts. As always, this will be framed in terms of what is known about customer participation (i.e., customer interest in the offering), performance (i.e., the energy and customer satisfaction impacts once on a program), and persistence (i.e., how long impacts last).

In parallel, the related issue of measuring impacts of electric service plans, which involves the challenging task of measuring energy savings attributable to changes in customer behavior, will continue to be explored in 2014 via a workshop to bring together utilities, evaluation professionals, and behavioral research experts.

Impact

- Saves time and resources required to pore over hundreds of pages of evaluation reports to understand the range of service plans tested, and the industry's state of knowledge regarding their impacts
- Provides clarity on research questions already answered and highlights those that have yet to be resolved so utilities can avoid redundancy and use their research funding efficiently
- Contributes toward industry-accepted behavioral program M&V approaches by connecting utilities with peers and experts who are employing different methodologies to measure impacts
- Contributes to the end vision of gathering enough rigorous evidence to develop deemed impact values for electric service plan program offerings

How to Apply Results

- Utilities can use the Evidence Review as inspiration for new program ideas to achieve demand reduction, energy savings, or customer satisfaction targets. The values reported regarding program impacts may be used as estimates for utilities to develop cost/benefit analyses for new program proposals.
- The Evidence Review's plain language and concise format make it excellent reference material for discussions with upper management and regulators, as well as educational material for new employees.
- Workshop learnings on how utilities are measuring impacts and obtaining credit for their behavioral programs can be used to support other utilities' pilot or program ideas with upper management, regulators, and others.

2014 Products

Product Title & Description	Planned Completion Date	Product Type
<p>What we know (and what we need to know) about electric utility customers: 2014 update on impacts of pricing, feedback, and control technologies: A concise assessment of what we know about how pricing, feedback and control technology impact customer electricity usage behavior, summarizing evidence regarding customer participation (how many customers sign up?), performance (what are the energy and customer satisfaction impacts?), and persistence (how long do impacts last?). This is an ongoing project that is updated annually as more evidence becomes available; its vision is to contribute to the development of deemed impact values for these types of program offerings. The final report will be accompanied by a summary PowerPoint presentation.</p>	12/31/14	Technical Update
<p>Measuring customer behavior: A workshop on M&V methods for evaluating impacts pricing, feedback, and other inducements that affect customer behavior: A workshop forum for utilities, their peers, and other evaluation experts to discuss approaches being used to measure and attribute value to behavioral programs, hear what different regulatory bodies are (and are not) accepting in this realm, and debate the challenges and opportunities of seeking industry standards for behavioral program M&V. Panel presentation materials will be made available to workshop attendees.</p>	12/31/14	Workshop, Training, or Conference

P182.003 Development and Demonstration of an ESP Portfolio Management Model (072119)

Description

This project is defining a framework for a portfolio management system to support making choices available to customers regarding how they buy electric services. Electric service plans are defined as offerings which combine pricing structures with other behavioral inducements, such as feedback and control technologies, resulting in a variety of electric services from which customers can select.

Diversity in service choices serves both customers and the utility. Customers can determine the degree to which they want to manage their electricity usage to have opportunities to benefit from lowering their bill, increasing electricity usage, or reducing or eliminating bill fluctuation risks. Each customer selects a service plan based on the value that choice imparts. Utilities constantly balance meeting long-term needs, maintaining reliability, and achieving efficiency using available supply and delivery resources. The gains from offering customer choices are tangible—reduced costs, improved reliability, and increased value in consumption—and produce benefits that accrue to all electricity consumers and to society.

The conventional one-rate-fits-all service philosophy, whereby customers are assigned to a service, leaves the benefits of choice, which are substantial, untapped. Offering choices rectifies that shortcoming. However, realizing the full extent of the benefits of choices requires changing the way utilities construct, promote, and manage electric services. They must be able to match supply costs with specific customer needs so that the

choices offered simultaneously fulfill customer wants and needs and reflect the cost of supplying power under the terms of those service plans.

Characterizing the diversity of customer electricity demand requires consumer preferences research. This project focuses on managing a portfolio of ESPs whose customer preferences and usage have been established. The portfolio management challenge is to determine how many customers should be subscribed to the available set of price response and demand response programs and establish expectations for load changes that subscribers are expected to undertake.

Approach

In 2014, EPRI proposes to develop a prototype electric service plan portfolio management module and test it under representative conditions. The prototype, a first-generation electric service plan value optimization model, will focus on managing a limited-scale and -scope portfolio that includes elements of pricing structures, control technologies, and feedback mechanisms. The initial limited scale of the portfolio management prototype facilitates developing a computational platform that can be expanded to take on more complex portfolio circumstances once this version's performance has been verified. The scope, which defines the customer population involved and the supply circumstances that affect electric service plan management, will be representative of one or more utility market and enterprise conditions. This is intended to demonstrate the application of the principles and operating mechanics that define the prototype model under transparent and verifiable conditions. Subsequently, the model can be extended to apply to a variety of market structures and the full range of price and demand response structures.

Model testing will be conducted first to demonstrate that the model performs as intended, producing logical and useful instructions from adjusting the number of electric service plans offered and the level of subscription to each consistent with specified supply and customer demand conditions and circumstances. EPRI intends to construct performance requirements that serve to evaluate the model's performance.

A second test will search for durable solutions that provide electric service plan availability guidelines associated with specific market conditions. Durable solutions are rules that can be applied generally and that are expected to require modification only under low-likelihood and specified (triggering) circumstances. For example, the model may indicate that critical peak pricing and peak time rebates be implemented to no more than 25% of total demand, ideally in equal proportions, and that feedback should be provided to all residential customers. This would be a durable result because this rule of thumb for implementing these electric service plans is expected to be consistent with market circumstances for the next year or two. The triggers define market condition that warrant a comprehensive reexamination of the need for demand response using a full portfolio evaluation. For example, a trigger may be a large generation plant that comes on line or goes out of service.

The result of these research activities will inform a plan for the development of a full-scale and -scope portfolio-management model that can be used in a variety of utility circumstances.

Impact

- Defines a pathway from traditional, one-size-fits-all ratemaking to the utility as a provider of a portfolio of services to satisfy diverse demands for electricity.
- Demonstrates the viability and capability of an electric service plan portfolio management model that utilities can employ to offer customers choices in how they buy electric service in an effective and responsible way.
- Establishes the path and requirements for developing a production portfolio management system.

How to Apply Results

Members will be able to use results to:

- Initiate the design and testing of electric service plans to diversify retail service offerings in anticipation of a full portfolio being ready in two to three years.
- Develop system, process, and decision requirements for integrating an ESP portfolio management system into utility operations, including planning, dispatch, and power exchanges.

- Begin developing a pathway—which may include regulatory, customer engagement, and enabling technology aspects—for moving from conventional ratemaking to designing and managing diverse electricity services.

2014 Products

Product Title & Description	Planned Completion Date	Product Type
Managing a Portfolio of Electric Service Plans (ESP) -- Methods, Protocols, and a Demonstration Application (EPRI Technical Update)	12/31/14	Technical Update

P182.007 Foundation for Providing Effective Premise-level Feedback (NEW)

Description

A growing body of field research suggests that providing customers with information about trends in monthly household electricity usage results (on average over large populations) in a reduction in total kilowatt-hours of consumption. The results of feedback that compares a household's usage to that of others also has been shown, to some extent, to lower electricity usage, as does augmenting either feedback mechanism by getting households to establish goals and track progress toward their achievement.

Results to date suggest that the impact is modest (2-4%) and it has not been demonstrated unequivocally that the usage changes are permanent—that what began as a behavior modification becomes habitual, and therefore is ingrained in the lifestyle of the consumers. However, feedback-induced energy reductions may be achievable at relatively low costs, and therefore yield positive net benefits. Moreover, routinely providing feedback to households establishes a dialogue that serves as the foundation for wider engagement, paving the way for promoting energy-efficiency, price-response, and demand-response program participation, and other services that improve the value of electric service.

The application of feedback mechanisms is inspired by cause-and-effect relationships that have their origins in the behavioral sciences. The model of social cognitive behavior posits that a combination of personal determination (behavior) and external factors (influences or inducements) drive consumer behavior. Consumer utility maximization, as portrayed by economists, treats feedback as a correction factor that better reflects the value of electricity. As a result, the household budget is reallocated among all goods and services, which might shift, reduce, or expand electricity usage. Others see feedback as a force to overcome an anchoring effect that prevents consumers from considering using electricity differently from how they have in the past.

There are other explanations for how feedback causes a change in behavior. All share a reliance on a series of internalized mental processes, triggered by a behavioral inducement, that cannot be seen or measured; all that is observed is the outcome that may have antecedents other than the directive inducement.

The project objective is to prepare a primer on how feedback influences electricity consumption that

- provides utility program designers with a synthesis and working knowledge of conceptual model of how feedback influences behavior,
- compares and contrasts derivative processes for using feedback to modify behaviors, and
- serves as a guide to determining which kinds of feedback will best contribute to the utility's strategic goals.

Approach

The project involves undertaking research syntheses and interpretation initiatives to connect the theory of behavioral sciences to feedback programs that members can implement today. The emphasis is on feedback that requires only periodic (monthly) billing data. This focus is appropriate because it addresses mechanisms that can be universally implemented now, and that can be augmented and enhanced when more granular data (AMI hourly usage, for example) becomes available.

Project activities are as follows:

- Prepare a tutorial on the fundamental tenets of behavioral sciences disciplines, with an emphasis on how each characterizes the way in which feedback and information influence behavioral change.
- Develop a practical characterization of alternative explanations for how behaviors can be influenced and transformed into habits, emphasizing differences that are important in applications such as feedback to electricity consumers.
- Provide examples of the use of these mechanisms and inducements in pertinent applications, such as anti-littering and stop-smoking campaigns, dieting, physical fitness and health care, where feedback is tailored to achieve a specific outcome.
- Review the role and potential benefits of establishing goals to enhance the performance of whole-premise feedback.
- Define methods and protocols that members can develop and implement internally to provide premise-level feedback on an ongoing basis.
- Define M&V and other measures to track program performance.

Impact

- Provides a practical reference source on behavioral science, theories, and methods as they apply to modifying household electricity usage
- Establishes the relative benefits and potential shortcomings of practical applications of behavioral sciences to create whole-premise feedback mechanisms.
- Defines specifications members can use in procuring commercial whole-premise feedback services
- Provides specifications for how members can develop and implement feedback internally

How to Apply Results

- Evaluate alternative methods for engaging customers through providing feedback
- Estimate the benefits expected from providing households with feedback
- Compare commercial and internal cost of providing feedback services on an ongoing basis

2014 Products

Product Title & Description	Planned Completion Date	Product Type
Whole Premise Feedback -- Conceptual Foundations and Practical Applications	12/31/14	Technical Update

P182.008 Customer Engagement and Electric Service Plans

Description

Consumers are expecting more and more of their service providers, and utility customers are no exception. Utilities realize they need to better understand and engage with their customers for them to more fully realize the benefits of utility programs and technology investments. The topic of customer engagement is broad and far-reaching; this work focuses on electric service plan (ESP) offerings and their potential value as tools for increased customer engagement. How can members translate generally favorable satisfaction ratings from utility electric service plan pilots into a quantifiable value that decision makers can use when considering new program concepts?

In particular, this project addresses two research questions:

- How can electric service plans be used to foster customer engagement
- How could this benefit be quantified?

Approach

- Broadly define what customer engagement means for residential and commercial customers, including the basic channels through which customer engagement can occur. Do this by drawing from foundational literature from the behavioral sciences and marketing, as well as from expert interviews (both utility and non-utility experts)
- Considering electric service plan offerings in particular, map out the ways that ESPs make use of these customer engagement channels.
- Perform utility interviews to gather opinions on how ESP pilots and programs affected (or did not affect) the ways in which customers engaged with the utilities.
- Examine evidence from electric service plan pilot/program evaluations on how providing electric service plans affects a customer's engagement with their utility, using metrics such as electric service plan pilot participation rates, customer satisfaction ratings from electric service plan-related surveys, subsequent uptake rates of other utility program offerings, or other potential metrics for measuring customer engagement to be determined.
- Assuming increased engagement occurs as a result of customers participating in ESPs, propose an approach for quantifying the value of this benefit. For example, is it possible to translate improved customer engagement to impacts on JD Power customer satisfaction scores? Is it possible to predict customer uptake of other programs as a result of the initial engagement via the electric service plan?

Impact

- Show a quantifiable benefit of electric service plans beyond energy and demand impacts alone. This can be used to help support the concept of providing customers with greater choice regarding how they buy electricity to upper management and regulators.
- More choice in and of itself may potentially lead to greater levels of customer satisfaction.

How to Apply Results

- Incorporate findings to bolster rationale for new electric service plan program proposals.
- Understand the channels through which customer engagement may occur as a result of offering electric service plans; use this understanding to cover all bases when designing communications plans associated with such offerings.
- Plan for future portfolio offerings with increased knowledge of how engagement via one service plan may lead to engagement on subsequent plans.
- Learn from others what did and did not work with regard to their customer engagement strategies in promoting electric service plans.
- Obtain common survey question wording that can be included in on-going electric service plan-related surveys so that satisfaction impacts can be tracked over time as well as across electric service plan offerings and utilities.

2014 Products

Product Title & Description	Planned Completion Date	Product Type
From Engagement to Overall Customer Satisfaction: The Role of Electric Service Plans: A description of the basic channels through which electric service plans may lead to customer engagement, supported by utility interviews. Customer engagement metrics are defined, such as pilot participation rates, customer satisfaction ratings, subsequent uptake of other utility program offerings, etc., and an approach is proposed to quantify the value of customer engagement. The final report will be accompanied by a summary PowerPoint presentation.	12/31/14	Technical Update

PS182B Linking the Operations of Wholesale and Retail Electricity Markets through Behavioral Programs (073567)

Project Set Description

Cause-and-effect linkages on how load changes influence current wholesale market operations and prices will be accomplished by synthesizing and building on the prodigious body of research available on the effects and influences of demand and price response. Expanding these associations to specifically account for load changes induced by behavioral programs (especially price structures) will produce insightful market characterization and metrics for quantifying the physical and monetary impacts. A wide view will seek to identify more holistic and effective arrangements, whereby demand and price response are fully integrated into both markets so that the benefits of price-responsive load are fully realized.

Project Number	Project Title	Description
P182.006	Linking Wholesale/Retail Linkages through Price and Demand Response	Design, test, and demonstrate the use of a model that quantifies the value of price and demand response, both generally and for specific programs and pricing structures, under a range of market structures for the full range of current and potential market supply-and-demand conditions.

P182.006 Linking Wholesale/Retail Linkages through Price and Demand Response (073568)

Description

In 2013, this project proposed a framework for quantifying the value of price and demand response. Its scale includes the family of price response structures as well as dynamic pricing, such as real-time and variable-peak pricing, critical-peak pricing, time-of-use pricing and other variations. It also addressed the value of demand response programs such as peak time rebate, and direct and customer-managed load control. Implicitly, it serves to establish the value (in effect the hedge premium) associated with highly hedged products (for example fixed bill and uniform pricing), an important distinction in valuing a portfolio of ESPs.

The project's scope extends to all electricity market structures, including traditional vertically integrated utilities, cooperatives and their supply entities, public power agencies and administrations and the retailer distributors they serve, and organized wholesale markets operated by ISOs/RTOs.

Approach

In 2014, EPRI proposes to develop an empirical model that quantifies the value of price and demand response under observed and forecasted market conditions. The model will characterize both the supply of and demand for electricity, baselines which are developed from indigenous historical market data, from market transaction data from representative markets, or both. This structure produces equilibrium market prices (hourly or for blocks of hours each day), prices that clear the wholesale market (supply equals demand) consistent with exigent supply-and-demand conditions.

This characterization facilitates addressing the key questions associated with valuing price response (PR) and demand response (DR), including how specific PR and DR structures and programs:

- Affect wholesale prices over the entire electricity supply function. It is likely that the marginal impact of additional PR and DR on market prices declines at some level of electricity demand curtailment.
- Affect both energy market prices and capacity prices, either explicitly (centralized markets) or implicitly (decentralized markets). The model's framework accommodates its extension to estimating the ancillary service market impacts of PR and DR.

EPRI intends to imbed the price formation model into a simulation environment that facilitates evaluating price formation under PR and DR program under a variety of market and customer circumstances, and the full range of potential PR and DR structures.

Impact

- Provides a consistent characterization of how PR and DR influence wholesale markets, including the level and distribution of expected benefits.
- Quantifies the short-term and long-term value of PR and DR programs for specific market conditions and for PR and DR programs operating in those conditions.
- Distinguishes benefits that involve transferring payments among market participants (suppliers and consumers) from societal benefits that accrue to all consumers as the result of better use of national and regional resources.

How to Apply Results

- Establish guidelines to inform and direct the development of PR and DR programs based on the likely range of benefits that would be realized.
- Evaluate existing and proposed PR and DR programs, both individually and comparatively, to determine near-term expected benefits.
- Develop a long-term strategy for fostering PR on an ongoing basis, and utilizing DR to address specific situations.

2014 Products

Product Title & Description	Planned Completion Date	Product Type
Quantifying the Value of Price and Demand Response; Methods, Models, and Applications		Technical Update

Supplemental Projects

Characterizing Residential Customer Preferences for Electric Utility Service Plans (073537)

Background, Objectives, and New Learning

Thanks to new metering and data management technologies, it is now technically feasible for electricity retailers to offer pricing structures like TOU, PTR, RTP and CPP, and variations thereof, to residential customers. Moreover, they can enhance the control and value of the standard or new services by appending other features such as providing information to track and technologies to control electricity usage. The term electric service plan has been adopted to distinguish conventional electric tariff for more diverse and behavioral change oriented commercial arrangements.

However, designing, marketing, implementing, and administering ESPs involves additional costs, many of them are up-front and fixed. These costs can be substantial, and act as a deterrent to implementing new service offering that have show promising results in pilots and demonstrations. In the absence of credible estimates of consumers' preferences for different ESPs, justifying those expenditures is difficult.

The objective of this project to develop survey tools and analyses protocols that retail service providers, either by themselves or as part of a state or regional collaborative, can administer to their customers to gauge preferences for alternative pricing structures. EPRI plans to take measures to acquire the survey responses as they are collected (properly protected) to create a research database that furthers the characterization of residential customer service plan preferences.

Project Approach and Summary

This research project will develop and test a survey instrument to solicit from residential customers their preferences for alternative electricity service plan. EPRI intends to solicit several utilities in whose market the field trials will be conducted; one or more preference elicitation models will be deployed to a sample of residential customers. The survey will be administered using commercial, web-based panels.

Benefits

Project deliverables will have immediate and valuable applications. Establishing relative preferences for alternative service plans will help retail service providers develop a strategic plan for improving customer satisfaction and realizing more efficient system operation. Service plan market share estimates, defined at a specified level of statistical precision, enable a comprehensive enterprise assessment of the costs and benefits of implementing an individual service, or a portfolio of services. The association of plan preferences to customer and premise characteristics, which is the expected result of the survey data analyses, reduces customer engagement and marketing costs.

The project results will demonstrate the value of establishing customer preferences for new ESPs, and make available the tools utilities and others need to estimates ESP preferences in their own market.

Matching Electric Service Plans to Achieve Utility Strategic Goals (105147)

Background, Objectives, and New Learning

EPRI Program 182 (Understanding Electric Utility Customers) seeks to develop a theoretical and practical foundation for expanding retail service tariffs to include a wide variety of options, called Electric Service Plans (ESPs). ESPs define the character and terms of service, and are constructed from three categorical ways of reflecting supply and delivery costs to influence electricity use – rate structures, feedback, and/or control technology offerings.

EPRI expects that it will require several years of research and development activity to devise, test, and implement an ESP portfolio design and management system. However, the fundamental elements of such a system are available now and can be utilized to advance utility strategic goals that involve inducing changes in electricity demand.

Therefore, the objective of this project is to develop and apply methods to help utilities determine what ESP offerings will help achieve both their utility and customer goals. Doing so under realistic utility circumstances will help expose approach conceptual shortcomings so that they may be remedied. It also provides guidance on how ESPs interface with utility data systems and existing rate design tools and practices. It identifies critical constraints that limit ESP availability. Finally, focusing on strategic goals will help utilities select those ESPs with the most immediate and potentially influential effects for further intensive study, possibly leading to field trials that would further inform knowledge on ESP impacts, as well as ESP design and implementation tools.

Project Approach and Summary

EPRI has developed a process by which the utility's enterprise, market, customer, technology, and regulatory circumstances can be used to screen the universe of ESP alternatives to identify those that contribute most to a utility's strategy goals, and establish a plan for their realization. This can be accomplished through a series of tasks, as follows:

Task 1. Articulate strategic enterprise goals that involve modifying electricity demand.

Task 2. Conduct first level screening. Categorize various ESPs according to how they may induce the desired demand modification (peak, off-peak, total usage, and targeted end-uses), by tariff class, and other customer distinctions.

Task 3. Conduct second level screening. Establish ESP impact parameters (behavioral responses) based on the results of pilots, experiments, and large-scale programs.

Task 4. Estimate customer acceptance. Develop estimates of likely levels of customer participation/subscription based on pilot and experimental research findings and the circumstances of the utility's customer populations.

Task 5. ESP Portfolio. Construct a service portfolio of ESPs that most contributes to advancing the utility's five-year strategic goals, and indicate barriers to their achievement.

Task 6. Expected Impacts. Develop first-approximation estimates of the five-year expected impacts and benefits from the implementation of the portfolio.

Task 7. Propose an implementation strategy. Devise a strategic plan for implementing the portfolio based on the utility's reckoning of impact and benefit priorities, equipment and system requirements and costs, and other factors.

Benefits

Early application of ESP screening approaches is a necessary first step in the development of the tools and protocols to become the standard for establishing the value of ESPs. It also contributes to understanding how to convey those benefits to customers and stakeholders. General acceptance of new tariff design and administration practices is an essential stepping-stone to industry-wide deployment.

Utilities and their customers should benefit from the reformation of the traditional, one-size-fits-all tariff philosophy to one that offers customer choices that both reduce utility costs and increase customer satisfaction.

The benefits expected from this project include:

- Individual applicability. Testing first-generation ESP design protocols in the context of a utility-specific strategic planning exercise is expected to serve as a first test of their applicability and value.
- Collective representation. EPRI anticipates that the diversity of utility strategic goals for modifying electricity demand serves to establish the usefulness and applicability of the protocols over a wide range of utility circumstances.
- Acceleration of development time. Starting with basic design principles is expected to support the accelerated development and testing of what will become a complete system for designing and managing ESPs.
- Utilities and the public gain from the collective knowledge the findings reveal about the relationship between the structure of the inducements that define ESPs and consumer behavior.

Evaluating Smart Thermostats' Impact on Energy Efficiency and Demand Response (105104)

Background, Objectives, and New Learning

Advances in technology have led to the development of a new generation of programmable communicating thermostats that hold the potential for energy and demand savings at a relatively low cost to electric and gas utilities.

Known as “smart thermostats”, these control devices for space conditioning systems have capabilities beyond just allowing the customer to program temperatures for different times of the day, and days of the week. They allow customers to remotely program their thermostat, often via internet-enabled devices (such as a PC or mobile device) with a consumer-friendly user interface. They enable two-way communication of data outside the building premises (either built-in or expandable), including indoor temperature data, operational sequence of space conditioning equipment, etc. They can also be adapted to receive demand response event signals from utilities.

Industry experience has shown that customer acceptance and usability can be key drivers to a thermostat's energy or demand reduction potential. Given that smart thermostats may offer better customer usability due to their remote programming capability, the objective of this project is to evaluate their energy and demand savings impacts, as well as how customers perceive and use them.

New learning for the industry and the public will come about by addressing the project's key research questions which are as of yet unanswered: Do smart thermostats result in energy and/or demand savings with residential customers? Other new learnings will be derived in answering secondary research questions relating to the technological characterization of various smart thermostats on the market, and customer interest and uptake.

Project Approach and Summary

Electric and/or gas utilities may participate in the project as either a Host or a Collaborator. Hosts will field a trial in their service territory, answering specific research questions of interest to them. Participation as a Collaborator is intended for utilities that are interested in possibly developing a smart thermostat program in the future, but are not yet ready to field a trial, or for utilities with trials in progress but that are interested in the results of others as well as the technology and market understanding.

The specific implementations will vary based on the eventual trial designs, but the overall primary tasks include:

- A technical review of market-ready smart thermostat technologies, including the development of selection criteria for subsequent trial recommendation
- Guidelines for designing and conducting smart thermostat trials and analyses to measure attributable energy and/or demand impacts
- The development of Host-specific EE and/or DR trial designs and analysis plans, including the trial objectives, sample frame, data acquisition methods, and recruitment plan

- Enabling delivery of demand response signals (if a DR deployment is chosen by Host) with the product vendor
- The set-up of systems to acquire data from the smart thermostats (Host-specific)
- Survey design and administration to assess customer reaction to the thermostats, and self-reports of customer behavior (Host-specific)
- Host-specific evaluations for EE and/or DR impacts after two main seasons (winter and summer) and after one complete test year
- A multi-Host analysis to assess commonalities and divergences amongst the findings, and potentially pool the data to develop a model

Benefits

This project will inform gas and electric utilities and the public of the potential energy savings benefits of smart thermostats. For utilities, it may provide a measure of how these thermostats fit into their programs, and key features that might promote energy efficiency and demand response. Demand response from residential air conditioners has been a target of many utility programs, but the cost of installation of load control devices and the perceived compromise in customer comfort have been large barriers. These thermostats, which are consumer-managed and possibly consumer-procured, may overcome these barriers at a relatively low cost. Also, the knowledge gained about how customers perceive and interact with these types of devices may potentially inform future product designs, and help bring about better thermostat choices for consumers.

Finally, this project offers the opportunity to pool and compare data across different utility and technology contexts, therefore contributing a larger breadth of results than any single one-off evaluation.