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ENERGY

Electricity Delivery
& Energy Reliability

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Reinvestment Act of 2009

Analysis of Customer Enrollment Patterns in Time-Based Rate Programs – Initial Results from the SGIG Consumer Behavior Studies

Smart Grid Investment
Grant Program

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Executive Summary

The U.S. Department of Energy (DOE), Office of Electricity Delivery and Energy Reliability (OE), is implementing the Smart Grid Investment Grant (SGIG) program under the American Recovery and Reinvestment Act of 2009 (Recovery Act). The SGIG program involves 99 projects that are deploying smart grid technologies, tools, and techniques for electric transmission, distribution, advanced metering, and customer systems. DOE-OE is examining the progress, impacts, and benefits of these projects and is presenting the results on www.smartgrid.gov.

A subset of the 99 SGIG projects is conducting consumer behavior studies. These studies examine the response of residential and small commercial customers to time-based rate programs that are implemented in conjunction with the deployment of advanced metering infrastructure (AMI) and customer systems such as in-home displays (IHDs) and programmable communicating thermostats (PCTs). The SGIG consumer behavior study effort presents an opportunity to advance the electric power industry's understanding of consumer behaviors in terms of customer acceptance and retention, and energy and peak demand impacts. This is important in assessing the cost-effectiveness of demand-side programs as resource options for use in planning and operating electric power systems.

Purpose and Scope

As deployment of AMI spreads, two-way communications networks are increasingly available as are meters capable of recording at least hourly interval electricity consumption data. As a result, electric utilities are now more able to implement time-based rate and customer systems programs for residential and smaller commercial customers. These offerings are relatively new, as the required metering technologies were largely absent in the residential sector up until now, and with some exceptions, there have been obstacles to enrolling customers in the programs. For example, consumer awareness, knowledge, and experience with the terms of the rates and programs and their potential benefits, is relatively low. This report presents information from analysis by Lawrence Berkeley National Laboratory (LBNL) of initial enrollment results from the nine projects conducting a total of eleven consumer behavior studies under SGIG (note that two projects have each initiated two studies).

This analysis is helpful in several ways for utilities, regulators, and others in evaluating the efficacy of these types of demand-side programs. For one, information on enrollments in studies or pilot-scale programs is needed to understand the validity of energy and load-shape impact estimates based on statistical power calculations; if enrollments are too low in relation to planned sample sizes, program evaluation efforts may not produce accurate impact estimates. In addition, improved estimates of enrollment rates are useful for planning and



forecasting the potential contribution of time-based rate programs in resource plans once the programs are scaled up and offered to large numbers of customers across utility service territories.

Major Findings and Lessons Learned

The primary metric for the analysis of enrollments is the recruitment rate, which is defined as the number of recruited customers divided by the number of solicited customers. Differences in recruitment rates often reflect the amount of time and effort that was devoted to market research and customer education, as well as the effectiveness of marketing materials and strategies.

- For the 19 solicitation efforts¹ that have occurred for the SGIG consumer behavior studies so far, recruitment rates range from 5% to 28% for opt-in offers, while those using opt-out offers have recruitment rates that range from 78% to 87%.
- During the planning stages, most of the studies did not accurately predict recruitment rates for their solicitation efforts. Of the six opt-in solicitation efforts that underachieved their planned recruitment rates, five had an actual recruitment rate that was 7 to 22 percentage points lower than planned, while five out of the six opt-in solicitation efforts that overachieved had an actual recruitment rate that was no more than 4 percentage points higher than planned. The sixth was 14 percentage points higher than planned, almost double the planned rate.
- More customers enroll in time-based rate programs with opt-out offers than with opt-in offers. When customers were solicited to join a study using **opt-out** recruitment approaches, the programs had an average recruitment rate of 84% (i.e., those solicited did not reject the offer and were placed into a program). On the other hand, when customers solicited using **opt-in** recruitment method (i.e., the customers were informed of the study and asked to join) only 11% accepted the offer.
- For opt-out solicitations, the type of time-based rate offer does not substantially affect the customer recruitment rate: time-of-use (TOU) rate offers had a recruitment rate of 81%, flat rates with critical peak pricing offers had an 81% recruitment rate, and time-of-use and critical peak pricing offers had a 78% recruitment rate. This finding holds for opt-in solicitations, as flat rates with critical peak pricing components had 17% recruitment rates, and those offering time-of-use rates had 16% recruitment rates. The addition of technology offerings also did not significantly alter this finding as programs

¹ A *program offer* represents the different types of time-based rate, technology, and opt-in versus opt-out proposals made to customers when they are solicited to enroll in a study. A *solicitation effort* is defined to be a one complete set of program offers made to one group of customers to participate in a particular study (e.g., one solicitation effort may have an opt-out offer, a TOU rate offer, and no technology offer).



involving IHDs had 16% recruitment rates, and those without IHDs had 17% recruitment rates.

The lessons learned are based on reports from the projects and include project team members' observations about enrollment strategies that did and didn't work.

- Many of the utilities found that focus groups, surveys, and other research on customer preferences were vital components for test marketing terms and concepts for convincing customers to participate in solicitation efforts. This was because the opinions of the utilities about what would be effective marketing terms frequently differed from what customers thought would be effective.
- However, several of the utilities also discovered that focus groups alone were not sufficient to understand customer preferences and that it was important to validate focus group results with other test marketing and survey efforts and cover a variety of customer segments to build a comprehensive profile of attitudes and awareness. For example, environmental reasons were often given initially by customers as a motivator for participating, but more detailed test marketing found that while environmental factors were important, the dominant reason customers would choose to participate was financial and the opportunity to save money on their bills.
- Many utilities also commented on the importance of effective training for installation personnel and contractors who meet with customers in their homes and install devices such as IHDs and PCTs. Installers were frequently asked questions about the program itself and being able to answer them accurately and represent the program effectively was said to be a key part of making the installation experience positive and customer-friendly.

Next Steps

DOE, LBNL, and the nine SGIG projects themselves are publishing reports on the results of the consumer behavior studies. These can be found at http://www.smartgrid.gov/recovery_act/consumer_behavior_studies. The nine SGIG consumer behavior study projects produce both interim and final evaluation reports. One of the projects (Oklahoma Gas & Electric) has posted an interim and final evaluation report on their study, another project (Marblehead Municipal Lighting Department) has generated only an interim evaluation report and is working to complete their final evaluation report, while the rest are in the process of producing interim evaluation reports. Over the next several months, seven of the projects will be publishing interim evaluation reports on the first year of their studies.

Subsequent reports by LBNL and DOE will examine a variety of topics related to customer acceptance and retention. Because this report is based on initial results, it includes only



information about the first stage of a customer's choice: whether to enroll in a study. Equally important is information on subsequent customer choices, including decisions to remain as program participants.

Plans for future reports include analysis of the number of customers who dropped out after the study treatment went into effect (perhaps after receiving the first bill), the number of customers who installed and subsequently used the customer systems (where applicable), and the number of customers who remained in the study for its duration. In addition, these reports may examine reasons for higher or lower recruitment and retention rates, including whether certain customer segments (e.g., low-income vs. high-income, high school educated vs. college educated) are more or less likely to choose to enroll.

Future LBNL and DOE reports also plan to analyze impacts on electricity consumption and peak demand. This analysis includes assessing whether certain customer segments are more or less responsive, whether customers exhibit persistence of responses over time (i.e., year 1 vs. year 2), the degree to which customer systems affect responses, whether enrollment methods (i.e., opt-in vs. opt-out) affect customer responses, and whether the existence of bill protection affect responses.



1. Introduction

The U.S. Department of Energy (DOE), Office of Electricity Delivery and Energy Reliability (OE), is implementing the Smart Grid Investment Grant (SGIG) program under the American Recovery and Reinvestment Act of 2009 (Recovery Act). The SGIG program involves 99 projects that are deploying smart grid technologies, tools, and techniques for electric transmission, distribution, advanced metering, and customer systems. DOE-OE is examining the progress, impacts, and benefits of these projects and is presenting the results on <http://www.smartgrid.gov/library>. In addition to this report, six others have been published:

- *“Smart Grid Investment Grant Program Progress Report,”* July 2012
- *“Demand Reductions from the Application of Advanced Metering Infrastructure, Time-Based Rates, and Customer Systems – Initial Results,”* December 2012
- *“Operations and Maintenance Savings from the Application of Advanced Metering Infrastructure – Initial Results,”* December 2012
- *“Reliability Improvements from the Application of Distribution Automation Technologies and Systems – Initial Results,”* December 2012
- *“Application of Automated Controls for Voltage and Reactive Power Management – Initial Results,”* December 2012
- *“Economic Impacts of Recovery Act Investments in Smart Grid,”* April 2013

There are also more than twenty case studies which report on initial results and lessons learned from specific SGIG projects. These can be found on http://www.smartgrid.gov/recovery_act/program_impacts/case_studies.

1.1 Purpose and Scope

The SGIG program is working with a subset of the 99 SGIG projects who are conducting consumer behavior studies (CBS). These studies examine the response of residential and small commercial customers to time-based rate programs which are implemented in conjunction with the deployment of advanced metering infrastructure (AMI) and customer systems such as in-home displays (IHDs) and programmable communicating thermostats (PCTs). The SGIG CBS effort presents an opportunity to advance the electric industry’s understanding of consumer behaviors in terms of customer acceptance and retention, and electricity consumption and peak demand impact.²

² See http://www.smartgrid.gov/recovery_act/consumer_behavior_studies for more information about the goals and objectives of the SGIG CBS effort.



With increased deployment of AMI, including two-way communication networks and meters that can record at least hourly interval consumption data, electric utilities are now more able to implement time-based rate and customer systems programs for residential and smaller commercial customers.³ These offerings are relatively new, as the required metering technology was largely absent in the residential sector up until now, and with some exceptions, utilities generally have encountered problems with enrolling customers in the programs. For example, consumer awareness, knowledge, and experience with the terms of the rates and programs and their potential benefits, is relatively low.

Because AMI business cases often include benefits from the reduction in electricity consumption and peak demand caused by time-based rate and customer systems technology programs enabled by AMI, there is increasing interest among policymakers, regulators, utilities, consumer advocates, and other stakeholders in understanding how many customers are likely to enroll and continue in such programs, and which factors affect these recruitment and retention rates.

This report presents information from analysis by Lawrence Berkeley National Laboratory (LBNL)⁴ of initial enrollment results from the nine projects who are conducting eleven consumer behavior studies under SGIG.⁵ This analysis provides information for utilities, regulators, and others in evaluating the efficacy of these types of demand-side programs. For one, information on enrollments in studies or pilot-scale programs is needed to understand the validity of energy and load-shape impact estimates based on statistical power calculations⁶. Because, if enrollments are too low, program evaluations may not produce accurate impact estimates. In addition, improved estimates of enrollment rates are useful for planning and forecasting the potential contribution of time-based rate programs in resource plans once the programs are scaled-up and offered to large numbers of customers across utility service territories.

While there are many studies of peak demand and energy impacts of time-based rate programs and customer systems, there has only been limited information of customer enrollment and

³ FERC (2011) 2011 Assessment of Demand Response & Advanced Metering: Staff Report. Washington, D.C. November 2011.

⁴ P Cappers et al (2013) Residential Customer Enrollment in Time-based Rate and Enabling Technology Programs, LBNL: P Cappers et al (2013) Summary of Utility Studies, LBNL

⁵ Two SGIG projects are each conducting two studies: (1) NV Energy is conducting a similar study in both its southern service territory (Nevada Power) and northern service territory (Sierra Pacific Power); and (2) eEnergy Vermont is conducting two studies as part of their SGIG project, one by Green Mountain Power and one by Vermont Electric Cooperative.

⁶ Power calculations are used to determine how large of a sample size is needed for a study to have confidence that empirical estimates of treatment effects are credible. For more information on power calculations, see Appendix A of Cappers et al. (2013) Summary of Utility Studies.



recruitment rates in the public sphere.⁷ As the electric power industry gains confidence in the validity of estimated impacts, and attention turns to scale-up and large-scale deployments, the relative importance of understanding the factors affecting customer decision making in joining or leaving programs becomes a higher priority.

The U.S. Energy Information Administration (Form 861) and the Federal Energy Regulatory Commission (Form 731) both collect and report on time-based rate enrollments from all U.S. utilities annually. However, it is difficult to analyze the data because utilities are not required to report information on the number of customers that were solicited or provide information that may explain factors that influenced recruitment rates. As such, there is limited public information to help utilities, regulators, and others to understand enrollment and recruitment rates for time-based rate and customer systems programs, and the factors that may affect them.

1.2 Organization of this Report

Section 2 of this report presents descriptive information about the nine SGIG projects undertaking the eleven consumer behavior studies. Section 3 summarizes the results of the initial analysis in three areas: (1) experimental results; (2) descriptive results; and (3) lessons learned. Experimental results are statistical estimates derived from experimentally designed tests. These results enable conclusions to be drawn about the causal effect of the treatments⁸ being tested. In contrast, descriptive results are based on comparisons of summary statistics and are not derived from experimentally designed tests. Because of this, the descriptive results, while illustrative and informative, are not used for determining causes since not all factors that affect causality have been accounted for properly (in a statistical sense.) Lessons learned are based on anecdotal information collected from reports and discussions with the SGIG consumer behavior study projects. The lessons learned enable better understanding of the context surrounding the results and include observations about the relative merits of alternative approaches.

⁷ See, for example, Charles River Associates 2005; Summit Blue Consulting 2007; Hydro One Networks 2008; Connecticut Light and Power 2009; Faruqui and Sergici 2009; eMeter Strategic Consulting 2010; EPRI 2011.

⁸ Treatments refer to the new rates or customer systems that are being deployed and evaluated.



2. Overview of the SGIG Consumer Behavior Studies

This section provides an overview of the nine SGIG projects that are conducting eleven consumer behavior studies. More detailed project and study descriptions can be found at http://www.smartgrid.gov/recovery_act/project_information. The information in this section is based on the two LBNL reports that were cited on page 2.

The SGIG consumer behavior study projects have their own implementation schedules. For example, two projects have already completed their studies (i.e., Oklahoma Gas & Electric and Marblehead Municipal Light Department). One project (NV Energy) has only recently recruited participants, while the remaining projects are in varying stages of implementation, data collection, and analysis and reporting. The projects conducting these studies involve a range of types of utilities including a smaller municipal utility (Marblehead Municipal Light Department with ~10,000 residential customers) and larger investor-owned utilities (e.g., Detroit Edison with ~1.9 M residential customers). While each of the studies shares common topics and methods, each also has unique features that reflect the specific objectives and rate and technology offerings of the utility conducting the study.

Table 1 provides a summary of the objectives of the SGIG consumer behavior studies.

Utility	Study Objectives ⁹
Detroit Edison	Evaluates the timing and magnitude of changes in residential customers’ peak demand and energy usage patterns due to a three period time-of-use rate with a critical peak price component, use of customer systems, and access to various information feedback methods. Assesses customer acceptance of the various types of control and information feedback technologies.
Cleveland Electric Illuminating Company	Evaluates the timing and magnitude of changes in customers’ peak demand and energy usage patterns due to alternative designs of critical peak rebates and use of various control technologies. Assesses customer acceptance of the various customer systems.
Green Mountain Power	Evaluates the timing and magnitude of changes in residential customers’ peak demand due to critical peak prices or critical peak rebates. Assesses customer preferences for different transition strategies towards more time-based rates.
Lakeland Electric	Evaluates the timing and magnitude of changes in residential customers’ peak demand and energy usage patterns due to exposure to a seasonal three-period time-of-use rate. Assesses residential customer acceptance, retention, and response associated with opt-in versus opt-out enrollment methods.

⁹ For information on the definitions of the different time-based rates discussed in this table, see http://www.smartgrid.gov/recovery_act/deployment_status/time_based_rate_programs.



Utility	Study Objectives ⁹
Marblehead Municipal Lighting Department	Evaluates the timing and magnitude of changes in customers’ peak demand and energy usage patterns due to a flat rate with a critical peak pricing component. Assesses residential customer acceptance and retention associated with this rate design, including effects from introduction of different control technologies and experiences with this rate design over time.
Minnesota Power	Objectives differ for two study phases. Phase 1 evaluates customer preferences for various electricity usage feedback approaches that are higher in latency (e.g., daily vs. monthly) and resolution (e.g., hourly vs. monthly) compared to what customers currently receive. Evaluates the timing and magnitude of changes in customers’ energy usage patterns due to the various feedback approaches. Phase 2 evaluates the timing and magnitude of changes in customers’ peak demand due to exposure to a time-of-use rate with a critical peak price component. Assesses customer acceptance and retention with the time-based rate.
NV Energy – Nevada Power	Evaluates the timing and magnitude of changes in residential customers’ peak demand and energy usage patterns due to seasonal multi-period time-of-use rates with a critical peak pricing component. Assesses residential customer acceptance, retention, and response associated with customer systems and customer education efforts.
NV Energy – Sierra Pacific Power	
Oklahoma Gas & Electric	Evaluates the timing and magnitude of changes in residential and small commercial customers’ peak demand and energy usage patterns from time-based rates and customer systems. Tests several combinations of time-of-use rate designs with a critical peak pricing component and customer systems. Assesses customer acceptance of both the offered rates and customer systems.
Sacramento Municipal	Evaluates the timing and magnitude of changes in residential customers’ peak demand patterns due to varying combinations of customer systems, different recruitment methods (i.e., opt-in vs. opt-out), and several time-based rates. Assesses customer acceptance of the different time-based rates under the alternative recruitment methods.
Vermont Electric Cooperative	Evaluates the timing and magnitude of changes in customers’ peak demand and energy usage patterns due to time-of-use rate with variable peak prices, enhanced customer service-based information feedback, and several types of control and information technologies. Assesses customer acceptance under customer service-based information vs. technology-based information.

Table 1. SGIG Consumer Behavior Study Objectives

2.1 Recruitment Methods

Table 2 presents a summary of the enrollment methods in the studies. All of the studies involve some form of “opt-in” recruitment, although three are augmenting this with an “opt-out” approach to study differences in recruitment methods. Two of these studies (Lakeland Electric



and Sacramento Municipal Utility District) are testing the same program design elements in both an opt-in and opt-out environments, which allows for an assessment of customer preferences for, and response to, the same rates and technologies under these two different recruitment methods.¹⁰

Opt-in versus opt-out recruiting is a major issue because it involves public policy and customer acceptance issues. Opt-in enables customers to volunteer to join a program, which is the traditional approach for utilities offering time-based rates. Opt-out makes the time-based rate offering the “default” rate design from which customers must contact the utility and drop out if they don’t wish to be on the rate. Each approach offers advantages and disadvantages, and has supporters and opponents, so fact-based information on the relative merits of the two recruitment methods provides a stronger basis for policy decisions on this issue.

Enrollment Methods		
Utility	Opt-In	Opt-Out
Detroit Edison	◆	
Cleveland Electric Illuminating Company	◆	
Green Mountain Power	◆	
Lakeland Electric	◆	◆
Marblehead Municipal	◆	
Minnesota Power	◆	◆
NV Energy – Nevada Power	◆	
NV Energy – Sierra Pacific Power	◆	
Oklahoma Gas & Electric	◆	
Sacramento Municipal	◆	◆
Vermont Electric Cooperative	◆	
TOTAL	11	3

Table 2. Summary of SGIG consumer behavior study enrollment methods.

¹⁰ Minnesota Power is only testing its information feedback treatments in both opt-in and opt-out environment. The rate treatments are exclusively implemented as an opt-in program offer.



2.2 Types of Time-Based Rates

Table 3 provides a summary of the types of time-based rates being evaluated in the studies. Seven studies are evaluating acceptance of and response to time-of-use (TOU) rates. All except one of these studies includes a critical peak pricing (CPP) component to see how this type of rate design affects peak demand reductions. Several of the studies are evaluating critical peak rebate (CPR) programs as components with existing flat and/or block rates¹¹. In one study, the utility is testing the response to CPP and CPR as single treatments in the study, but also as treatments that customers are exposed to in sequential years (CPR in year one and CPP in year two).¹² Two studies are evaluating a novel rate design, variable peak pricing (VPP), which has similar features as TOU rates except that peak period prices change daily, instead of seasonally, to reflect daily changes in system costs and reliability conditions.

Types of Time-Based Rates				
Utility	CPP	TOU	VPP	CPR
Detroit Edison	◆	◆		
Cleveland Electric Illuminating Company				◆
Green Mountain Power	◆			◆
Lakeland Electric		◆		
Marblehead Municipal	◆			
Minnesota Power	◆	◆		
NV Energy – Nevada Power	◆	◆		
NV Energy – Sierra Pacific Power	◆	◆		
Oklahoma Gas & Electric	◆	◆	◆	
Sacramento Municipal	◆	◆		
Vermont Electric Cooperative			◆	
TOTAL	8	7	2	2

Table 3. Summary of the types of time-based rates in the SGIG consumer behavior studies.

¹¹ Block rate programs involve rate designs that charge customers for electricity usage based on how much electricity they consume. For these rates, blocks of usage are defined (e.g., the first 500 kilowatt-hours, the next 500 kilowatt-hours, and so on), and the price for each block of usage is set. In the case of inclining block rates, the prices for the blocks of consumption increase as usage increase. Inclining block rates are intended to have a conservation effect. In the case of declining block rates, prices decrease as usage increase. Declining block rates are intended to boost electricity consumption and today are not commonly used.

¹² The reason for the sequential aspect of exposure to these rates involves increases in customer acceptance as some contend that CPR is a way for customers to more easily transition to CPP than from a flat rate.



2.3 Non-Rate Treatments

Table 4 provides a summary of the non-rate treatments being evaluated in the studies. These treatments are either offered in conjunction with time-based rates or as stand-alone options. Five of the studies include offers of some type of IHD and/or PCT. One study (represented by its two subsidiaries) is evaluating the role of customer education on response and attrition, while a second study is evaluating information on customer electricity consumption accessed from a web portal. The ability of customer systems such as IHDs, PCTs, and web portals to augment customer acceptance and response to time-based rates is another key policy and program design issue being evaluated by stakeholders.

Non-Rate Treatments				
Utility	IHD	PCT	Education	Web
Detroit Edison	♦	♦		
Cleveland Electric Illuminating Company	♦	♦		
Green Mountain Power	♦			
Lakeland Electric				
Marblehead Municipal				
Minnesota Power				♦
NV Energy – Nevada Power		♦	♦	
NV Energy – Sierra Pacific Power		♦	♦	
Oklahoma Gas & Electric	♦	♦		
Sacramento Municipal	♦			
Vermont Electric Cooperative				
TOTAL	5	5	2	1

Table 4. Summary of SGIG consumer behavior studies by type of non-rate treatment.

2.4 Experimental Designs

In carrying out the SGIG consumer behavior studies, DOE is requiring the projects to apply randomized controlled experimental methods and employ random selection and random sampling methods.¹³ The purpose is to produce impact estimates that are internally valid and

¹³ For more information on techniques for achieving randomization, see Appendix A of Cappers et al. (2013) Summary of Utility Studies.



increase the likelihood that the estimates are more precise and can be extrapolated to similar groups outside of the study sample (i.e., they are externally valid) as compared to studies that do not use such methods.

The SGIG consumer behavior studies were designed by the utilities to test treatments by using one of two types of randomized experimental designs: Randomized Controlled Trials (RCT) design or Randomized Encouragement Designs (RED). With RCTs, customers sign up for studies either through opt-in or opt-out methods. Once they sign up, customers that opted-in (or did not opt-out) are randomly assigned to either: (1) treatment groups, which receive the treatments being tested; or (2) control groups, which either receive treatments that are delayed by a year or do not receive treatments at all. With REDs, customers are randomly assigned to either a treatment group, which is encouraged to sign up for the offered treatment through an opt-in or opt-out method, or a control group, which is not notified of the study and thus not encouraged to sign up to receive the treatment. For both RCTs and REDs, treatment groups are compared to control groups to determine the effects of the treatments.¹⁴

One of the studies is augmenting their randomized study with an additional aspect that uses a non-randomized, within-subjects method, to test a treatment. Within-subjects methods compare the treatment group during times when it receives the treatment to times when it does not receive the treatment. Figure 1. shows the types of experimental designs being implemented by the SGIG consumer behavior studies.

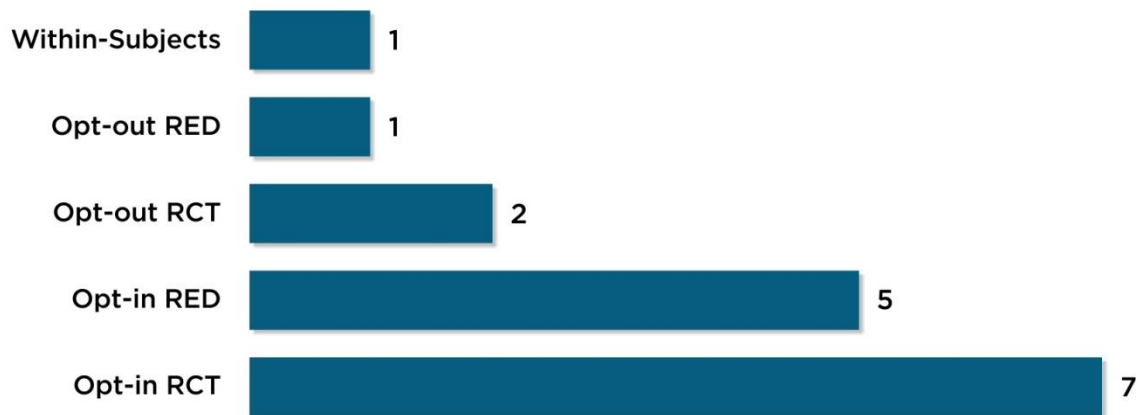


Figure 1. SGIG consumer behavior study experimental designs.

¹⁴ REDs require substantially larger sample sizes than RCTs to achieve comparable levels of power and precision for an estimation of treatment effects. However, utilities and other stakeholders might prefer to implement a RED because they would not have to deny or delay any customer who wants to participate in a study.



3. Analysis of Initial Enrollment Results

The initial analysis of enrollment results includes three types of findings:

- **Experimental results** apply to the subset of studies that chose to test enrollment rates experimentally. The results for these studies are presented in Section 3.2.
- **Descriptive results** apply to all of the studies and these are presented in Section 3.3.
- **Lessons learned** apply to all of the studies and these are presented in Section 3.4.

3.1 Technical Approach

Customer enrollments take several forms. It is important to characterize how enrollment efforts are implemented so accurate comparisons of customer recruitment rates can be made. In this subsection data collection methods and the approach to analyzing enrollment data are described.

Enrollment and Retention Stages

Customer enrollment involves several stages. Figure 2 illustrates how each stage of enrollment may decrease the pool of available customers for subsequent stages. First, out of the total pool of residential customers, the utility may choose a certain subset of *qualified customers* that meet certain criteria (e.g., energy use criteria, geographic criteria, and the presence of central air conditioning). Second, out of the pool of qualified customers, the utility may only market the study to a subset of *solicited customers* (e.g., if marketing to too many customers is too costly). Third, once solicited, only some customers choose to participate (either by opting-in or not opting-out) and this results in yet smaller pools of *recruited customers*. Fourth, the utility may decide to screen some customers out after they signed up, leading to an even smaller subset of *selected customers* (e.g., if a survey is part of the selection process, customers may be selected based on their answers to survey questions).

These stages lead to the final number of *enrolled customers* that will take part in the study. Data was collected on the number of customers in each of these customer enrollment stages¹⁵ for each of the nine CBS studies for which enrollment data is available.¹⁶ The results in this analysis cover approximately 400,000 solicited customers and approximately 44,000 enrolled customers.

¹⁵ For this study, only data on the aggregate number of enrolled customers was analyzed. In future reports, individual customer demographic and electricity data will be available to allow customer segmentation analysis.

¹⁶ As of the drafting of this report, the two NV Energy consumer behavior studies have not yet begun enrolling customers so they are not included in this report.

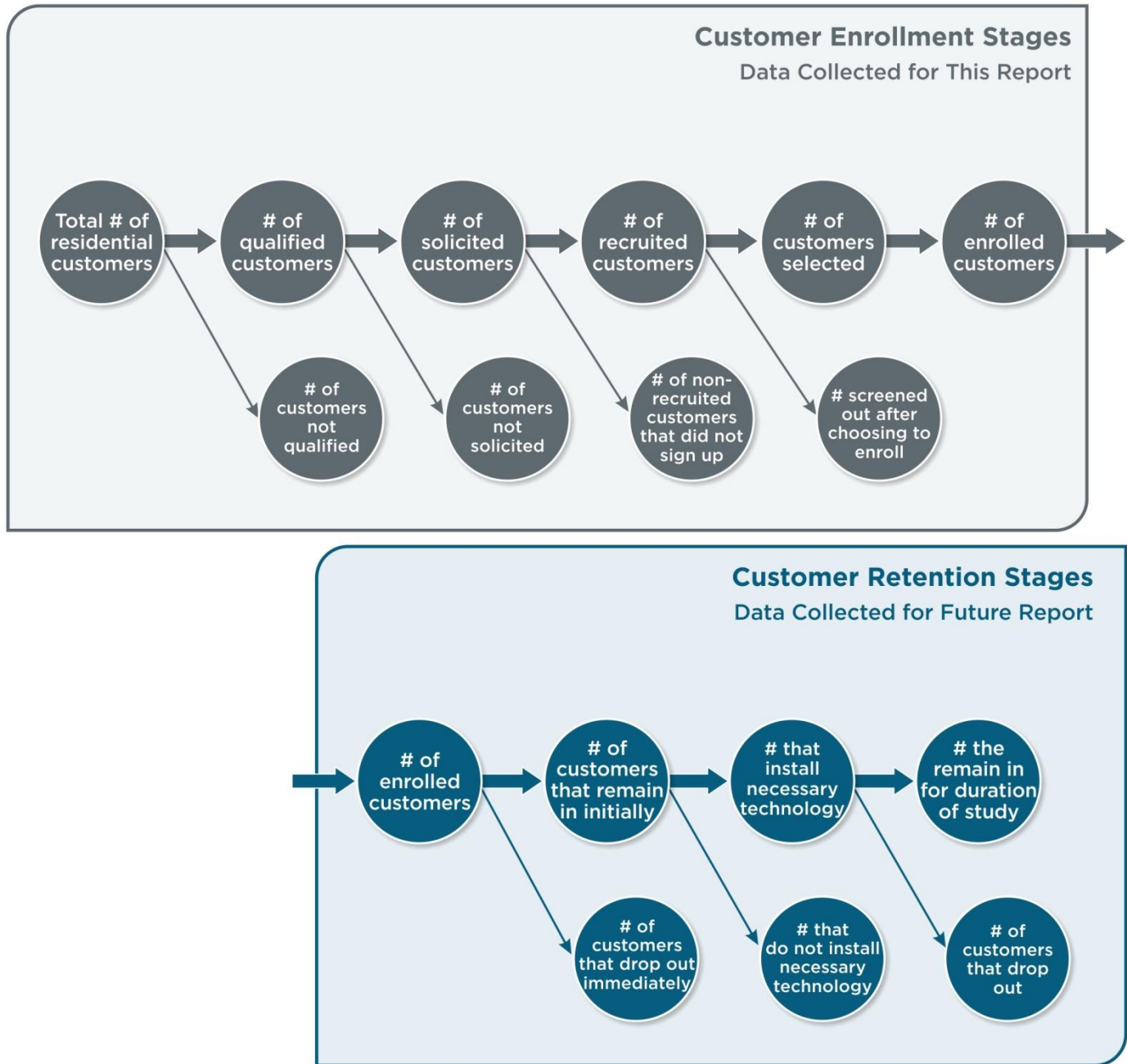


Figure 2. Data elements collected through various stages of customer enrollment and retention.

Once studies begin, and treatment(s) go into effect, customer pools go through several additional stages of *customer retention*, as shown in the lower panel in Figure 2. For example, enrolled customers may decide to drop out immediately after enrollment but before being exposed to treatment(s). Customers may also decide not to install required technologies, or



they may decide to drop out at some point before the studies end. This report addresses the enrollment stages while future reports are planned to analyze data for the retention stages.

Recruitment Strategies

The term *program offer* represents the different types of time-based rate, technology, and opt-in versus opt-out proposals made to customers when they are solicited to enroll in a study. The term *solicitation effort* represents one complete set of offers made to one group of customers (e.g., one solicitation effort to residential customers may have an opt-out offer, a TOU rate offer, and an IHD offer).

In general, there are two types of solicitation efforts depending on the experimental design of the study:

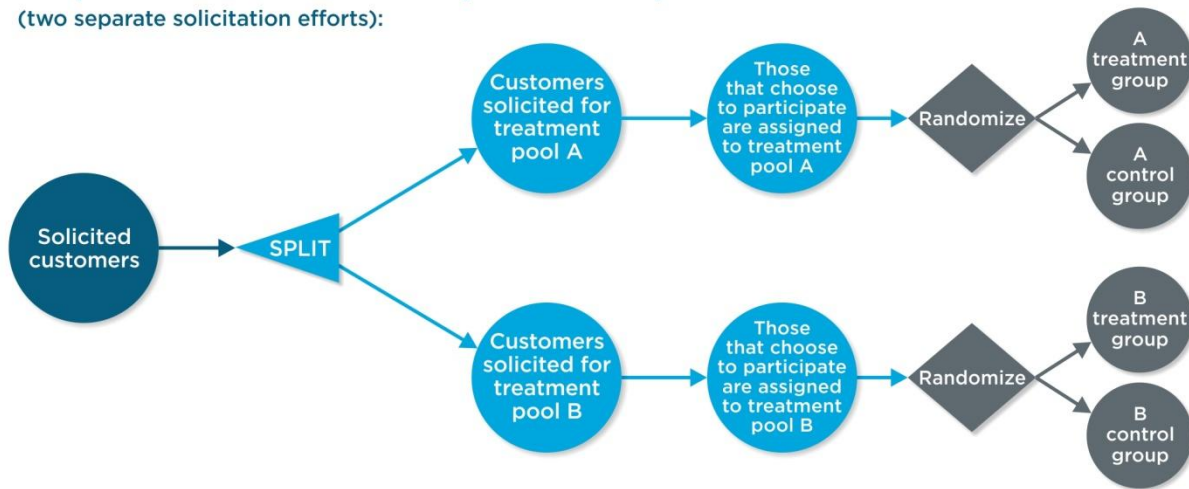
1. **Recruitment into a specific treatment**, which is shown in example 1 in Figure 3.. In this case, utilities first select a group of customers that are targeted for the solicitation. These customers are then split into two (or more) pools, where each is assigned to be solicited for a specific treatment. Once a customer signs up for the study, the customer is assigned to the specific treatment pool for which he or she was solicited. Customers in a specific treatment pool are then randomly assigned to either the treatment group, which receives the treatment, or the control group. For example, one group of customers is solicited specifically for a TOU rate, and customers that sign up are placed in the TOU treatment pool; a second group is solicited specifically for a CPP rate, and customers that sign up are placed in the CPP treatment pool. Utilities would pursue this approach to recruitment if they wanted to explicitly understand customer preferences for different combinations of rate and/or technology treatments. (In this example, two solicitation efforts are made by this utility; one TOU solicitation effort and one CPP solicitation effort.)
2. **Recruitment into a generic study**, which is shown in example 2 in Figure 3.. In this case utilities first select a group of customers for a solicitation effort. These customers are then solicited for a single, generic study that includes two or more treatments. Once a customer signs up for the study, only then does the utility split customers into specific treatment pools. Customers in a specific treatment pool are then randomly assigned to either the treatment group or the control group. For example, a utility solicits a group of customers for a study in which they may be placed into a TOU rate treatment pool, or they may be placed into a CPP rate treatment pool. Utilities pursue this approach to recruitment if they want to ensure that customers in different treatment groups are



similar, so that results can be compared properly.¹⁷ (In this example, one *solicitation effort* is made by this utility; one “TOU or CPP” solicitation effort.)

Based on this definition of a solicitation effort, there are nineteen different customer solicitation efforts analyzed in this report.¹⁸

Example 1: customers solicited into two specific treatment pools (two separate solicitation efforts):



Example 2: customers solicited into one generic treatment pool (one solicitation effort):

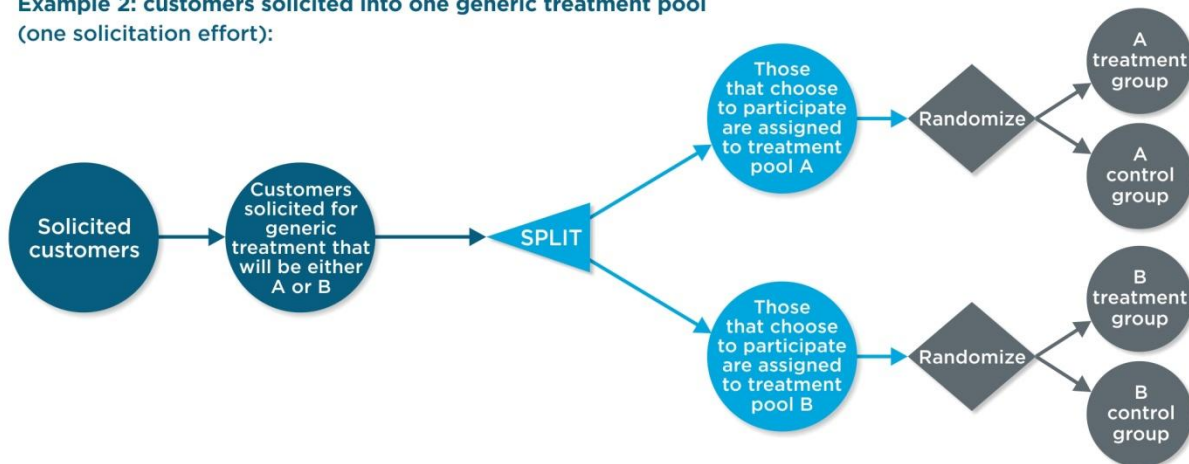


Figure 3. Examples of solicitation efforts.

¹⁷ Results across different treatment groups cannot be directly compared when customers are recruited into specific treatments, because different types of customers may decide to sign up for different treatments. Different treatments would then have different types of customers, and so any observed differences between the treatments may be due to the difference in customers, not due to the treatments.

¹⁸ The nineteen solicitations for both opt-in and opt-out recruitment methods are shown in Figure 8 on page 19 of this report.



Recruitment Rates

Most of the analysis in this report is focused on the number of customers that sign up to participate in the studies (i.e., recruited customers) out of those that are invited to participate (solicited customers). Equation 1 defines how recruitment rates are calculated.

$$\text{Equation 1: Recruitment Rate} = (\text{Recruited customers}) / (\text{Solicited customers})$$

Recruitment rates for each of the nineteen solicitation efforts are analyzed, and include three types of program offers: (1) opt-in versus opt-out, (2) different time-based rates, and (3) different technologies. Also analyzed is how well the utilities were able to forecast recruitment rates. As shown in Equation 2, actual versus planned recruitment rates are defined as the percentage difference between the actual and the planned recruitment rate. This is helpful in determining how accurate the utilities were in planning their recruitment efforts.

$$\text{Equation 2: Actual Versus Planned Recruitment Rate} = (\text{Actual recruitment rate} - \text{planned recruitment rate}) / (\text{planned recruitment rate})$$

Eight of the nineteen solicitation efforts experimentally tested the relative success of different types of offers by randomly assigning customers to receive different program offers. For these studies, it is possible to draw causal inferences about which specific types of offers result in higher recruitment rates. Experimental results are presented from the following randomized trials:

- A test of an opt-out versus an opt-in offer;
- A test of an opt-in Flat w/CPP offer versus a TOU offer;
- A test of opt-out for: TOU w/CPP offers, versus TOU offers, and versus Flat w/CPP offers; and
- A test of an opt-in IHD technology offer versus no technology offer.

For each of these comparisons, a statistical test of differences¹⁹ is performed to determine which solicitation methods resulted in higher recruitment rates. For situations in which there are two or more utilities testing the same solicitation method (e.g., two utilities that are testing opt-in versus opt-out recruitment methods), a test is performed with the total number of customers aggregated across utilities, as well as a separate test segmented by each utility. Because these results are based on experimentally-controlled tests, they are reported as *experimental results*.

¹⁹ A two proportion Z test was used in the analysis. A Z-test is a statistical test for which the distribution of the test statistic under the null hypothesis can be approximated by a normal distribution.



For the *descriptive results* statistical tests of differences were not performed because they are based on comparisons and not experimentally-controlled tests. Instead, the descriptive results use un-weighted average recruitment rates for opt-in and opt-out studies and these averages are grouped by the types of time-based rates offered and the types of technologies offered. Because each utility chose the types of time-based rates and the types of technologies to include in their own study, it is not possible to interpret differences in recruitment rates across all of the studies as being caused by the recruitment characteristics. However, it is possible to observe the range in recruitment rates that these utilities achieved and use them to compare boundaries on recruitment rates for similar efforts.

3.2 Experimental Results

Figure 4 shows recruitment rate results for studies of opt-in versus opt-out program offerings. It shows that more customers enroll into a time-based rate program with an opt-out offer (84%) than with an opt-in offer (11%).

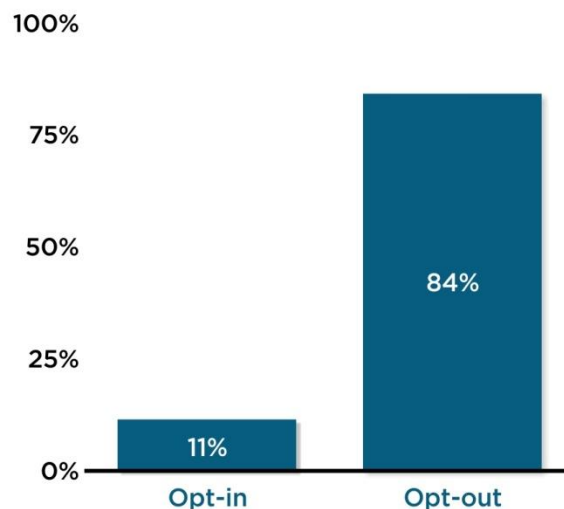


Figure 4. Recruitment rates for tests of opt-in versus opt-out program offers.

Percentages include the total number of customers across the two utilities that randomized opt-in versus opt-out program offers (N=100,000).

Figure 5 shows that for opt-out offers, the type of rate offered to customers did not affect recruitment rates. The rates were 81% for TOU offers, 81% for the Flat w/CPP offers, and 78% for the TOU w/CPP offers. The differences between any pairings of the rates were small and the differences were not found to be statistically significant.

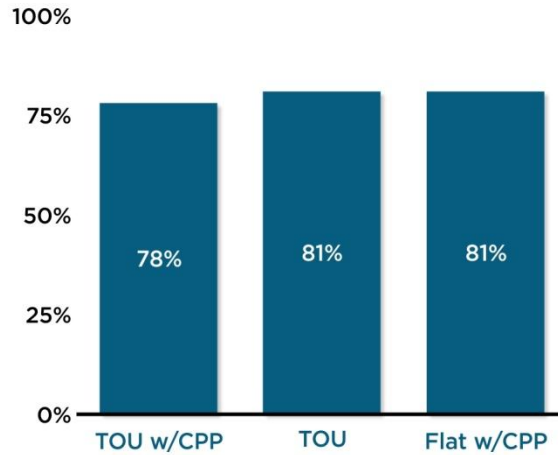


Figure 5. Opt-out recruitment rate results for tests of time-based rate offers.

Percentages include the total number of customers within the lone utility that were randomly assigned to receive opt-out offers of one of three time-based rates (N=4,000).

Figure 6 shows that the previous result also held for opt-in offers in that the type of rate did not affect recruitment rates. As shown, a flat rate offer with a CPP component offer had a 17% recruitment rate while the TOU offer had a 16% recruitment rate; the difference, although small, is statistically significant.

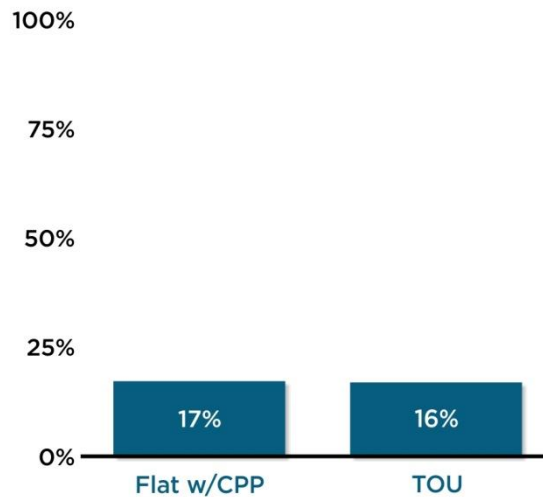


Figure 6. Opt-in recruitment rate results for tests of time-based rate offers.

Percentages include the total number of customers within the lone utility that were randomly assigned to receive a CPP offer versus a TOU offer (N=50,000).



Figure 7 shows that the previous results also held for opt-in offers that involved customer systems. As shown, recruitment rates for offers with and without IHDs were 16% and 17%, and the difference was small and was not found to be statistically significant.

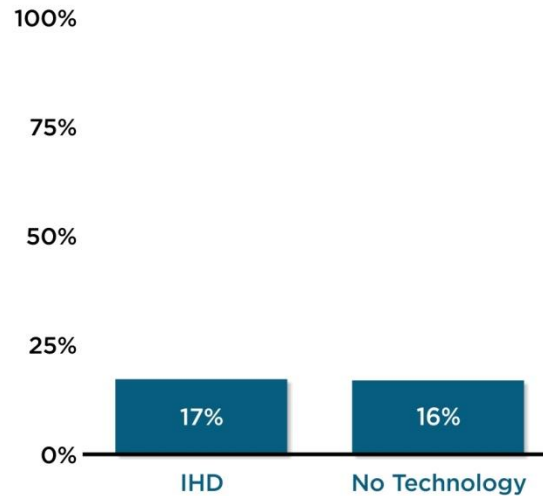


Figure 7. Opt-in recruitment rate results for tests of technology offers vs. no-technology offers.

Percentages include the total number of customers within the lone utility that were randomly assigned to receive an IHD offer versus no technology offer (N=50,000).

3.3 Descriptive Results

Figure 8 shows recruitment rates for the 19 solicitation efforts under the SGIG consumer behavior studies. For time-based rate and customer systems studies that use an opt-in program offer, recruitment rates range from 5% to 28%. For those that use an opt-out program offer, recruitment rates range from 78% to 87%. Looking across the opt-in studies, utilities appear able to achieve at least 5% recruitment rates. Under ideal circumstances, recruitment rates for opt-in solicitation efforts can exceed 20%.

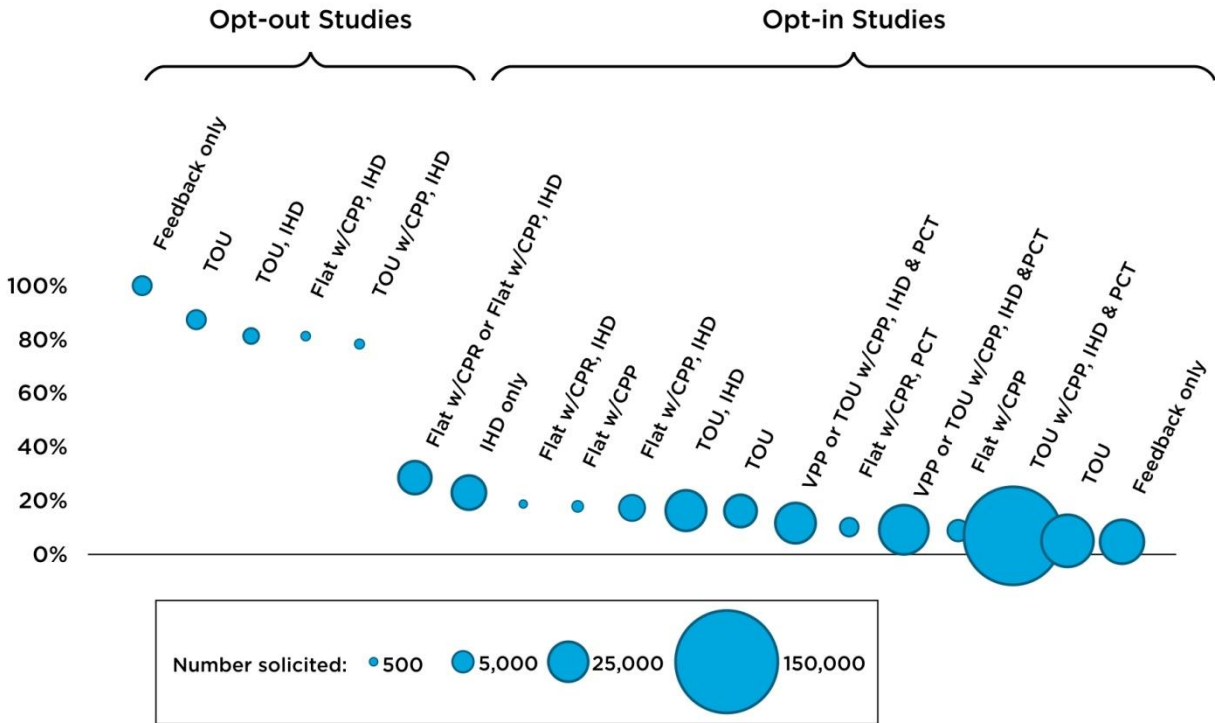


Figure 8. Recruitment rates for each solicitation effort.

Total solicitation efforts listed: 19. Circle size represents the total number of customers solicited.

Figure 9 shows planned versus actual recruitment rates for the 19 solicitation efforts. Most of the studies did not accurately predict recruitment rates for their solicitation efforts. Of the six opt-in solicitation efforts that underachieved their planned recruitment rates (shown in orange) five had an actual recruitment rate that was 7 to 22 percentage points lower than planned, representing an actual recruitment rate that was at least a quarter of what was planned. Five out of the six opt-in solicitation efforts that overachieved had an actual recruitment rate that was no more than 4 percentage points higher than planned. The sixth was 14 percentage points higher than planned, almost double the planned rate. While overachieving recruitment rates may not have severe consequences, underachievement can cause problems with the study’s evaluation and require changes to the study’s design. For example, when studies plan to recruit a certain number of customers and the actual number is far less, steps may need to be taken such as reducing the number of treatments being tested so that statistically valid load impact estimates can be made.

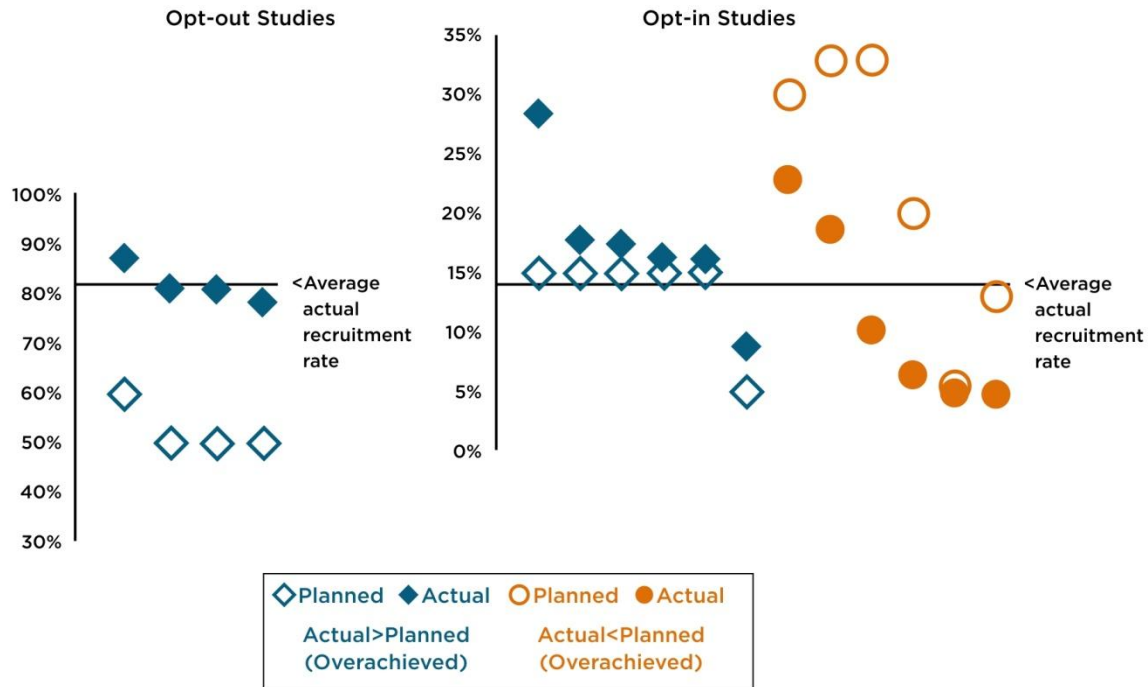


Figure 9. Actual versus planned recruitment rates.

3.4 Discussion of Lessons Learned

In carrying out the SGIG consumer behavior studies, the utilities reported a number of observations about strategies that did and didn't work. Following are several of the lessons learned that have been observed during the design and enrollment phases of the studies.

Many of the utilities found focus groups, surveys, and other research on customer preferences to be vital components for test marketing the terms and concepts for attracting customer interest and engaging them to participate in the solicitation efforts. For example, prior to test marketing materials for soliciting participation in studies involving time-based rates, many utilities believed words like "critical," "emergency", and "events" would convey what the rate was trying to accomplish and the importance of customers to participate. The studies that conducted test marketing of these terms found that they did not necessarily attract customer interest and often had the opposite effect. Several studies found that these terms tend to deflate a sense of personal control (e.g., "emergencies" are out of a customer's control) and that many customers preferred terms about new rates that gave a stronger sense of personal involvement control over energy consumption and costs such as "control," "choice," and "sense."



Several of the utilities also discovered the importance of validating results like these that came from focus groups with more detailed market research and survey efforts that included more customers and customer segments and circumstances. For example, in several cases the initial focus groups showed customers saying that one of the primary motivations for participating in time-based rate programs was the opportunity to support environmental improvements. However, subsequent test marketing and more detailed customer surveys that evaluated multiple motivations such as “saving money,” “environmental stewardship,” “taking control,” and “having fun” found that while all of the other motivations were valid, the dominant reason for customers choosing to participate was financial and to save money on their bills.

Another lesson learned by many of the utilities is the amount of time and resources needed for the period of time between soft and hard launches of the programs.²⁰ This was found to be much more than expected to adjust messaging and other aspects of implementation properly in response to initial feedback from the subset of customers involved in the soft launch. Several of the utilities included a two week soft launch period during enrollments to provide time for identifying and addressing problems that did not show up during internal planning and test marketing. For one of the utilities, the two week soft launch period was not sufficient to address all of the early feedback they received from customers and in retrospect would’ve allocated even more time to re-do certain marketing materials and make them more appealing to customers.

Other lessons concerned customer sensitivities about technologies such as IHDs and PCTs that were installed inside their homes. Several utilities learned that their studies would have benefitted from more time spent understanding potential customer concerns with technologies and identifying the available pool of participants who best qualify and be willing to accept the technologies. In several cases, assumptions made about the number of customers capable and willing to receive certain types of customer systems (e.g., presence of central air conditioning to receive a programmable communicating thermostat) were found to be inaccurate. Better estimates of the size of the available population that pre-qualifies for specific customer systems, the number of customers that would be willing and/or able to accept those technologies, and the number that are willing to have installers enter their homes are valuable and help control recruitment costs.

Another technology-related lesson concerns the need to ensure that all utility representatives and contractors that interact with customers at any level are informed, committed, and properly trained so that they are enabled to make the installation experience positive and

²⁰ A soft launch is a type of release for a campaign where the product or service being offered is incrementally released to a small and limited audience. A hard launch is a type of release for a campaign where the product or service being offered is released to a broad and complete audience.



“customer-friendly.” One way utilities found to do this was by focusing on communications skills as much as technical skills when hiring or recruiting people to conduct installations of technologies. In fact, many of the utilities initially thought that the individuals responsible for installing technologies at customer premises would have little effect on customer decisions to complete the enrollment process. However, this was found to generally not be the case and that, in many cases, technology installers actually played important marketing and public relations roles.

3.5 Observations

The SGIG consumer behavior studies are an important element of the entire SGIG program. Information is being collected on the efficacy of several different types of time-based rates, customer systems, information and education offerings, and recruitment and retention strategies.

DOE is requiring the nine SGIG projects undertaking consumer behavior studies to apply randomized, controlled experimental methods. In addition, DOE is requiring each of the studies to submit customer-level interval meter and demographic data for further analysis. To meet these requirements, DOE provides each of the studies with technical assistance through LBNL, who has produced a series of twelve guidance documents to assist the projects in achieving consistency of their experimental designs and adherence to data collection and reporting protocols. LBNL assembled teams of experts to work with the projects and provide additional guidance as needed to help ensure the success of the studies. DOE and the projects believe this approach has worked well and that the analysis of customer acceptance, retention, and response will be more useful to the industry as a whole as a result.

These initial results on enrollments in time-based rate and customer system programs reveal important preliminary findings about the use of opt-in versus opt-out recruitment strategies, and other important issues involving the design and implementation of programs. Opt-out approaches (i.e., those which use time-based rates as default rates) result in significantly higher rates of customer participation than opt-in approaches. This result has significant implications for both costs and benefits of time-based rate and customer system programs. An important next step in the analysis is to determine if more customers remain on the time-based rate and customer system programs over time under opt-in vs. opt-out. In addition, follow-on analysis should focus on how customers who volunteer and opt-in differ in their responses versus those who are placed on the new rates and have the choice to opt-out.

Comprehensive information on customer acceptance, retention and response can help policymakers assess the magnitude of the impacts on electricity demand from comparably sized customer populations solicited for enrollment under opt-in vs. opt-out recruitment approaches.



This question is not unique to recruitment and enrollment in utility demand-side programs and applies to other types of programs including, for example, retirement and health care, and so is of general interest to policy makers in many arenas. Several of the SGIG consumer behavior studies are evaluating opt-in versus opt-out recruitment methods and there will be more comprehensive analysis of the results in the future.

These preliminary results also indicate that residential customers show little difference in their preferences for various time-based rates and appear indifferent to the offer of customer systems in conjunction with time-based rates. The next step in the analysis is to determine if acceptance differs by customer segment. Gaining this knowledge is crucial for utility decision making for allocation of marketing budgets and design of program recruitment strategies. While certain customer systems (i.e., IHDs) did not appear to boost customer acceptance of different forms of time-based rates, it is possible that these and other devices (e.g., PCTs) can boost customer response to those rates. There is evidence from the Oklahoma Gas and Electric consumer behavior study that this is the case.²¹ Utilities and policymakers need to understand the role of customer systems to determine if and how to offer IHDs and devices to different customer segments. This type of analysis is another important aspect of the comprehensive analysis that DOE and LBNL intend to accomplish for the SGIG consumer behavior studies.

Utilities across the country have been implementing time-based rates and other demand-side programs for many years and there is a wealth of experience and lessons learned upon which to base program design and implementation decisions. However, the introduction of modern advanced metering infrastructure, communications systems, and customer systems have been game changers for many utilities and the experiences of those implementing the SGIG consumer behavior studies indicates that there are many new learning curves to climb. In these instances, utilities can learn from one another about what works, and in some cases even more important, what doesn't. This includes quantitative information about recruitment, enrollment, retention, and response, and also qualitative information about marketing, customer attitudes, education practices, installation procedures, and other aspects that affect customer experiences.

For example, it seems that there may be at least two underlying factors for understanding the reasons why there were differences among the utilities with regard to the effectiveness of recruitment and enrollment efforts. One involves the starting point of the utility and their level of experience and expertise with marketing customer-facing programs before they undertook SGIG consumer behavior studies. The second is the level of resources devoted to marketing

²¹ U.S. Department of Energy, "Demand Reductions from the Application of Advanced Metering Infrastructure, Time-Based Rates, and Customer Systems – Initial Results," December 2012.



efforts. Both of these factors will be assessed more fully as more information from the consumer behavior studies becomes available.

There is thus a continuing need for expanding information exchange activities to share observations about what does and doesn't work so that lessons learned can be shared, best practices can be replicated, and pitfalls can be avoided. DOE plans to continue its efforts to support these activities and is interested in working with others committed to these same ends.



4. Next Steps

DOE, LBNL, and the nine SGIG projects themselves are publishing reports on the results of the consumer behavior studies. These can be found at http://www.smartgrid.gov/recovery_act/consumer_behavior_studies. The nine SGIG consumer behavior study projects produce both interim and final evaluation reports. One of the projects (Oklahoma Gas & Electric) has posted an interim and final evaluation report on their study, another project (Marblehead Municipal Lighting Department) has generated only an interim evaluation report and is working to complete their final evaluation report, while the rest are in the process of producing interim evaluation reports. Over the next several months, seven of the projects will be publishing interim evaluation reports on the first year of their studies.

Subsequent reports by LBNL and DOE will examine a variety of topics related to customer acceptance and retention. Because this report is based on initial results, it includes only information about the first stage of a customer's choice: whether to enroll in a study. Equally important is information on subsequent customer choices, including decisions to remain as program participants.

After the projects have completed their studies, plans for future reports include analysis of the number of customers who dropped out after the study treatment went into effect (perhaps after receiving the first bill), the number of customers who installed and subsequently used customer systems (where applicable), and the number of customers who remained in the study for its duration. In addition, these reports may examine reasons for higher or lower recruitment and retention rates, including whether certain customer segments (e.g., low-income vs. high-income, high school educated vs. college educated) are more or less likely to choose to enroll.

Future LBNL and DOE reports also plan to analyze impacts on electricity consumption and peak demand. This analysis includes assessing whether certain customer segments are more or less responsive, whether customers exhibit persistence of responses over time (i.e., year 1 vs. year 2), the degree to which customer systems affect responses, whether enrollment methods (i.e., opt-in vs. opt-out) affect customer responses, and whether the existence of bill protection affects responses.