Panel Studies – The Perfect Marriage of Formative and Summative Evaluations

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ABSTRACT

The National Action Plan for Energy Efficiency (NAPEE) *Model Energy Efficiency Program Impact Evaluation Guide* (2007) defines process evaluations as evaluations that "assess program delivery, from design to implementation, in order to identify bottlenecks, efficiencies, what worked, what did not work, constraints, and potential improvements. Timeliness in identifying opportunities for improvement is essential to making corrections along the way." Unfortunately, due to regulatory cycles, the majority of evaluations conducted are more summative in nature— as they are conducted at the end of the program cycle, traditionally in one to two-year increments. Although potentially timely for program improvements for the next program cycle, opportunities for mid-program cycle improvements are often lost. Panel studies, specifically those utilizing split panel study designs, are able to bridge this gap to support both formative and summative evaluation objectives. A panel study is a type of longitudinal study that surveys a selected group of people over a period of time. Panel studies enable program implementers to collect process, customer engagement, and market characterization information to not only understand these data at a single point in time, but also to understand changes across time, in a cost-effective manner. This paper discusses challenges encountered, steps taken to overcome these challenges, and lessons learned.

Introduction

Using the traditional stages of the research process as a framework, this paper builds on past panel study literature as well as the authors' experience designing and conducting three panel studies: two for Midwest Utilities, and one for a Northeastern Utility. This paper is organized into the following sections:

1. Panel Studies Defined
2. Instrument Design Considerations
3. Data Collection Considerations
4. Data Analysis Considerations
5. Conclusions

Panel Studies Defined

Historically, terminology around panel studies has been a source of confusion. The term "longitudinal study" and "prospective study" are sometimes used interchangeably with the term "panel study." For this paper, a panel study is defined as a type of longitudinal study in which the same individuals are studied at successive points in time. In contrast, repeated cross-sectional research involves collecting data from a different sample at each time point, and the within-person temporal aspects of the phenomenon under study are not available. There are three different types of panel studies: cohort studies, rotating panel studies, and split panel studies. Cohort studies are studies of a

group of individuals with a shared common experience (i.e., born during the same year, married couples with two children, etc.). Rotating panel studies are studies in which groups of participants are brought in and out of the sample in some specified pattern. Split panel studies are a combination of cohort studies and rotating panel studies that measure the same sample over time, but also introduce a new sample at each point during the specified time. Thus, the types of panel studies described are defined by the sampling strategies employed for each time point. These time points are often referred to as study waves. In order to maximize the value of this method for process evaluations, and to understand any potential method effects, a best practice is to employ a split panel design.

Another differentiator between types of panel studies often discussed in the literature is the consistency of the variables studied in each wave; however, these definitions vary across and within fields of study. While all definitions seem to indicate that panel studies consist of a portion of study variables that remain consistent in each wave to measure change, some definitions are less strict and also include a set of variables that change from wave to wave. In order to maximize the use of panel studies to inform both formative and summative evaluation objectives, the researchers suggest including a set of questions that remain consistent from wave to wave as well as a set of questions that differ between waves.

The remainder of this section presents how panel studies are applied in the energy efficiency context, a discussion of the benefits of panel studies, and a discussion of the challenges with panel studies.

Panel Studies and Energy Efficiency Evaluations

Historically, panel studies have been infrequently used within the energy efficiency context; however, panel studies offer a valuable opportunity to assess a number of key attributes, including tracking market trends and long-term energy impacts. Three types of evaluations traditionally characterize the energy efficiency industry: (1) impact evaluations, (2) process evaluations and (3) market effects evaluations. Panel studies lend themselves to elements of all three types of evaluations. Next is a discussion of how panel studies can be applied to each type of evaluation in turn.

First, with regard to impact studies, panel studies provide a unique method to assess net savings, which is the portion of the energy savings attributable to the program under study. Literature in the energy efficiency industry commonly focuses on two components of net savings: free-ridership and participant spillover. Free riders are program participants that would have implemented the same or similar energy efficiency project in absence of the program. Spillover refers to individuals who take additional energy efficiency actions as a result of program influence, without additional program assistance (e.g., incentives, technical assistance). The most commonly utilized approach for estimating free-ridership and spillover is the self-report method, which relies on participating customer surveys and interviews. However, the measurement of free-ridership and spillover through self-report is an area of significant controversy in the industry, since these concepts were first enumerated over 20 years ago (Wilson-Wright et al. 2011; Mahone 2011; Friedmann 2011). Recall issues related to the self-report approach are a known challenge to data validity. In most cases, evaluations are completed after the conclusion of the program year and to assess free-ridership, participants are asked to recall what they would have done without the program. In addition, often enough time has not passed to adequately assess spillover, potentially producing an imbalanced net savings estimates. When designed appropriately, panel studies can minimize recall issues regarding measuring free ridership as measurement can occur much closer to the actual decision to participate. In a later wave, where enough time has passed, like and unlike spillover can be assessed by asking the same program participants about spillover.

Panel studies can also be applied to process evaluations. The National Action Plan for Energy Efficiency (NAPEE) *Model Energy Efficiency Program Impact Evaluation Guide* (2007, ES-1) defines process evaluations as evaluations that "assess program delivery, from design to implementation, in order to identify bottlenecks, efficiencies, what worked, what did not work, constraints, and potential improvements. Timeliness in identifying opportunities for improvement is essential to making corrections along the way." Unfortunately, due to regulatory cycles, the majority of process evaluations conducted are more summative in nature - as they are conducted at the end of the program cycle, traditionally in one to two year increments. Although potentially timely for program improvements for the next program cycle, opportunities for mid-program cycle improvements are often lost. Split panel studies are able to bridge this gap to support both formative and summative evaluation objectives. For example, a panel study can be used to assess marketing approaches mid-program cycle to understand which approaches are working and should be retained and possibly increased, and which approaches are ineffective and should be adjusted or abandoned. With a split panel study, tweaks to marketing approaches can be measured in subsequent waves, with the random sample of new program participants. For example, a set of marketing messages for inclusion in a direct mail campaign can be pre-tested in one wave of the study, and the selected messages can be post-tested for recall and appeal in a subsequent wave. If this were done with the same participants, the post-test results would likely be biased. However, with a split sample, this can be avoided by using the new sample for post-testing. Formative evaluation objectives can also be measured by capturing participant expectations of the measures or program in the first wave, and in future waves understanding if the measure or program is meeting those expectations.

Lastly, NAPEE (2007, ES-2) defines market effects evaluations as evaluations that *"*estimate a program's influence on encouraging future energy efficiency projects because of changes in the energy marketplace. These evaluations are primarily, but not exclusively, used for programs with market transformation elements and objectives." Panel studies can be used to assess market effects because they can track participant knowledge, purchases, and behaviors over time. By asking the sample pool of respondents about various market effects, evaluators can definitively say how program implementation impacted individuals before, during, and after program implementation. These results are even stronger when a split panel design is employed wherein the new participant sample for each wave can act as a control group to control for panel conditioning in the repeat participant sample. If panel studies are done repeatedly over program cycles, with a new population for each program cycle, longer term market effects can be assessed— potentially eliminating the need to conduct a general population survey five to ten years after a market intervention.

Benefits of Panel Studies

Benefits of panel studies include the ability to: (1) make causal inferences, (2) measure change over time, (3) collect data to inform formative and summative evaluation objectives, and (4) track behavior changes and market trends. Each of these benefits to panel studies is discussed in turn. First, there are three necessary conditions to make causal inferences. The first requirement is time order. Causation is present if the cause precedes the effect. In the case of energy efficiency programs, program participation must occur prior to energy savings being realized in order to attribute the cause of the energy savings to participation in the program. The second requirement is that causation can occur only if there is an association between the two variables under study. A program must address a particular energy savings measure in order for an association to exist between program participation and the energy savings measure. Finally, before effects are attributed to causes, alternative explanations must be ruled out. While it is often impossible to rule out all causes, the more causes that can be ruled out, the stronger the case for causality. The relationship between program participation and energy savings must be nonspurious; that is, the relationship between program participation and energy savings must not be

due to a third variable, such as a new national marketing campaign. Panel studies often satisfy the first two necessary conditions (time order and association), given that panel studies represent measurement of variables over time, and are able to associate independent and dependent variables. If designed appropriately, panel studies may also be used to rule out alternative explanations, such as looking at the interactive effects of other energy efficiency actions in the market. "The panel study is a relatively powerful non-experimental method for examining causality." (Johnson & Christensen 2008).

The second benefit of panel studies is that they can measure change over time. Panel studies are more powerful and often produce more accurate results than cross-sectional studies, as many confounding variables are controlled for when measuring change. Because panel studies measure change at the individual level, as compared to measuring different sets of potentially matched people at different times, individual differences between participants are removed. This eliminates a key set of potential confounding variables.

Panel studies also enable evaluators to conduct both formative and summative evaluations. Formative evaluation focuses on "ways of improving and enhancing programs rather than rendering definitive judgment about effectiveness" (Patton 2008). Formative evaluation contrasts with summative evaluation. "Summative evaluations judge the overall effectiveness of a program and are particularly important in making decisions about continuing or terminating an experimental program or demonstration product" (Patton 2008). Given that panel studies include data collection at multiple time points, both continuous improvement and effectiveness data can be collected and analyzed.

Finally, panel studies can reveal shifting attitudes and patterns of behavior that might go unnoticed with other research approaches. This is particularly useful for tracking behavior changes and market trends. For example, a panel study can track customers' attitudes toward a utility throughout the program participation lifecycle. Consider this program participation continuum: A customer can shift from being unaware of a program to aware, to considering participating to participating, to being satisfied with the program experience, and finally - to advocating that others participate in the program. A survey conducted at a particular time point might capture how many people are at various points on the continuum, and be able to correlate it with overall customer satisfaction with the utility. A panel study would also be able to look at whether a particular customer's satisfaction shifts over time as they move along the participation continuum, and model the types of factors that influence satisfaction at each stage. In addition to these program-related variables, panel studies can also be used to track energy efficiency actions over time. This is particularly useful for behavior-change programs, since energy savings are dependent on participants sustaining their behavior change over time. Knowing customer behaviors prior to program implementation, during implementation, and after implementation can help determine program influence on the behavior in the short and long term.

Challenges of Panel Studies

Despite the above benefits, panel studies also present a number of challenges, mainly attrition and panel conditioning. Despite researchers' best efforts to maintain their panel study sample, some attrition is to be expected. Studies indicate attrition between waves to be a common concern among evaluators (Winkels & Withers 2000). If people do not drop out of the study in a random fashion, this becomes an even bigger issue. If the participants who drop out of the study are different than those who remain in the study, it is called differential attrition. Differential attrition can affect both external and internal validity. If there is something different about those that drop out, then external validity may be reduced because the sample is no longer representative of the population. However, nonresponse bias is not a concern if lost panelists and active panelists share similar responses to the same questions. Given the potential concerns caused by differential attrition, it is important for researchers to look at the characteristics of people who dropped out and identify any trends by comparing those who dropped out and those who did not. The researcher then needs to consider any implications of potential nonresponse

bias when forming conclusions.

Panel conditioning arises if repeated questioning of panel members affects responses such that responses to questions differ for experienced panelists as compared to new panelists. Repeated questioning may affect respondents' views about the topic under study, especially with regard to topics for which their views would not have been well developed prior to the survey. Panel studies can also affect respondents' actions if questions increase their awareness, interest, or information about the subject, or if the questions "shame" them into changing behavior. Panel studies may also change how respondents answer questions without changing their behavior. This could occur if: 1) the respondent learns how to answer questions so as to minimize their time spent on the survey/interview; or 2) respondents get better at answering questions because they have learned the requirements of the response process, and thus adjust their responses accordingly. Research indicates that knowledge-related questions are much more impacted by conditioning than behavior or attitudinal questions (Toepoel, Das, & van Soest 2009). Given this panel conditioning concern, a best practice is to employ a split panel design so that panel conditioning can be tested at each wave, by using the new sample for each wave as a control group.

Instrument Design Considerations

In developing a panel study, the instrument guide is of utmost importance because it is used repeatedly. Making sure questions in the instrument guide are clear, minimize bias, and designed to effectively assess responses over time is critical. This section identifies two significant considerations in survey design: survey mode and analysis needs. Survey mode is the method by which the survey will be fielded: telephone, web, mail/paper, or in person. Re-contacting the same respondents repeatedly is a more expensive option when using telephone, mail/paper, and in-person survey modes, and the authors have found that these modes made this method too costly for evaluation budgets. Increased cost is minimal when conducting a web-based panel and thus, this paper focuses on the benefits and disadvantages of web surveys - the mode the authors utilized in the panel studies conducted. In addition to the mode, the type of data collected, whether qualitative and/or quantitative, can have implications for how the data will be used. In addition to describing these two instrument design considerations in more detail, the authors also present a research example highlighting each consideration.

Survey Modes

Evaluators within the energy efficiency field most typically use telephone or web surveys to collect data, with increasing reliance on web surveys in recent years. Because panel studies are unique in that surveys are fielded over a period of time with the same sample of individuals, web surveys tend to be the most cost-effective. The following paragraphs present the benefits and disadvantages of web surveys, and include a research example that compares web and telephone surveys.

Benefits of Web Surveys. In recent years, web surveys have become increasingly popular. In the past, the representativeness of web-based surveys was an issue of concern due to limited Internet access for some demographics; however, the proliferation of Internet access in recent years has mitigated this concern. Representativeness is also less of a concern, especially for non-residential populations, because of near universal Internet access. Web surveys can provide a number of key benefits over traditional CATI (telephone) surveys. These benefits and their application to panel studies are described below.

- Per-respondent costs are often less for web surveys compared to phone surveys: cost-effectiveness is important to panel studies because multiple waves are fielded.

- Web surveys can be distributed to a larger population and result in the collection of more data: large samples are key to panel studies to ensure representative samples in final waves.
- Web surveys can be completed by the respondent at his or her convenience: ease of completing surveys can increase the response rate, which is important to limit respondent attrition in panel studies.
- Web surveys can be quicker to complete: timeliness can be important if panel study waves are conducted within a short time period.
- Web surveys can display text and images to facilitate respondents' comprehension of questions: this allows panel studies to study more complex issues across waves.

Disadvantages of Web Surveys. There are also a number of disadvantages with web surveys. With a web survey, the respondent must be able to comprehend a question without help. The survey designer can anticipate the questions and provide additional information. Understanding can be determined based on the salience of responses, especially to open-ended questions. While this is typically a disadvantage of web surveys, panel surveys do allow evaluators to respond to respondent confusion because evaluators can re-word the question in future waves. However, re-wording the question could jeopardize comparison of responses between waves.

Response rates may be lower for web surveys due to Internet security concerns, junk mail and spam filters, and the ease with which email invitations can be ignored. Some research found significantly lower response rates for web surveys (e.g., Spijkerman, Knibbe, Knoops, van de Mheen, & van den Eijnden 2009). However, other studies outside the energy industry have found higher response rates to web surveys compared to other modes (e.g., Baruch & Holton 2008). The difference in response rate findings can be due to many factors, including: population effects, survey design, and changing use of technology. Panel studies may be impacted by this concern less than traditional surveys, because respondents in subsequent waves would be able to recognize the sender or subject line.

Respondents may demonstrate a lack of effort in web surveys by skipping questions, since there is often no means of enforcing responses; however, evidence has been mixed (Manfreda, Batagelj, & Vehovar 2002; Yun & Trumbo, 2000). Lindhjem and Navrud (2011) found no difference between face-to-face and web respondents in non-response. For open-ended responses, research has generally found responses in web surveys to be lengthier and more "self-disclosing" than those in telephone surveys (Batinic, Reips, & Bosnjac 2002). Level of effort can be determined by reviewing respondent-generated skips (non-response or "don't know" responses), neutral responses, and the level of detail provided in open-ended responses.

A Research Example Comparing Phone and Web Modes. In order to evaluate the effectiveness of a web-based survey mode for future evaluations, the authors implemented a web survey with utility program participants while concurrently fielding a similar telephone survey. Separate samples for the web survey and telephone surveys were taken from the same population, and were given identical questions, although in some cases there were slight modifications to the way questions were presented or how skips were determined, to accommodate the difference between survey modes.

With regard to four key issues of concern identified through prior research, the researchers sought to detect these biases by comparing the results of the web and telephone surveys, described below.

- **Response rates**: The response rate was slightly higher for web surveys than for phone surveys. This was true even with fewer attempts per response made for web surveys, which had, at most, a single reminder email. Phone surveys were dialed up to five times.

- **Selection bias**: The respondents for both phone and web surveys were not different from each other. No statistical differences were found between business type, number of employees, or electricity consumption as a percentage of operating expenses.
- **Normative effects**: No statistically significant differences were found for the mean response to satisfaction questions, or for two questions where normative effects might be expected: those regarding what the participant would have done without the program, and plans to make future efficiency improvements.
- **Cognitive effects**: Qualitative review of open-ended questions found a few examples of greater detail and clarity provided by web respondents. In addition, there were no statistically significant differences in the percentage of neutral responses provided by web and phone respondents. User skips, where the respondent chose not to answer a follow-up question, such as "Why were you less than satisfied," were also no different between telephone and web survey respondents.

Quantitative and Qualitative Data

In addition to mode, another major consideration in instrument design is the type of data required to assess the evaluation objectives. While panel study surveys typically are used to collect quantitative data, they can also be used to collect qualitative data. Additionally, a particular wave of a study could be used in conjunction with in-depth interviews or focus groups to further understand participant responses. Quantitative and qualitative analysis can also be conducted within the survey format itself. In other words, while the focus of a particular panel study may be used to quantitatively track particular variables over time, the survey could also be used to ask open-ended questions to participants about their experiences with particular program elements at each wave. Implementers can use the data to make mid-course adjustments to program implementation, or guide future program development efforts. The sections below describe the benefits and tradeoffs to mixed-method panel study designs, and a research example.

Benefits and Tradeoffs of Using Mixed-method Designs with Panel Studies. Mixed method design involves combining the rich context of qualitative data with the statistical affordances of quantitative data (see Tashakkori & Teddlie 2003). This approach allows researchers to ask questions in different ways, triangulate data, and combine methods that complement each other to allow for the inherent strengths and weaknesses for a particular method. It can also allow researchers to follow up with panel respondents in different ways to either gain more information to better understand closed-ended data, or to gain clarity or establish statistical precision with emerging trends. For example, an unexpected finding from a quantitative survey can be explored further by following up with qualitative in-depth interviews. The researcher gains clarity, does not have to guess at ambiguous responses, and is able to gain a richer explanation of the data. Such qualitative understanding can help shape the next phase of data collection with the panel.

Some potential disadvantages to consider include costs. Collecting and analyzing qualitative data is usually more time consuming. The research must consider the value of collecting both qualitative and quantitative data, balanced with spending less time or budget in other ways, such as less analysis, using a smaller sample size, etc. In order to gain the most value from collecting data using different methods, it is especially important to ensure that interview and survey questions are worthwhile and designed to obtain the information that is sought. Finally, there is always the issue that following up with respondents when they are not expecting it can lead to "survey fatigue" or an unwillingness to participate, or even increase customer dissatisfaction. These concerns must be weighed carefully against

the advantages of an approach that has the potential to add more clarity and different perspectives to the data that are collected.

A Research Example Using a Mixed-method Design. An ongoing panel study being conducted for a utility in the Midwest was designed to collect data on (1) factors influencing business customer satisfaction with the utility and its programs, and (2) business customers' reactions to marketing efforts.

The panel study consists of a series of four web surveys over the course of the year, and as-needed follow-up studies to address questions raised by each wave of the survey. The surveys were designed to build on knowledge gained from past process evaluations that showed business customer program participants were generally more satisfied with the utility than business customers who had not participated in an energy efficiency program. One hypothesis that will be tested in the current panel study is that satisfaction scores are likely to increase as customers shift from becoming aware of the utilities' energy efficiency programs, to considering participating in a program, to participating in a program, to developing an affinity for the program, to recommending it to other business customers. An interesting preliminary finding suggests that business customers who are simply aware of the energy efficiency program may be willing to recommend the utility's programs to another business even though their company has not yet participated.

This study is not without its challenges. The survey results showed that 58 customers who were listed as 2012 program participants in the utility's database reported that they had *not* participated in the program in 2012. Similarly, 43 customers for whom the utility had no 2012 participation record reported that they *had* participated in the program in 2012. In total, 101 out of 500 respondents reported their participation status differently than what the utility records showed (see Table 1 for full break-out). To explore this issue further, the research team quickly developed a short interview guide used to call these 100 customers to determine the source of the discrepancy.

Table 1: Comparison of Self-Reported and Database-Reported Participation

	Number of Database-Reported Participants				
Number of Self-Reported Participants		2011-2012 Participant	Participant before 2011	Non-Participant	Total
	Participated in past year	**68**	**14**	**29**	**111**
	Did not participate in past year	**58**	**25**	**302**	**385**
	Total	**126**	**39**	**331**	**496**

The data collection for these qualitative interviews is currently underway. It is possible that business customers who reported participating in a program and yet were missing from the utility's records simply cannot remember participating, or that the survey did not reach the appropriate decision-maker. It is also possible that the customers could have participated at a different address, which would explain the lack of utility record for their participation. Another possibility is that they participated in programs offered through another utility. For example, some customers only receive one type of fuel service from the utility the study is being conducted for. If those companies that thought they participated in their electric utility's program had actually participated in their gas utility's energy efficiency program, it would be important to understand the implications of this confusion on the companies' branding and marketing strategy. The only way to effectively address these possibilities is to engage in two-way communication with the respondent that allows for probing and clarifying questions.

The research team will be able to gather a set of likely explanations for the discrepant information. The possible explanations will be shared with the utility to see if the explanations make sense given what they know about their business customers. Understanding this participation reporting issue will be important for designing questions for the second wave of the online survey.

Data Collection Considerations

As described, while there are various ways to conduct a panel study, this paper focuses on web surveys as they provide a cost-effective means to reach a large sample over multiple waves. There are a number of data collection considerations when using web surveys for panel studies, including recruitment methods and respondent retention.

Recruitment Methods

Emailing a survey link is an easy way to recruit respondents for an online panel study. However, one challenge researchers face when conducting online surveys is how to secure email addresses. In the case of contact lists procured from utility data, phone numbers may be more readily available. Recruiting via phone can then be conducted, and email addresses can be collected at the time of recruitment. While phone recruitment can sound onerous and costly, the authors found phone recruitment to be a fairly quick process. Collecting additional emails has allowed the authors to cost-effectively reach a representative sample over multiple waves, because phone calls are only made once. Additionally, the authors were able to seek verbal commitments from respondents that they would complete the online survey(s).

A best practice is to ensure that the survey goes out as soon as possible following the recruitment phone call. When a quick follow-up is not possible, response rate typically decreases. For example, a sample of 750 business customers of a Midwest utility had been recruited via phone to collect email addresses for an online panel study. However, due to client needs, the first survey was delayed. To help alleviate dropout due to the amount of time that was passing, the authors sent at least two emails reminding the recruited panelists about the study, and providing reassurance that they would receive the first survey within several weeks. The first survey was finally sent out about six weeks after the initial recruitment. The team had targeted a 75% response rate for the wave 1 survey (564 responses). By the third week of the wave 1 survey, the research team had sent out three reminder emails urging those who had not completed the survey to do so, but it was clear that the 75% response rate would not be met, as only 500 responses had been completed. To help increase the number of responses, the research team decided to make phone calls to those who had not yet responded. Unfortunately, this effort did not yield enough of a response to make it worthwhile (there was a 12% response rate from the phone calls). Thus, the research team determined it would be more worthwhile and cost-effective to spend additional funds to keep the 500 wave 1 completes in additional waves than to get more, reluctant participants, to join the first wave. Originally, the evaluation team had aimed for 75% of the phone recruits to complete the wave 1 survey, and then 65% retention wave-to-wave. Instead, 67% of the phone recruits completed the web survey, meaning that subsequently 73% retention was needed for wave 1 to wave 2.

Respondent Retention

As described previously, one of the biggest challenges to panel studies is attrition. To retain panel survey respondents over time, the authors used a variety of techniques: email reminders, messaging, incentives, and large sample designs.

The authors used email reminders to encourage recruits to complete the survey in three different panel studies conducted via an online survey. The email reminders were sent prior to the survey, typically from utility program staff and/or the evaluation team, and served to remind recruits of their

participation in previous waves and/or their verbal commitment to participate in the study. Email reminders also served to alert recruits not to delete the upcoming message with the survey link.

The authors also used persuasive messaging to encourage recruits to participate in each wave of the study. Messaging focused on how respondent feedback was valuable, and how continued participation was important to the study objectives. The authors hoped that providing panel study respondents with "nurturing" messages focused on gratitude and developing a long-term relationship with them would increase retention over time.

As with any survey, incentives can be used to help eliminate sampling bias and survey completion (Goritz 2006a). They can also be used to help retain survey respondents over time (Jäckle & Lynn 2007). A financial incentive can serve as the final push to encourage a respondent to spend time completing a survey, especially when asked to complete the survey for multiple waves. In a panel study conducted for a Midwestern utility, the authors increased the incentive over time (from $25 to $50) in order to retain higher response rates in subsequent waves. While the authors do not know the exact effect of the increased incentive, they found much better response rates with the larger incentive (28% response rate in wave one and 47% response rate in wave two).

Lastly, to mitigate attrition in panel studies, the authors have also relied on very large sample sizes for the first wave. While using large sample sizes does not necessarily help retain respondents over time, it does help to ensure a larger sample once the final wave is fielded. In one of the panel studies conducted for a Midwestern utility, the authors assumed a 35% attrition rate for subsequent waves, and then incorporated that figure into the sample frame for the first wave. This allowed the final wave to provide adequate confidence and precision despite losing a number of respondents over time.

Data Analysis Considerations

Data cleaning and preparation for a panel study is similar to a cross sectional study, which examines a sample population at only one specific point in time. Typical steps include assessing the population file for completeness and accuracy (e.g., ensuring the needed variables are included, and populated if any stratification is to be used), ensuring that all cases have the needed contact information (e.g., phone numbers for a telephone survey; email addresses for a web survey), and removing those that do not, and de-duplicating the file by the phone number or email address to ensure participants are not contacted more than once to participate in the survey. The resulting file is the sample frame for the panel study.

In terms of data management for the study, the primary concern is ensuring an effective system is in place to track respondents. In some panel studies, everyone enters the panel at the same time— Wave 1; in others, new panel members may enter the panel in different waves. Also, it is inevitable that not all panel members will respond to each and every wave. Implementing an effective means of tracking respondents aids in sample management and streamlines subsequent analyses

Conclusions

This paper discussed considerations and best practices regarding instrument design specifically focused on web-based surveys, data collection, and data analysis with respect to panel studies. With careful consideration of these issues, panel studies, especially those employing split panel study designs, can be utilized to gather key data to inform process, impact, and market evaluations. With the ubiquity of the Internet, concerns with representativeness of web-based surveys have diminished, making panel studies much more cost-effective than in previous years. Panel studies increase the overall return on research investment— not only through informing energy efficiency programs at points throughout the

program lifecycle, but by providing key data at the end of the program cycle that summarizes the overall success of the initiative.

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