EMI CONSULTING

Pacific Gas & Electric Company 2015 Retail Plug-Load Portfolio Program

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DRAFT
Evaluation
Plan

Presented To:

Phil Broaddus
Emerging Technologies Group
Customer Energy Solutions
Pacific Gas and Electric Company 245 Market St.
San Francisco, CA 94105

Presented By:

Todd Malinick, *EMI Consulting*
&
Richard Ridge, *Ridge & Associates*

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1. INTRODUCTION

This document presents the evaluation plan that EMI Consulting and Ridge & Associates propose using to evaluate Pacific Gas and Electric Company's (PG&E) 2015-2016 Retail Plug-Load Portfolio (RPP) Program Trial. This is a second-year continuation of the RPP Program Trial that was originally launched in 2013-2014 with a single retailer in a limited number of stores, but that will be scaled up to include more and larger retailers, as well as multiple utilities and partners.

Rather than serve as a final ex post evaluation, such as those led or overseen by the Energy Division of the California Public Utilities Commission (CPUC-ED), this can be viewed as a second-phase developmental evaluation.[1] As such, it not only incorporates the significant number of "lessons learned" from leading and conducting the evaluation of the initial 2013-2014 RPP Program Trial, but is also designed to be flexible and adaptive to support the development of emergent and refined evaluation methods, as well as providing useful and rapid feedback to further tune and refine program design and implementation moving ahead.

Ultimately, the goal of this evaluation is to assess the efficacy and performance of the program including the validation of the program theory. More specifically, the intent of evaluation plan proposed herein is to present a theory driven evaluation[2] framework that:

- Identifies key metrics (both program performance and market effect metrics) to be developed, collected, and tracked as part of the evaluation,
- Suggests the frequency at which these metrics should be collected not only to evaluate and assess short-term program activities, outputs, and outcomes, but also to establish baselines for mid- to long-term outcomes that will serve as valid and reliable indicators of market transformation, and
- Provides the foundation upon which future evaluation methods and analyses are built to support defensible conclusions regarding the efficacy of the RPP Program.

The primary audience for the evaluation results will be PG&E program managers, the third-party program implementers, and the CPUC-ED and its consultants. However, it is important to note that, although this document addresses the evaluation of *PG&E's* implementation of the RPP Program, efforts are well underway to expand the implementation of the RPP Program to a national level. PG&E and a group of utility partners, including (but not limited to) the Sacramento Municipal Utility District (SMUD), the Northwest Energy Efficiency Alliance (NEEA), the Northeast Energy Efficiency Partnerships (NEEP), Efficiency Vermont, Baltimore Gas & Electric, DC Sustainable Energy Utility, and The Potomac Electric Power Company (Pepco) are working with the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Program to leverage scale and develop a coordinated approach to align energy efficiency programs at a national level with retailers' business models using the RPP Program design. As such, a secondary objective of this evaluation plan is to inform these national-level efforts by providing input, insight, and direction to how an RPP Program might be evaluated in

[1] Patton, M.Q. 2010. *Developmental Evaluation. Applying Complexity Concepts to Enhance Innovation and Use*. New York, NY: Guilford Press.
[2] Chen, H.T. 1990. *Theory-Driven Evaluations*. Thousand Oaks, CA: Sage.

various jurisdictions, and other audiences are expected, including other utilities, utility partners, advocacy groups, regulators in other jurisdictions, and evaluators.

This is not to say that the exact evaluation methods proposed herein are necessarily recommended or appropriate for all other jurisdictions – this is ultimately a question that needs to be answered by the regulators of each jurisdiction in terms of what will be accepted as credible evidence for energy savings claims and attribution. Nevertheless, the PG&E implementation of the RPP Program is inherently under the auspices of the CPUC-ED, and the approaches proposed in this evaluation plans are aimed at meeting regulatory constraints in the State of California.

It is expected that, should the CPUC-ED approve a future program rollout, that the CPUC-ED will eventually conduct a multi-year ex post evaluation that will assess the ultimate efficacy of the program. Of course, this ED-led impact evaluation should be done in close collaboration with the IOUs participating with the 2015 trial. PG&E looks forward to collaborating with the participating IOUs and the CPUC-ED and sharing the methodological lessons we have learned throughout this evaluation.

The remainder of this first chapter provides more detailed discussion of the RPP Program, introduces the logic model, and outlines some program and evaluation goals for the 2015-2016 RPP Program. The second chapter introduces the concept of market transformation and provides a detailed discussion of how it relates to the evaluation of the RPP Program. The remaining chapters outline the proposed evaluation approach.

1.1 RPP Program Rationale and Description

Because plug loads represent a significant proportion of residential electricity consumption, reducing plug load energy consumption is a critical step on the path towards achieving California's residential Zero Net Energy (ZNE) goals. The 2012 ZNE Technical Feasibility Report stated that "…minimizing plug loads will be critical to meeting ZNE goals",[3] and recommended that utilities "continue equipment efficiency incentive programs" and "aggressively promote equipment efficiency regulations at the state and federal level".[4]

In response, PG&E has developed and launched the Retail Plug-Load Portfolio (RPP) Program. The RPP Program uses a mid-stream design to influence retailers to stock and sell more energy efficient models of home appliances and consumer electronics in targeted product categories. Retailers are paid per-unit incentives for every program-qualified model that they sell during the program period. Program-qualified models are typically models that meet or exceed the minimum ENERGY STAR specification in each product category. By increasing the sales of energy efficient models over less efficient models, the RPP Program will generate gross energy and demand savings in the short- and mid-term through participating retailers, while transforming the overall market towards higher

[3] Arup, Davis Energy Group, Sun Light & Power, New Buildings Institute, Engineering 350, and Sustainable Design + Behavior. 2012. *The Technical Feasibility of Zero Net Energy Buildings in California.* Page 8. Developed on behalf of Pacific Gas & Electric Company. Retrieved from: http://www.energydataweb.com/cpucFiles/pdaDocs/904/California_ZNE_Technical_Feasibility_Report_Final.pdf

[4] Ibid. p. 51.

efficiency—resulting in energy and demand savings—in the long-term. The broader RPP Program strategy is discussed in detail in the PG&E document *Retail Plug-Load Portfolio Trial Plan.*[5]

The RPP Program initially was tested with a single participating retailer (Kmart) in its stores located in the PG&E and Sacramento Municipal Utility District (SMUD) service territories in a trial that took place from November 2013 to December 2014. The 2013-2014 Trial incented six product categories, including: (1) air cleaners, (2) DVD/Blu-Ray players, (3) home theaters-in-a-box (HTIBs), (4) freezers, (5) refrigerators, and (6) room air conditioners.

The 2015-2016 RPP Program Trial is being expanded to include more retailers (see Table 1-1), with plans to launch in July 2015 and run through June 2016.

Table 1-1: 2015-2016 RPP Program Trial Participating Retailers

Retailer	Number of Stores
Home Depot	98
Best Buy	42
Sears	37
Kmart	37

The 2015-2016 RPP Program Trial will include incentives for five targeted product categories (Table 1-2), including: (1) air cleaners, (2) sound bars, (3) home theaters-in-a-box, (4) freezers, and (5) electric clothes dryers.

Table 1-2: 2015-2016 RPP Program Incentives

Product Category	Draft Efficiency Specification	Draft Per-Unit Incentive
Air Cleaners	Energy Star	$20
Sound Bars	Energy Star + 50%	$15
Home Theaters-in-a-Box	Energy Star	$15
Freezers	Energy Star	$20
Electric Clothes Dryers	Energy Star	$50

As part of the RPP Program, retailers are expected to commit to creating and implementing a marketing plan for increasing the sales of energy efficient models in the targeted product categories. Examples of strategies incorporated in retailer-created marketing plans for increasing sales of energy efficient models include the following:

- Product assortment changes (e.g., displaying additional qualified models)[6]

[5] Navitas. 2013. *PG&E Retail Plug-Load Portfolio (RPP) Trial Plan*. Prepared for PG&E by Navitas.

[6] A retailer's assortment is defined by the set of products carried in each store at each point in time. The goal of assortment planning is to specify an assortment that maximizes sales or gross margin subject to various constraints, such as a limited

- Product pricing strategies (e.g., reducing prices or initiating price promotions for the most efficient model in a product category)
- Product promotion strategies (e.g., increasing the promotion/advertisement of energy efficient models)
- Product placement strategies (e.g. devoting "prime" shelf and/or store locations to energy efficient models)
- Staff training (e.g., educating sales associates and managers on the benefits of energy efficiency products)
- Educating customers about the benefits of purchasing energy-efficient products

1.2 RPP Program Logic Model

Logic models go hand-in-hand with program theory in the market transformation literature. Rosenberg and Hoefgen state: "program logic models are graphic representations of the causal links between program activities, short-term responses to those activities among market actors, and longer-term market effects."[7] The elements used to describe or represent a logic model include inputs, activities, and outputs, which in combination loosely form a program process theory, short-term outcomes (sometimes called initial, proximal, or immediate outcomes), mid-term outcomes (sometimes called intermediate or proximal outcomes), and long-term outcomes (sometimes called distal outcomes or impacts), which are intended to represent a program impact theory.[8,9,10,11] In these logic models, activities are the actions undertaken to bring about a desired end, outputs are the immediate results of an action, and outcomes are the anticipated changes that occur directly or indirectly as a result of inputs, activities, and outputs.

The RPP Program concept is built upon a series of hypothesized causal linkages between program activities, outputs, and intended program outcomes that are depicted in the program logic model as illustrated in Figure 1-1. The development of this logic model evolved over a 12-month period and is based on three sources of information:

1. Prior theory and research (e.g., economics of the firm, retailer behavior, consumer behavior, etc.)
2. Implicit theories of those close to the program (e.g., PG&E program managers, the experience of experts in the retail industry, experience of CPUC-ED and its consultants, and PG&E EM&V staff and its consultants), and
3. Observations of the program in operation during the Phase I trial.

budget for purchase of products, limited shelf space for displaying products, and a variety of miscellaneous constraints such as a desire to have at least two vendors for each type of product.

[7] Rosenberg, M. and L. Hoefgen. 2009. *Market Effects and Market Transformation: Their Role in Energy Efficiency Program Design and Evaluation*. Prepared for the California Institute for Energy and Environment. p. 48. Available at: http://uc-ciee.org/downloads/mrkt_effts_wp.pdf

[8] Donaldson, S. I. 2007. *Program Theory-Driven Evaluation Science*. New York, NY: Lawrence Erlbaum

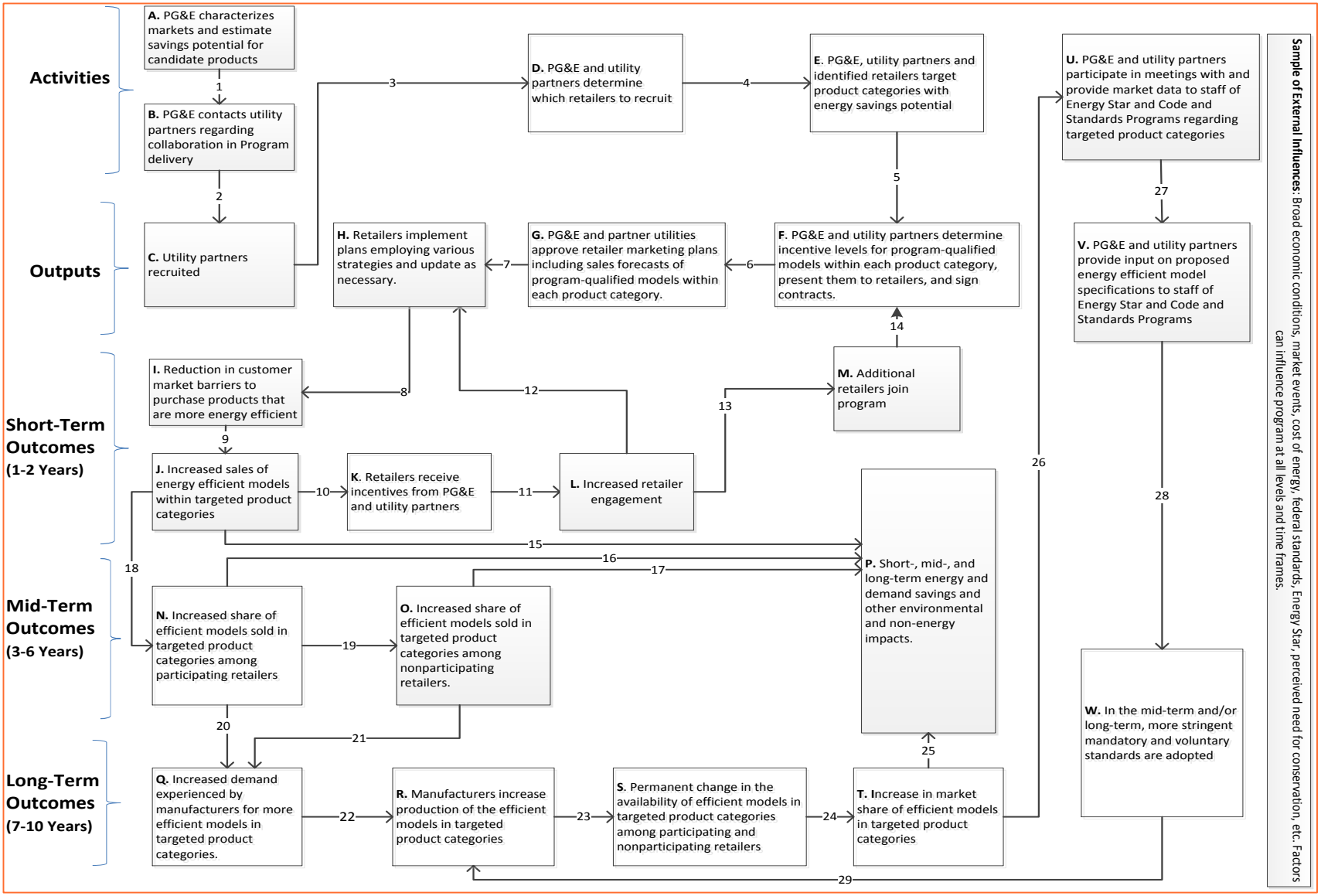
[9] Donaldson, S. I., & Lipsey, M. W. 2006. "Roles for Theory in Contemporary Evaluation Practice: Developing Practical Knowledge." *In:* I. Shaw, J. C. Greene, & M. M. Mark (Eds.), *The Handbook of Evaluation: Policies, Programs, and Practices* (pp. 56-75). London, UK: Sage.

[10] Lipsey, M. W., Rossi, P. H., & Freeman, H. E. 2004. *Evaluation: A Systematic Approach* (7th ed.). Thousand Oaks, CA: Sage.

[11] Patton, M. Q. 2008. Utilization-Focused Evaluation (4th ed.). Thousand Oaks, CA: Sage.

A more detailed description of the program theory and logic is provided in Appendix A.

Figure 1-1: RPP Program Logic Model



Importantly, the RPP Program concept is one of the first programs of its type aimed at longer-term market transformation in the State of California through an intervention strategy with a midstream emphasis. As a result, outcomes of the program are expected to occur over different time frames. Initial program activities are aimed at characterizing the market and savings potential for candidate product categories (A), developing the program teams (B) and determining and recruiting participating retailers (D), and determining which product categories to target (E). Next, the utility partners and program/implementation team determine incentive levels and sign contracts with the participating retailers (F). Once contracts are signed, the retailers develop marketing plans and strategies for selling more energy efficient products (G) and begin implementing these plans (H). The retailer efforts reduce customer market barriers (I), resulting in increased sales of efficient products in the targeted product categories (J). Incentives for the sale of energy efficient products are paid to retailers (K), which are expected to increase the engagement of participating retailers (L), and perhaps non-participating retailers may also sense market signals suggesting that more efficient products are profitable and decide to join the program (M). The reduction of customer market barriers and the increased sale of efficient products also will, in the short-term, result in energy, demand, and other environmental and non-environmental impacts (P). In the mid-term, success of the program will be evidenced by participating retailers selling an increased share of efficient products (N). If the potential benefits seem great enough, nonparticipating retailers might simply begin stocking more efficient products without joining the program (O) which also will, in the mid-term, result in energy, demand, and other environmental and non-environmental impacts (P). In the long-term, both demand pressures experienced by manufacturers (Q) as well as policy-related effects on standards (U, V and-W) are expected to alter manufacturer supply of efficient products (R), which ultimately will result in permanent changes in the availability and sales of efficient models in the marketplace (S and T), which also will, in the long-term, result in energy, demand, and other environmental and non-environmental impacts (P).

1.3 Objectives

The objectives for the 2015-2016 RPP Program Trial fall into two categories: (1) performance objectives and (2) operational objectives. The performance objectives are those objectives that are achieved through a measureable change in key performance metrics from baseline values. The operational objectives are facilitated by the program team and the implementers and build upon the lessons learned from the evaluation of the 2013-2014 RPP Program Trial and are aimed at building a robust framework for program implementation and evaluation that could support the further scaling up of the RPP program concept from a trial to a multi-year program. The performance objectives and operational objectives are listed below.

Performance Objectives

- Achieve an increase in sales of program-qualified models in targeted product categories among participating retailers
- Achieve gross and net energy and demand reductions associated with the sales of program-qualified models in targeted product categories among participating retailers

Operational Objectives

- Conduct activities that are expected to lead to outputs (see Figure 1-1), including:

  - Activities A, B, D, E and possibly U
  - Outputs C, F, G, H and possibly V
- Determine the level of retailer support needed to ensure program is implemented effectively
- Refine data collection, processing, and management protocols, as well as identify responsible parties for each stage and task (e.g., retailers, utility staff, evaluators)
- Extend proof of concept to multiple retailers and utility partners to extend test and validation of program operations, evaluation methods, and incentive structures
- Test the impact of a uniform incentive across participating retailers for each product category based on state, regional, and national estimates of market share
- Refine the necessary data infrastructure, including quality control protocols, to administer incentives in an accurate and cost-effective manner

Evaluation Objectives

Because the RPP Program concept is one of the first programs of its type aimed at longer-term market transformation in the State of California, the evaluation will focus heavily on assessing various program trial processes in addition to identifying and measuring performance and market effects metrics. Evaluation objectives for the 2015-2016 RPP Program Trial are listed below.

- Validate the program theory and logic
- Identify, operationalize, collect, and analyze key short and mid-term program performance metrics
- Identify, operationalize, collect and track key mid- and long-term market effects metrics to develop baselines for comparison in future years
- Estimate gross and net energy and demand savings
- Continue to test various methods to evaluate the RPP Program
- Conduct secondary literature review of similar evaluation metrics for MT programs

To the extent possible, the evaluation of the RPP Program Trial will comply with the California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals[12] and The Program Evaluation Standards: A Guide for Evaluators and Evaluation Users.[13] However, because of the diversity of evaluation objectives that exist for the RPP Program, no single methodology is suitable for assessing all objectives. Some objectives are more qualitative in nature and will involve assessing and evaluating operational activities and processes to ensure that the program trial is being implemented as planned and functioning as expected. Other objectives are more quantitative in nature and will involve defining, measuring, and analyzing specific metrics that will serve as indicators of program progress, attribution, and/or success. Also, since this is a relatively new and novel program concept aimed at market transformation, an additional objective of the evaluation process includes assessing the array of potential approaches to evaluating the program to identify which approaches are most effective, informative, and feasible to apply moving forward should the program be further scaled up in ensuing years.

[12] TecMarket Works Team, 2005. *California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals.* Prepared for the California Public Utilities Commission.

[13] Yarbrough, D. B., L. M. Shulha, R. K. Hopson and F. A. Caruthers. 2011.*The Program Evaluation Standards: A Guide for Evaluators and Evaluation Users.* Los Angeles, CA: Sage Publications.

2. MARKET TRANSFORMATION AND THE RPP PROGRAM

The California Public Utilities Commission (CPUC) has defined market transformation as:

> "[L]ong-lasting, sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where continuation of the same publicly-funded intervention is no longer appropriate in that specific market. Market transformation includes promoting one set of efficient technologies, processes or building design approaches until they are adopted into codes and standards (or otherwise substantially adopted by the market), while also moving forward to bring the next generation of even more efficient technologies, processes or design solutions to the market."[14]

However, there has been movement recently to move away from viewing market transformation as an end point, but instead to view it as an intervention strategy or policy tool:

> "This alternative approach is based on the concept that market transformation efforts are most effective when they emphasize thorough consideration of which specific markets have leverage points that will yield to market transformation, and then promote the development of systematic but flexible long-term strategies for influencing those leverage points. We call this approach "Targeted Market Transformation," which is in turn advanced by "Targeted Market Transformation Initiatives." This approach can in turn be defined as follows: [Targeted] market transformation interventions are designed to induce sustained increases in the adoption and penetration of energy efficient technologies and practices through structural changes in the market and in behaviors of market actors."[15]

The design of the RPP Program is consistent with this definition of a targeted market transformation program. The fundamental program theory is that, with the right combination of incentives and engagement, market barriers for both retailers and consumers—and eventually manufacturers—can be reduced.[16] As a result, retailers will increase their sales of more energy efficient models (models that meet and/or exceed ENERGY STAR specifications) to more informed

[14] CPUC Application – Decision: 08-07-021, Filed 7/21/08 Section 4.6.1. Defining Market Transformation – page 2; updated in D.09-09-047[14] at page 88-89. Updates from definition in the California Long Term Strategic Plan are in italics.

[15] Prahl, R. and K. Keating. 2014. *Building a Policy Framework to Support Energy Efficiency Market Transformation in California.* Final Review Draft. California Public Utilities Commission.

[16] Note that the RPP is not a "lift" program, which pays an incentive only for the number of units sold that is greater than the forecasted number of units that would have been sold normally. That is, in a lift program design, incentives are paid only for the incremental, or net, units above this baseline forecast. Rather, in the RPP Program, an incentive will be paid for every program-qualified unit. In this sense, RPP is no different from a standard utility rebate program, which pays an incentive for every qualified measure, e.g., a refrigerator. Some portion of program participants are always free riders, the proportion of which that is estimated as part of an ex post evaluation. To mitigate the risk of high freeridership, program designers must determine incentive levels which result in the promotion of energy-efficient measures that have relatively low sales and market shares and market shares within the participating retailers, use less energy, and cost more than the standard efficient units.

customers than they would have absent the program, thereby generating energy savings, and with sustained engagement, transforming the retail channel market in delivering energy efficient plug load products and appliances.

In the short term, the RPP Program is intended to motivate participating retailers to promote and sell more efficient models. Over time, other retailers, investor-owned utilities (IOUs), and administrators outside of PG&E's service territory (e.g., municipal utilities such as SMUD, and regional bodies, such as NEEA and NEEP) collaborate in this effort to get retailers to regularly demand, stock, and promote the most efficient models available. This broader scale will be necessary because the markets for these types of products are complex and world-wide and it may be difficult for a single utility or state to significantly influence the market forces to affect how manufacturers and mid-stream players act. Peters and colleagues underscored this fundamental program design principle:

> "Manufacturers design and market products for a national, even international market. They are already faced with country-specific requirements and strongly dislike "patchwork" requirements. In fact, many manufacturers stated they were unlikely to comply with energy efficiency program requirements that apply at municipal levels. Thus, programs will have the greatest impact on the electronics market if they coordinate with one another in setting energy efficiency targets, incentive levels, and program participation requirements."[17]

The resulting increase in regional and/or national demand for these models will eventually cause their manufacturing partners to permanently shift a greater proportion of their production to these models, thus transforming the market and reversing the trend of increasing energy use due to plug loads and appliances.

Thus, in the current environment where plug load energy consumption is growing, "low hanging fruit" for energy savings are diminishing, and regulatory scrutiny is intensifying, the RPP Program offers a number of advantages:

- **Aggregation** – Applies PG&E's considerable resources and experience to a portfolio of measures, reducing administrative costs over a single product category-based approach and creating a more attractive financial value proposition for retailers.
- **Collaboration and Negotiation** – Brings PG&E and retailers together during critical retailer planning periods to determine energy efficient product assortments and program options.
- **Transformation** – Promotes retailer behavior change towards energy efficiency, while acquiring energy savings by changing product (and potentially facility) energy profiles. Shapes the market while interacting at multiple organizational levels to elevate of energy efficiency as an enterprise-wide initiative.

It is important to note that, while the RPP Program promotes five specific product categories, they can be grouped into two major categories: (1) home appliances, and (2) consumer electronics. The technological change for the former is much slower than the latter.

[17] Peters, J.S., M. Frank, J. Van Clock and A. Armstrong. 2010. *Electronics and Energy Efficiency: A Plug Load Characterization Study*. Prepared for Southern California Edison. p. 45

> "Consumer electronics products change continuously. As soon as one product is designed, the next product design process begins, and manufacturers note energy efficiency often improves in each successive model. Programs thus need to reevaluate energy efficiency targets and the levels at which incentives are provided to ensure that only the most efficient products qualify. For example, a set-top box manufacturer suggested efficiency standards for set-top boxes should be tightened every one or two years."[18]

The major appliance market moves much more slowly simply because many efficiency improvements have already been made and the measure lives are much longer. Ultimately, each product category has its own technical challenges, development timeline, supply chain, end-users, barriers, and opportunities. Although there are similarities across product types, programs should treat each product individually when designing an implementation strategy. It is not advisable to treat a diverse portfolio of product categories as if a single strategy can address this collection of unique challenges.

That the RPP Program is a regional program presents unique challenges. Peters and colleagues go on to note that: "Successful intervention by utilities and government agencies will require new strategies, exceptional adaptability, and unprecedented cooperation among efficiency organizations."[19] Working with manufacturers is also a critical component of any mid-stream program:

> "Manufacturers praise ENERGY STAR for its inclusive specification development process and nearly all interviewees were interested in working with utilities to promote energy-efficient products. Programs should draw on manufacturers' expertise and leverage their distribution channels."[20]

Finally, while PG&E has worked with many of the retailers targeted by this program for participation, most recently in the Upstream Lighting Program, and most are ENERGY STAR Partners, there is continued focus on prioritizing the retailer relationships by the utility. This was a specific recommendation to the program in KEMA's Impact Evaluation Report for Business and Consumer Electronics Program (WO34): "Maintain retailer relationships. Retailers are a key player in the supply chain for most plug load products. Thus, programs should seek to build long-term relationships with retailers and design program elements with the retailer's business case in mind.[21]"

[18] Ibid. p. 45
[19] Ibid. p. 2
[20] Ibid. p. 45
[21] KEMA, Inc. Impact Evaluation Report Business and Consumer Electronics Program (WO34). Oakland, CA. April 15, 2013. http://calmac.org/publications/WO34_BCE_Impact_Evaluation_Report_-_Phase_1_FINAL_2013-04-15.pdf.

3. OVERVIEW OF EVALUATION APPROACH

In this section, a theory-driven evaluation approach is proposed, methodological challenges are identified, the need to minimize the various sources of error is recognized, and management and communication protocols are presented.

3.1 Theory-Driven Evaluation

The RPP Program involves a diverse group of market actors including utilities, regional bodies, government agencies, manufacturers, retailers, and end users. The relationships among these market actors are complex and are expected to extend over a ten-year period in an environment in which other federal, regional, and state efficiency program also are affecting the broader market. These factors combine to make the assessment of program attribution for the RPP Program similarly complex and uncertain. Traditional evaluation approaches, which typically estimate whether net outcomes[22] have been achieved over a relatively short period of time, are not equipped to address such complex situations. For a complex program such as the RPP Program, plausible causal mechanisms must be identified and related hypotheses tested in order to build a case for attribution. This challenge requires a very different approach, a theory-driven evaluation, which is well suited to evaluate such programs.[23] For this evaluation, theory-driven evaluation is defined as:

[22] Net outcomes are those that would not have been achieved absent the program.

[23] For detailed descriptions of theory-driven evaluation see:
Chen, H.T. 1990. *Theory-Driven Evaluations*. Thousand Oaks, CA: Sage.
Rogers, P.J. 2000. "Program Theory Evaluation: Not whether programs work but how they work." *In:* D.L. Stufflebeam, G.F. Madaus, and T. Kelleghan (Eds.), *Evaluation Models: Viewpoints on Educational and Human Services Evaluation*, (pp. 209-232). Boston, MA: Kluwer.
Rogers, P.J. 2008. "Using Program Theory to Evaluate Complicated and Complex Aspects of Interventions." *Evaluation*. 14: 29-48.
Rogers, P.J., Petrosino, A., Huebner, T.A., & Hacsi, T.A. 2000. "Program Theory Evaluation: Practice, Promise, and Problems." *In*: P.J. Rogers, T.A. Hacsi, A. Petrosino, & T.A. Huebner (Eds.), *Program Theory in Evaluation: Challenges and Opportunities* (pp. 5–14). New Directions for Evaluation, No. 87. San Francisco, CA: Jossey-Bass.
Weiss, C.H. 1995. "Nothing as Practical as Good Theory: Exploring Theory-based Evaluation for Comprehensive Community Initiatives for Children and Families." *In*: J. Connell, A. Kubisch, L.B. Schorr, & C.H. Weiss (Eds.), *New Approaches to Evaluating Community Initiatives: Volume 1, Concepts, Methods, and Contexts* (pp. 65-92). New York, NY: Aspen Institute.
Weiss, C.H. 1997a. "How Can Theory-based Evaluations Make Greater Headway?" *Evaluation Review*, 21: 501-524.
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Weiss, C.H. 2004a. *On Theory-based Evaluation: Winning Friends and Influencing People*. The Evaluation Exchange, IX, 1-5.
Coryn, C.L., L.A. Noakes, C.D. Westine, and D.C. Schröter. 2011. "A Systematic Review of Theory-Driven Evaluation Practice from 1990 to 2009," *American Journal of Evaluation*, 32(2).

> "[A]ny evaluation strategy or approach that explicitly integrates and uses stakeholder, social science, some combination of, or other types of theories in conceptualizing, designing, conducting, interpreting, and applying an evaluation."[24]

Coryn and colleagues systematically examined 45 cases of theory-driven evaluations published over a twenty-year period to ascertain how closely theory-driven evaluation practices comport with the key tenants of theory-driven evaluation as described and prescribed by prominent theoretical writers. One output from this analysis was the identification of the core principles and sub-principles of theory-driven evaluation (listed below), that will provide the basic framework for the evaluation the 2015-2016 RPP Program Trial.

1. Theory-driven evaluations/evaluators should formulate a plausible program theory
    a. Formulate program theory from existing theory and research (e.g., social science theory)
    b. Formulate program theory from implicit theory (e.g., stakeholder theory)
    c. Formulate program theory from observation of the program in operation/exploratory research (e.g., emergent theory)
    d. Formulate program theory from a combination of any of the above (i.e., mixed/integrated theory)
2. Theory-driven evaluations/evaluators should formulate and prioritize evaluation questions around a program theory
    a. Formulate evaluation questions around program theory
    b. Prioritize evaluation questions
3. Program theory should be used to guide planning, design, and execution of the evaluation under consideration of relevant contingencies
    a. Design, plan, and conduct evaluation around a plausible program theory
    b. Design, plan, and conduct evaluation considering relevant contingencies (e.g., time, budget, and use)
    c. Determine whether evaluation is to be tailored (i.e., only part of the program theory) or comprehensive
4. Theory-driven evaluations/evaluators should measure constructs postulated in program theory
    a. Measure process constructs postulated in program theory
    b. Measure outcome constructs postulated in program theory
    c. Measure contextual constructs postulated in program theory
5. Theory-driven evaluations/evaluators should identify breakdowns, side effects, determine program effectiveness (or efficacy), and explain cause-and-effect associations between theoretical constructs
    a. Identify breakdowns, if they exist (e.g., poor implementation, unsuitable context, and theory failure)
    b. Identify anticipated (and unanticipated), unintended outcomes (both positive and negative) not postulated by program theory
    c. Describe cause-and-effect associations between theoretical constructs (i.e., causal description)

[24] Coryn, C.L., L.A. Noakes, C.D. Westine, and D.C. Schröter. 2011. "A Systematic Review of Theory-Driven Evaluation Practice from 1990 to 2009," *American Journal of Evaluation*, 32(2):, p.201.

d. Explain cause-and-effect associations between theoretical constructs (i.e., causal explanation)
    i. Explain differences in direction and/or strength of relationship between program and outcomes attributable to moderating factors/variables
    ii. Explain the extent to which one construct (e.g., intermediate outcome) accounts for/mediates the relationship between other constructs

Coryn goes on to state:

> "All in all, the perceived value of theory-driven evaluation is, in part, generating knowledge such as not only knowing whether a program is effective or efficacious (i.e., causal description; *that* a causal relationship exists between A and B) but also explaining a program's underlying causal mechanisms (i.e., causal explanation; *how* A causes B)."[25]

Within a theory-driven framework, the assessment of program performance through the use of multiple research designs and analyses of key leading indicators of program performance is the best way to manage risks faced by each stakeholder.[26] Such early and regular feedback from the various evaluation teams will allow timely course corrections increasing the likelihood of achieving the ultimate objectives of the RPP Program. Within this theory-driven framework, an effective evaluation of the RPP Program Trial requires a robust, yet flexible design that takes into consideration several challenges:

- **Program effects will be challenging to assess in the short-term (e.g., the first or second year of retailers' participation).** The greatest impacts from the program will result from retailers altering their product assortment over time, thus increasing the proportion of energy efficient models available for sale to customers, while simultaneously reducing the availability of less efficient models. During the first year of participation, retailers will have very limited opportunity to alter their assortments due to retail buying cycles. That is, for many or most product categories, retailers will have already made stocking and purchasing decisions *prior* to the start of their participation in the program. Notable assortment changes are expected to emerge after the first year, gaining pace after the second year, once retailers have had the opportunity to fully recognize the benefits of participating in the program. As a result, during the first and second years, the main program effects are expected to result almost exclusively from marketing efforts aimed at increasing sales of program-qualified models. However, detecting increases in sales due to these marketing efforts are more challenging to assess because total sales volumes tend to be lower than they would be with an assortment change, and changes in metrics such as the proportion of program-qualified units sold are sensitive to any other efforts a retailer may make to also promote the sales of any non-qualified models.

[25] Ibid, p.203

[26] Ridge, R., S. Kromer, S. Meyers, D. Mahone, J. Luo, V. Richardson, and R. Friedmann. *Energy Efficiency Portfolio Risk Management: A Systematic, Data-Driven Approach for Timely Interventions to Maximize Results.* A paper presented at the International Energy Program Evaluation Conference in August, 2007.

- **Attribution of program impacts will likely be complex.** In addition to the impacts the RPP Program are expected to have on the sales of program-qualified models, there are other market pressures and trends that will also be happening at the same time independent of the program that can also affect the sales of energy efficient products. For example, increasing of federal efficiency standards for some products is driving an increase in the sales of more efficient products. Thus, it will be important to be able to determine which market effects are attributable to the program versus natural market trends.
- **The mid- and longer-term effects on the broader marketplace need to be assessed by developing reliable market baseline indicators to support evaluating change in future years.** The RPP Program is aimed at transforming the overall market for targeted products. However, this transformation will not be immediate. While some program effects are expected in the short-term (i.e., one to two years), some program outcomes are not expected until the mid-term (three to six years), while other, longer-term outcomes are not expected until the long-term (i.e., seven to ten years). The evaluation design needs to ensure robust and reliable baselines are developed for key metrics to ensure changes can be assessed moving ahead in order to ensure all the benefits of the program are accurately measured.

This theory-driven approach relies on a mixed method approach involving the collection and analysis of both quantitative and qualitative data covering program inputs, activities, outputs and outcomes. This implies the need for a comprehensive, integrated analysis that involves both a process evaluation and an evaluation to inform savings claims that *extends over the life of the program*.

The process evaluation will be focused on assessing the operationalization of the program and validating the program theory. The evaluation to inform savings claims, while also intended to validate aspects of the program theory, will be focused on measuring the more quantitative program impacts, such as changes in the proportion of program-qualified units sold, total sales volumes of program-qualified units sold, and energy and demand impacts. Also, incorporated into both the savings claim estimation and process evaluations will be the determination and development of key market effects indicators intended to baseline the marketplace to support assessing the transformation of the market over the longer-term.

Though the process evaluation and the evaluation to inform savings claims are presented separately, it is important to emphasize their interdependence. Given the complex and dynamic plug load market that the RPP Program is intended to effect over a ten-year period, estimating program impacts from the RPP Program solely through traditional evaluation methods runs the risk of misstating the true scale of effects or possibly misattributing effects to the program. Thus, key to the evaluation design is the ability to validate the activities, outputs, and outcomes – as well as their linkages – as denoted in the RPP Program logic model to draw well-supported conclusions regarding the performance and efficacy of the program in a way that also supports plausible estimates of attribution. One important implication of a theory-driven approach is that a single net-to-gross ratio presenting program efficacy will not be produced, both rather an internally consistent, coherent and plausible story about the efficacy of the RPP Program. In order to assess the cost-effectiveness of the RPP Program using the CPUC Benefit-Cost Calculator, a range of plausible NTGRs, consistent with this story can be provided in order to see their effect on the Total Resource Cost (TRC) Test.

Because of this complexity and the relatively novel program and evaluation design, PG&E and the evaluation team look forward to the opportunity to share findings and collaborate with the CPUC-ED

to ensure this works informs future ED-led ex post evaluations, and also facilitates integration of the ex post evaluations with future utility-led process evaluations.

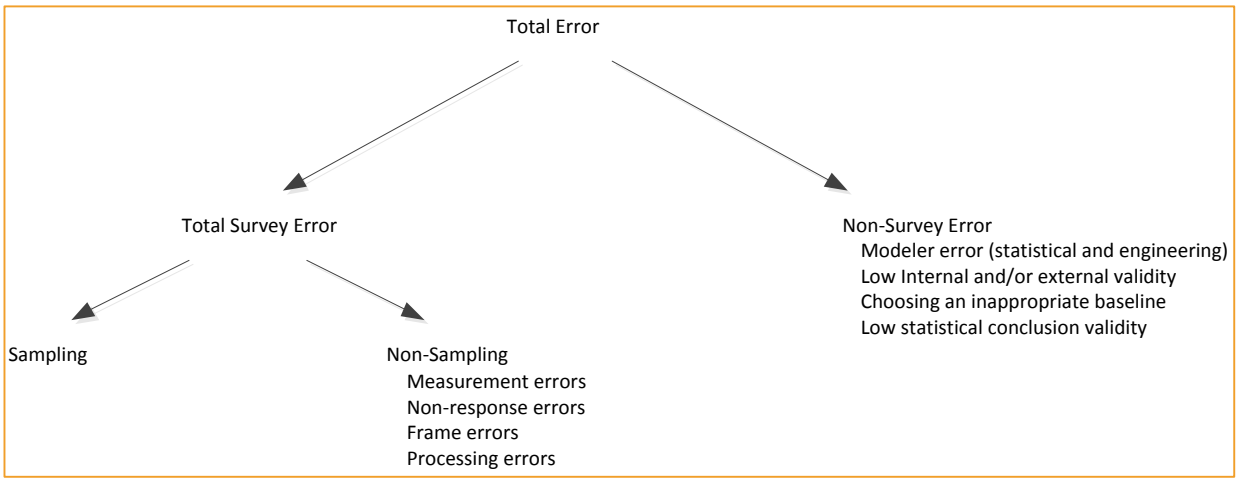
3.2 Level of Rigor

Any measure that is expected to represent 2% or more of total IOU portfolio savings is referred to as a high impact measure (HIM). Evaluations aimed at estimating the savings for HIMs, due to their relative importance to the portfolio, are typically designed at a higher level of methodological rigor. The question is whether the savings associated with the RPP 2015 bundle of measures represent 2% of PG&E's estimated net savings. If not, is the bundle likely to achieve HIM status at some point in the future? Given that in 2015, only four retailers are currently engaged with the RPP Program that is incenting only five product categories, achieving HIM status in 2015 is unlikely. However, going forward, as more retailers engage with the RPP Program that will expand the number of product categories that it covers, the chances of achieving HIM status at some point in the future increases. Given this likelihood, this evaluation plan for the RPP Program is set at the *enhanced* level of rigor. This represents a "no-regrets" evaluation design since we do not want to be in a position of not establishing baseline indicators for key performance metrics for a program that may eventually achieve HIM status.

3.3 Error Minimization

In the design and implementation of any evaluation design that may inform savings claim estimates, we will attempt to cost-effectively mitigate various sources of error in estimating program impacts. Figure 3-1 presents a typology of some of the most important sources of error.

Figure 3-1: Sources of Error in Estimating Energy and Demand Savings



With respect to sampling error, for program-level samples, the minimum standards for confidence and relative precision are targeted at 90/10 for estimating gross energy and demand savings and for surveys at the program level. If the planned or achieved confidence and precision cannot meet the 90/10 standard, we will clearly indicate the reasons it was not practical and offer a detailed justification.

However, in any given study, the potential for bias could be much more important than sampling error.[27,28,29,30,31] Unfortunately, some evaluators make the mistake of focusing almost exclusively on reducing sampling error by insisting on large samples while devoting relatively little attention to addressing the many other sources of error. As a result, some studies achieve a high level of confidence and precision around a biased estimate, which compromises the objective of obtaining reliable estimates of energy and demand impacts. As appropriate, we will attempt to mitigate the various sources of error in this evaluation. To do so, we will be flexible in responding to data issues as they arise in order to maximize the reliability of the savings.

3.4 Management and Communication

In order to ensure that the evaluation team is able to provide timely and useful information to program staff and the third-party implementation team to facilitate program improvement, representatives of the evaluation team will attend periodic team meetings so that we can share emergent findings, information, and recommendations with other project team members in a timely manner. A Mid-Study Progress Report presentation will be developed and shared with the project team and the CPUC-ED roughly halfway through the trial period, which will provide a more structured and thorough summary of preliminary findings across the majority of the metrics we will be collecting as part of this study. This Mid-Study Progress Report, however, will not be comprehensive, and will be intended to provide a snapshot of select findings to allow the evaluation and project teams, as well as the CPUC-ED, to begin to gauge progress to-date. Periodic, interim meetings may be requested with the CPUC-ED, as needed, to share key findings or seek collaboration and input on critical issues. The final evaluation report to be completed at the end of the trial will present the comprehensive findings and analyses of all results.

[27] Groves, R.M. 2004. *Survey Errors and Survey Costs*. Hoboken, New Jersey: John Wiley & Sons, Inc.

[28] Biemer, P., R.M. Groves, L.E. Lyberg, N.A. Mathiowetz, and S. Sudman. 2004. *Measurement Error in Surveys*. Hoboken, New Jersey: John Wiley & Sons, Inc.

[29] Lyberg, L., P. Biemer, M. Collins, E. de Leeuw, C. Dippo, N. Schwarz, and D. Trewin. 1997. *Survey Measurement and Process Quality*. New York: John Wiley & Sons.

[30] TecMarket Works. 2004. *The California Evaluation Framework*. Prepared for the Southern California Edison Company.

[31] TecMarket Works Team. 2006. *California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals*.

4. PROCESS EVALUATION

The objectives of the process evaluation of the 2015-2016 RPP Program Trial include:

- Assessing and informing operationalization of the program
- Validating key components of the program theory
- Providing data and information to aid the assessment of attribution

The process evaluation will consist of several primary data collection tasks, including:

- Participating retailer contract reviews
- Participating retailer marketing plan reviews and field team verification
- Participating retailer interviews/surveys
- Customer barriers research
- Manufacturer interviews
- RPP Program staff interviews
- Interviews with RPP Program collaborators (e.g., key staff members of SMUD, NEEA and ENERGY STAR staff)
- Sales Force database analysis
- Other program management/implementation data reviews

The following sections outline each of these data collection tasks and describe the specific metrics we propose collecting by each task, along with which RPP Program logic model components and constructs the metrics are intended to operationalize. Though this evaluation plan is targeted at outlining data collection activities proposed for the 2015-2016 RPP Program Trial evaluation, it also incorporates the longer-term, market transformation perspective, by providing recommendations regarding the frequency with which the different performance and market effects metrics might be collected moving beyond 2016. Here, it is important to note that not all metrics developed as part of this evaluation will be used to assess performance or effects for the 2015-2016 Trial. Instead, some will be collected to serve as baselines for longer-term comparisons, which are crucial for assessing the degree to which the program is transforming the market into the future.

It is also worth noting that some components of the logic model and certain constructs appear in multiple tasks. This is intended to support the evaluation of different aspects of the logic model's activities, outputs and outcomes. For example, while we propose assessing the retailer marketing plans in order to catalog and verify the retailers' planned activities for promoting efficient models in targeted product categories through the *Marketing Plan Reviews and Field Team Verification* task (Section 4.3), we also plan to gain additional insights into these plans, how they were developed, and plans for the future through the Retailer Staff Interviews (Section 4.4). Further, because much of the evaluation is aimed at supporting reliable conclusions regarding attribution, some components of the logic model are covered in both the process evaluation and the evaluation to inform savings estimates. Retailer Contract Reviews

Each participating retailer signs a contract with the utility formalizing the retailer and utility's obligations related to participation in the RPP Program. These contracts outline details such as the time frame for which incentives will be paid, the product categories for which incentives will be paid,

the amount of the incentives, access to retailer staff for evaluation purposes, the types and format of data that will be provided by the retailer. Table 4-1 shows the components of the logic model that will be assessed through the retailer contract review, along with the metrics proposed for operationalizing the conceptual constructs and the proposed frequency for analyzing this information. Note that though the *content* of the contracts themselves do not support the proposed evaluation metrics, as part of this task the evaluation team will also review the contracts to determine if any changes or recommendations are warranted to help support more effective program implementation.

Table 4-1: Logic Model Components, Constructs, and Proposed Metrics to be Assessed Through Retailer Contract Review

Logic Model Component	Construct	Proposed Metrics	Proposed Frequency
Output F: PG&E and utility partners determine incentive levels for program-qualified models within each product category, present them to retailers, and sign contracts	Recruited retailers (signed contracts)	Number of signed contracts	Once per contract
Short-Term Outcome K: Increased retailer engagement	Retailer engagement and continued participation	Number of new or extended signed contracts with participating retailers	
Short-Term Outcome L: Additional retailers join program	Expansion of program to new retailers	Number of new signed retailers with additional retailers	

For the 2015-2016 RPP Program evaluation, the evaluation team will review and tally each signed contract as retailers enter or are added to the program. The same frequency is recommended for the longer-term program moving beyond 2016.

4.1 Retailer Marketing Plan Reviews and Field Team Verification

This component of the 2015-2016 RPP Program Trial process evaluation will consist of two distinct but related tasks: (1) retailer marketing plan reviews, and (2) field team verification of marketing activities. Each of these tasks is described below.

Retailer Marketing Plan Reviews

Each participating retailer is expected to develop strategies for marketing and assorting products incented through the program during their period of participation. While these plans are intended to be flexible and can be revised over time in accordance with retailers' operational and business needs, it is expected that they will include clear descriptions of the specific marketing activities that are planned for targeted product categories. Typical marketing plans might include plans for:

- Product assortment changes (e.g., stocking and displaying additional qualified models)
- Product pricing strategies (e.g., reducing prices or price promotions for the most efficient model in a product category)

- Product promotion strategies (e.g., promoting energy efficient models over standard efficiency models)
- Product placement strategies (e.g. devoting "prime" shelf and/or store locations to energy efficient models)
- Staff training (e.g., educating sales associates and managers on the benefits of energy efficiency products)

Retailers do not need to commit to all of these activities, and may actually plan additional activities not mentioned in the list above. Further, the planned activities can, and likely will, vary across different product categories as the retailers see fit. This flexibility is fundamental to the RPP Program concept. That is, the program is intended to allow retailers—those who should know the most about selling products—the flexibility to do whatever they see fit to best promote and sell these products.

As part of the process evaluation, the evaluation team will review the marketing plans and inventory the proposed marketing activities, by retailer, including the type of activity (e.g., sale price, signage, unique placement, etc.) and the expected implementation period. Table 4-2 shows the components of the logic model that will be assessed through the retailer marketing plan reviews, along with the metrics proposed for operationalizing the conceptual constructs.

Table 4-2: Logic Model Components, Constructs, and Proposed Metrics to be Assessed Through Retailer Marketing Plan Reviews

Logic Model Component	Construct	Proposed Metrics	Proposed Frequency
Output G: PG&E and utility partners approve retailer marketing plans, including sales forecasts of program-qualified models within each product category	Retailer Plans	Number of marketing/promotional strategies and tactics	Once upon approval of plan; as needed if plans are updated
		Types of strategies and tactics (e.g., price, promotion, placement)	
		Clearly defined and measurable sales goals for program-qualified models	
Output H: Retailers implement plans employing various strategies and update as necessary	Product	Plans to add additional program-qualified models	
	Price	Size of price discount and frequency and duration of sales promotions for program-qualified models	
	Placement	Placement of program-qualified products	
	Promotion	Amount and placement of in-store and web-based advertising	

For the 2015-2016 RPP Program evaluation, we plan to review each participating retailer's marketing plan upon approval by PG&E. Because the marketing plans are flexible and subject to revision, we will also review any updates to plans. The same frequency is recommended for the longer-term program moving beyond 2016.

Field Team Verification of Marketing Plan Activities

PG&E RPP program staff oversee a field team under contract to PG&E that conducts periodic visits to retail stores participating in the array of various PG&E energy efficiency programs. These visits occur

throughout the year with the exception of peak holiday season (about the second week of November though the end of the year). Most stores for the 2015-2016 RPP Program Trial participating retailers are visited on roughly a monthly basis.

For the 2015-2016 RPP Program Trial process evaluation, we propose that the field team support verification of the implementation of the activities proposed in each of the participating retailers marketing plans. The evaluation team will provide a schedule of expected promotional activities by retailer to the PG&E program staff overseeing the field team to ensure store visits are coordinated with the scheduled marketing activities. This effort will examine the targeted product categories in the stores by photographing and logging the promotions, placement, and pricing of program-qualified models. This information will be provided to PG&E program staff as part of the regularly scheduled monthly reports that will then be forwarded to the evaluation team for review and analysis. These efforts will be ongoing during the duration of the trial period.

4.2 Retailer Staff Interviews/Surveys

Because of the mid-stream focus of the RPP Program design, the retailers play the central, and most important, role. Without retailers willing to participate in the program, the program would not exist. Retailers are also the actors designing and implementing the marketing strategies that are aimed at increasing sales of targeted products. Retailers are also the final conduit to the consumers, who ultimately decide to purchase—or not purchase—energy efficient products. As such, gaining an in-depth understanding of the retailers' perspectives, experiences, and expectations is a significant component of the process evaluation.

As part of the process evaluation of the 2015-2016 RPP Program Trial, the evaluation team proposes conducting two main forms of primary data collection with retailer staff: (1) in-depth interviews with retailer buyers and marketers, and (2) web-based surveys with participating store managers, or the people most familiar with the sales and promotion of RPP Program product categories in the retailers' stores. The following presents the main concepts that will be probed with the different audiences.

The **buyer interviews** will be focused on assessing:

- General awareness and knowledge regarding product energy efficiency
- Knowledge about energy efficiency initiatives underway at the retailer
- Degree of collaboration among departments within the retailer (e.g., buying, marketing, distribution, sales, etc.) regarding energy efficiency initiatives
- Degree of collaboration between the retailer and RPP Program staff and/or the 3rd-party implementer regarding energy efficiency initiatives
- Knowledge about energy efficiency as it relates to the targeted product categories part of the RPP Trial
- Distribution of products purchased (i.e., do any program-qualified products go to non-participating stores outside PG&E's service territory?)
- Awareness of the RPP Program Trial
- Influence of the RPP Program Trial on their purchasing and assortment decisions
- Estimated influence of the RPP Program on sales of targeted products during the program period
- Future plans to purchase and stock energy efficient products

- Experiences and satisfaction with the RPP Program Trial as well as feedback on improvement

The **marketer interviews** will be focused on assessing:

- General awareness and knowledge regarding product energy efficiency
- Knowledge about energy efficiency initiatives underway at the retailer
- Degree of collaboration among departments within the retailer (e.g., buying, marketing, distribution, sales, etc.) regarding energy efficiency initiatives
- Degree of collaboration between the retailer and RPP Program staff and/or the third-party implementer regarding energy efficiency initiatives
- Knowledge about energy efficiency as it relates to the targeted product categories part of the RPP Trial
- Targeted product marketing initiatives (i.e., pricing, placement, and promotion)
- Awareness of the RPP Program Trial
- Influence of the RPP Program Trial on their promotion decisions
- Future plans to promote energy efficient products
- Experiences and satisfaction with the RPP Program Trial as well as feedback on improvement

The **store manager/staff surveys** will be focused on assessing:

- General awareness and knowledge of corporate marketing initiatives
- General awareness and knowledge of product energy efficiency
- Adherence to third-party marketing plans generally, and each retailer's approved RPP marketing plan specifically
- Awareness and knowledge regarding their customers' demands for energy efficient products
- Knowledge about energy efficiency as it relates to the targeted product categories part of the RPP Trial
- Knowledge about corporate marketing initiatives generally, and energy efficiency initiatives specifically, underway at the retailer
- Awareness of the RPP Program Trial
- Corporate communications regarding corporate marketing initiatives generally, and the RPP Program and its implementation specifically, within the retailer's stores
- Possible increase in efficient product sales due to RPP Program Trial
- Staff training and its perceived efficacy in helping bolster sales of targeted products, if included in the retailer's RPP marketing implementation plans

Table 4-3 shows the components of the logic model, the constructs, and proposed metrics that will be assessed through the retailer interviews and surveys, along with the proposed frequency for collecting and analyzing this information.

Table 4-3: Logic Model Components, Constructs, and Proposed Metrics to be Assessed through Retailer Staff Interviews/Surveys (Depending on Elements Contained in Retailer-Generated Marketing Implementation Plans)

Logic Model Component	Construct	Proposed Metrics	Proposed Frequency
Output H: Retailers implement plans employing various strategies and update as necessary	Product	Plans to add additional program-qualified models	Baseline at start of retailer's participation in program; once annual follow-up
	Staff Training	Frequency and length of sales force training	
		Awareness, knowledge and attitudes of store merchants and sales force regarding energy use of targeted products	
Short-Term Outcome L: Increased retailer engagement	Retailer engagement	Self-reported satisfaction with the program	
		Self-reported retailer interest in continued participation in the program	
Mid-Term Outcome O: Increased share of efficient models sold in targeted product categories among *nonparticipating* retailers	Targeted product sales/program-qualified share	Total sales volumes of targeted product categories at the market level	
Long-Term Outcome S: Permanent change in the availability of efficient models in targeted product categories among participating and nonparticipating retailers	Product assortment	Self-reported percent of shelf space allocated by retailers to targeted products	
		Self-reported retailer commitment to maintain and even increase the number of qualified products purchased and displayed	

For the 2015-2016 RPP Program Trial process evaluation, as well as future process evaluations of the RPP Program, we propose conducting two waves of interviews/surveys with retailer staff: (1) at the beginning of each retailer's participation in the program in order to derive baselines, and (2) a follow-up towards the end of the trial period (or annually for retailers continuing participation) to re-assess the issues and facilitate the evaluation of change.

To help manage evaluation costs, we propose conducting telephone-based in-depth interviews with the buyers and marketers and web-based surveys with the participating store managers. In-depth interviews are ideal for the research with buyers and marketers. Even though in-depth interviews are more costly, they allow for a flexible, adaptive discussion between the interviewer and interviewee, allowing the researcher to probe emergent topics and ask for greater clarification as needed. However, there will be a much larger number of store managers, and we feel web-based surveys are more appropriate for this population, in order to help reduce overall evaluation costs, as well as minimize the time and burden on the store managers – a concern emphasized by corporate staff of the retailer that participated in the 2013-2014 RPP Program Trial. Because each participating retailer will develop its own marketing implementation plans, the content of the interviews will be tailored separately for each participating retailer to the extent necessary.

We plan to conduct roughly 32 in-depth interviews with retailer staff over the course of this evaluation, consisting of 4 interviews per retailer per retailer per wave. We expect the 4 interviews

per retailer per wave will consist of: 1 home appliance buyer, 1 home appliance marketer, 1 consumer electronics buyer, and 1 consumer electronics marketer. The evaluation team will coordinate with retailer corporate staff as needed to facilitate these interviews and minimize the burden and inconvenience to the retailers. Four separate interview guides will be developed and vetted through the project team and retailer corporate staff prior to scheduling and conducting the interviews: (1) baseline buyer guide, (2) baseline marketer guide, (3) follow-up buyer guide, and (4) follow-up marketer guide.

We also propose programming and distributing web-based surveys to all participating store managers or department heads across the four participating retailers both at baseline and follow-up. We expect roughly 214 total participating stores in the PG&E service territory across the four retailers, but realistically do not expect that all store managers will respond to the surveys. Thus, we feel an attempted census will maximize the amount of useful information we will be able to collect from this population. Table 4-4 shows the targeted number of total completed surveys by retailer, and the response rate that will need to be obtained to reach these goals.[32] Since this survey will be web-based and can be distributed and analyzed very efficiently, an attempted census will do little to increase the costs associated with task above what they would be for a sample, and will help facilitate attaining these response rates.

Table 4-4: Total Number of Targeted Survey Completes and Response Rates for Retailer Store Manager Surveys, by Retailer

Retailer	Number of Stores	Targeted Number of Completes	Target Response Rate
Home Depot	98	49	50%
Best Buy	42	21	50%
Kmart	37	19	51%
Sears	37	19	51%
TOTAL	**214**	**108**	**51%**

The baseline and follow-up survey instruments will be developed by the evaluation team and vetted with the project team and retailer corporate staff before programming and distribution. The surveys will be programmed, distributed, and collected using the survey software program Qualtrics™, a robust package that integrates all aspects of web-based survey development, distribution, collection, and analysis.

4.3 Customer Barriers Research

Depending on the strategies retailers choose to pursue, one short-term outcome of the program may be an increase in awareness, knowledge, attitude, and behavior (AKA-B) of the participating retailer's customers in regards to more energy efficient products (either specifically ENERGY STAR products, or plug load in general). This will likely be the case if retailers pursue program strategies that explicitly target customer AKA-B. Examples of these strategies include increased promotion of

[32] Confidence and precision are not applicable since a census of all 128 store managers will be attempted.

energy efficient products, sales staff education, and general customer education about the benefits of energy efficiency. However, retailers are not *required* to implement program strategies that explicitly target customer AKA-B. Retailers may choose to instead focus on "behind the scenes" strategies such as changes in product assortment or product price reductions, which will reduce the information/search barrier for customers, and reduce the time it takes for customers to find energy efficient products.

While over the mid- to longer-term it is expected that the RPP Program may reduce customer barriers to purchasing more efficient products by altering peoples' AKA-B with regards to ENERGY STAR products and plug load energy consumption in general, this is not the current focus of the RPP Program. Also, the incremental effect of the program on AKA-B would be difficult to detect in the general population until large-scale strategies aimed specifically at AKA-B are integrated into the program. That said an immediate focus of the program *is* on altering customer purchasing decisions by affecting the availability and promotion of more efficient products.

Table 4-5 shows the components of the logic model, constructs, and proposed metrics that operationalize the metrics that will be used to assess customer market barriers.

Table 4-5: Logic Model Components, Constructs, and Proposed Metrics Used to Assess Customer Market Barriers

Logic Model Component	Construct	Proposed Metrics	Proposed Frequency
Short-Term Outcome I: Reduction in customer market barriers	Increased availability of energy-efficient products)	Proportion of models program-qualified in participating stores	Baseline at start of program; follow-up at end of Trial
	Awareness, knowledge and attitudes of store customers regarding ENERGY STAR and energy use of targeted products	ENERGY STAR AKA-B	Annually [a]
	Awareness, knowledge and attitudes of store customers regarding residential plug load	Plug Load AKA-B	

[a] Note that though the EM&V team proposes conducting annual data collection to assess AKA-B, customer data collection is not being proposed as part of this Trial.

However, since affecting AKA-B is not a *current* focus of the program, as part of the 2015-2016 RPP Program Trial evaluation we propose examining only the first item listed in Table 4-5. We propose assessing the issue of product availability at the start of the program in mid-2015, and then again near the end of the trial period in order to determine if there is evidence of change. We propose that same cadence moving ahead for future year evaluations. The data used to assess the proposed metric will be the participating retailer program sales data.

If the program begins to incorporate a stronger focus on affecting customer AKA-B in terms of ENERGY STAR products or plug load, we recommend incorporating a data collection effort with

customers – likely a general population survey – to assess awareness, knowledge, attitudes, and behaviors. The recommended cadence for this effort would be annually.

4.4 Manufacturer Interviews

Though the effects are expected in the longer-term, changes in targeted product manufacturing play a key role in the RPP Program theory, especially in terms of market transformation. Market signals reflecting the success of participating retailers and their increased engagement in the program may direct non-participating retailers (inside and/or outside the PG&E service territory), to either join the program, or simply adopt similar marketing strategies or assortment changes (even though they would not receive any incentives), to ensure they remain competitive in terms of promoting and stocking the same energy efficient models as participants. These outcomes are expected to lead to increased share of efficient models in targeted product categories both among participating retailers as well as non-participating retailers. Ultimately, these forces, combined with the pressures brought upon by the RPP Program to support more stringent mandatory and voluntary standards, are expected to increase the demand for more efficient models. In response, manufacturers are expected to shift production to these more efficient models. Over time, this will result in a permanent change in the availability of more energy efficient products in the marketplace, eventually leading to long-term energy and demand savings as well as environmental and other non-energy benefits. Of course, these are not short-term effects, but rather they are mid- to longer-term effects that will emerge over time.

Given the above, the evaluation team proposes conducting in-depth interviews with select manufacturers to establish baselines and probe issues, such as:

- Historical and current retailer purchasing trends
- Retailer buying practices
    - Do retailers specifically request efficient products?
    - What kind of pressure, if any, does this put on production or research and development?
- Manufacturer focus on energy efficiency research and development
- The influence of mandatory and voluntary standards on manufacturer production
- Forecasts for production of energy efficient products over the next few years
- The structure of the manufactures competitive marketplace (e.g., are there new entrants offering new efficient products? what do they think this will look like in the near future?, etc.)

The evaluation team will conduct screening to ensure we speak with manufacturer representatives that are most informed and able to provide insightful responses the questions. It is likely we may need to speak with more than one representative from the contacted manufacturers, as specific individuals may not have knowledge or insights to answer questions in all the topical areas.

Table 4-6 shows the components of the logic model, the conceptual constructs, and the metrics the evaluation proposes for operationalizing these constructs, along with the proposed frequency of data collection and analysis. It is worth noting that all of the data collected with respect to the proposed metrics shown in the table will not support the evaluation of the 2015-2016 RPP evaluation, but we propose that they also continue to be collected to track the transformation of the

marketplace over time. As such, we propose the results we derive serve as baselines against which any future progress can be measured.

Table 4-6: Logic Model Components, Constructs, and Proposed Metrics to be Assessed Through Manufacturer Interviews

Logic Model Component	Construct	Proposed Metrics	Proposed Frequency
Long-Term Outcome Q: Increased demand experienced by manufacturers for more efficient models in targeted product categories	Manufacturer efficient product demand	Manufacturer self-reported changes in demand	Annually
Long-Term Outcome R: Manufacturers increase production of the efficient models in targeted product categories	Manufacturer efficient product supply	Manufacturer self-reported efforts to retool and shift production	
		Number of new entrants to the market	

Table 4-7 shows the estimated number of manufacturers for the product categories included in the 2015-2016 RPP Program Trial. Each manufacturer may produce several brands of products. For example, Electrolux products are sold under both the Electrolux and Frigidaire brands. Certain manufacturers (and brands) hold the dominant market share within certain product categories. For example, the freezer market is dominated by Electrolux, which holds almost two-thirds of the total market share, and only has two real competitors.[33]

Table 4-7: 2015-2016 RPP Program Trial Targeted Product Category Manufacturers

Product Category	Number of Manufacturers
Air Cleaners	11
Freezers	9
Home Theaters-in-a-box and Soundbars [a]	22
Electric Clothes Dryers	TBD

[a] Note that most manufacturers of HTIBs and soundbars are the same manufacturers.

[33] Peters, Jane S., Marti Frank, April Armstrong, Alexander Dunn, Rob Bordner, A. J. Howard, Zach Baron, and Stephen Parry. 2012. *Program & Technology Review of Two Residential Product Programs: Home Energy Efficiency Rebate (HEER)/Business & Consumer Electronics (BCE)*. Prepared for the Pacific Gas & Electric Company and the Southern California Edison.

As part of the 2015-2016 RPP Program Trial process evaluation, the evaluation team proposes conducting roughly 12 in-depth interviews with representatives of manufacturers of targeted product categories. We propose conducting about three interviews for each of the product categories shown in Table 4-7 (note that we will consolidate the home theaters-in-a-box and soundbar interviews, as these are predominantly the same manufacturers). As part of this effort, the evaluation team select a convenience sample of manufacturers that are the dominant players for each of the product categories, and target our interviews on these manufacturers, since these manufacturers likely have the most comprehensive and detailed view of the marketplace, but also will the manufacturers that most likely will be driving innovation and change in their respective markets in the near future.

The evaluation team will develop interview guides that we will vet with the project team before conducting these interviews. For the purposes of the 2015-2016 RPP evaluation, we propose conducting these interviews once. For future evaluations, we recommend conducting these interviews on an annual basis to be able to gauge change and update the market effects metrics.

4.5 RPP Program Staff Interviews

In-depth interviews will also be conducted with relevant utility staff including implementers. These interviews will focus primarily on the operational aspects of the RPP Program and include topics such as:

- Lessons learned about the development and implementation of the program (e.g., what has worked, what has not? what have been the greatest hurdles? what have been the greatest successes?)
- Recommendations for change and improvement of the program
- Administrative processes and protocols – Are they appropriate and scalable?
- Frequency and effectiveness of the communication between the utility, implementers, and retailer
- Identify information that needs to be tracked by the RPP Program Trial
- The level of effort for all program activities illustrated in the logic model
- The level of satisfaction with the quantity and quality of the outputs illustrated in the logic model

The evaluation team will develop interview guides that will be used for conducting these interviews. For the purposes of the 2015-2016 RPP evaluation, we propose conducting these interviews once. For future evaluations, we recommend conducting these interviews on an annual basis to be able to gauge change and update the market effects metrics.

4.6 Interviews with RPP Program Collaborators

As part of the implementation of the RPP Program, program staff and the implementation team network with an array of different organizations, such as staff from other utilities, regional utility partners (e.g., Northwest Energy Efficiency Alliance), and ENERGY STAR staff. These interactions are targeted at topics such disseminating information and raising awareness about the RPP Program, recruitment of utility partners, collaboration on program design and delivery, decision-making

regarding what products to target, and participation in discussions on voluntary (e.g., ENERGY STAR) and mandatory standards (e.g., Codes & Standards).

The evaluation team proposes conducting in-depth interviews with representatives of these utility partners to assess and validate key components of the logic model. Table 4-8 shows the components of the logic model, the constructs, and proposed metrics that will be assessed through the program collaborator interviews, along with the proposed frequency for collecting and analyzing this information.

Table 4-8: Logic Model Components, Constructs, and Proposed Metrics to be Assessed Through Program Collaborator Interviews

Logic Model Component	Construct	Proposed Metrics	Proposed Frequency
Activity B: PG&E contacts utility partners regarding collaboration in Program delivery	Inter-partner communications and interactions	Number and type of interaction (e.g., emails, phone calls, meetings) by utility partner (e.g., ENERGY STAR staff, other utility staff, codes & standards program staff, etc.)	Bi-Annually
Activity U: PG&E and utility partners participate in meetings with and provide market data to staff of ENERGY STAR and Codes & Standards Programs regarding targeted product categories	IOU/utility partner and ENERGY STAR/C&S Program collaboration	Counts of interactions with ENERGY STAR and Codes & Standards Programs (e.g., emails, phone calls, meetings)	
		Types and amounts of data provided	
		Types of support provided to ENERGY STAR and Codes & Standards Programs (e.g., meeting participation, public comments)	
Output C: Utility partners recruited	Regional inter-partner collaboration (network analysis)	Number, type and frequency of communications/interactions, level of collaboration	
Output V: PG&E and utility partners provide input on proposed energy efficient model specifications to staff of ENERGY STAR and Codes & Standards Programs	Meeting participation	Number of meetings attended	
		Topics discussed	
Mid-Term Outcome W: In the mid-term and/or long-term, more stringent mandatory and voluntary standards are adopted	Codes & Standards	New standards planned and/or adopted	

We propose conducting up to 20 interviews with utility partners (about 10 at the start of the program; 10 more towards the end of the Trial). The evaluation team will develop interview guides that we will vet with the project team before conducting these interviews. For future evaluations, we recommend conducting these interviews on a bi-annual basis to not only gauge the proposed metrics, but to also allow for timely feedback to program staff and the implementation team.

4.7 Sales Force Data Analysis

Sales Force is a database platform that supports logging, storing, categorizing, and reporting an array of qualitative and quantitative information. Key communications and interactions between the implementation team and PG&E, other utilities, utility partners, and other stakeholders (e.g., ENERGY STAR, Codes & Standards program staff, retailers, product manufactures, etc.), including emails and notes from phone calls and meeting agendas and minutes, will be logged and tracked by the implementation team in a Sales Force database on a regular basis. The evaluation team will systematically code, classify, and summarize this qualitative and quantitative information in a manner aimed at describing the communications and interactions and their frequency. The objective is to better understand the frequency, flow, and content of communications and validate key components of the program logic model. Table 4-9 shows the components of the logic model that will be assessed through analysis of the Sales Force data along with the metrics proposed for operationalizing the conceptual constructs and the proposed frequency of which the information should be reviewed.

Table 4-9: Logic Model Components, Constructs, and Proposed Metrics to be Assessed Through Sales Force Data Analyses

Logic Model Component	Construct	Proposed Metrics	Proposed Frequency
Activity B: PG&E contacts utility partners regarding collaboration in Program delivery	Inter-partner communications and interactions	Number and type of interaction (e.g., emails, phone calls, meetings) by utility partner (e.g., ENERGY STAR staff, other utility staff, codes & standards program staff, etc.)	Bi-Annually
Activity U: PG&E and utility partners participate in meetings with and provide market data to staff of ENERGY STAR and Codes & Standards Programs regarding targeted product categories	IOU/utility partner and ENERGY STAR/C&S Program collaboration	Counts of interactions with ENERGY STAR and Codes & Standards Programs (e.g., emails, phone calls, meetings)	
		Types and amounts of data provided	
		Types of support provided to ENERGY STAR and Codes & Standards Programs (e.g., meeting participation, public comments)	
Output C: Utility partners recruited	Regional inter-partner collaboration (network analysis)	Number, type and frequency of communications/interactions, level of collaboration	
Output V: PG&E and utility partners provide input on proposed energy efficient model specifications to staff of ENERGY STAR and Codes & Standards Programs	Meeting participation	Number of meetings attended	
		Topics discussed	
Mid-Term Outcome W: In the mid-term and/or long-term, more stringent mandatory and voluntary standards are adopted	Codes & Standards	New standards planned and/or adopted	

For the 2015-2016 RPP Program Trial evaluation, we propose analyzing the Sales Force data twice: once about halfway through the trial period to assess progress and provide any appropriate input for altering or improving processes, and again near the end of the trial to ensure we capture activities during the full program period. A summary of the mid-term findings and recommendations will be incorporated into the Mid-Study Progress Report; the findings and recommendations from the second wave of analyses will be included in the final evaluation report.

Over the longer term, beyond the 2015-2016 Trial, we recommend that the Sales Force data continue to be analyzed bi-annually (roughly every six months) in order to gauge progress with these activities, outputs, and outcomes as well as inform needed mid-course changes.

4.8 Other Program Management/Implementation Data Reviews

PG&E RPP Program staff and the third-party implementation team also collect and track an array of other information that will be reviewed by the evaluation team as part of the 2015-2016 RPP Program

Trial process evaluation. This information will be used to assess and validate several components of the logic model, as well as provide the evaluation team with the ability to provide early feedback and recommendations that can support mid-course corrections to improve program design and implementation. The source of this information will be interviews with and documents provided by PG&E program staff, third-party implementation staff, and RPP Program collaborators. Information regarding these concepts will also be extracted from the Sales Force Database.

Table 4-10 shows the components of the logic model that will be assessed through the review of program management/implementation data, along with the metrics proposed for operationalizing the conceptual constructs.

Table 4-10: Logic Model Components, Constructs, and Proposed Metrics to be Assessed Through Other Program/Implementation Data Reviews

Logic Model Component	Construct	Proposed Metrics	Proposed Frequency
Activity A: PG&E characterizes markets and estimate savings potential for candidate product	Energy savings potential	Estimated sales volumes, estimated market shares and potential	As needed
Activity D: PG&E and utility partners determine which retailers to recruit	Potential retailers	Number of retailers identified Types of retailers identified	Annually
Activity E: PG&E, utility partners, and identified retailers target product categories with energy savings potential	Targeted product categories	Identified product categories Number of targeted product categories	
Activity U: PG&E and utility partners participate in meetings with and provide market data to staff of ENERGY STAR and Codes & Standards Programs regarding targeted product categories	IOU/utility partner and ENERGY STAR/C&S Program collaboration	Types of support provided to ENERGY STAR and Codes & Standards Programs (e.g., meeting participation, public comments)	Annually
Output C: Utility partners recruited	Recruited utility partners	Number of utility partners recruited Type of utility partner (e.g., utility, agency) Reach (e.g., number of customers served, geographic extent)	As each new retailer is recruited
Output F: PG&E and utility partners determine incentive levels for program-qualified models within each product category, present them to retailers, and sign contracts	Recruited retailers	Types of retailers Reach (e.g., annual number of customers, number of outlets, number of targeted product categories sold, sales volume of targeted product categories) Energy savings potential (e.g., estimated sales volumes, estimated UES values)	
Output V: PG&E and utility partners provide input on proposed energy efficient model specifications to staff of ENERGY STAR and Codes & Standards Programs	Meeting participation	Number of meetings attended Topics discussed	Annually
Short-Term Outcome K: Retailers receive incentives from PG&E and utility partners	Incentives	Total incentive amounts paid by PG&E and/or utility partners by targeted product category by retailer	Tracked monthly by PG&E; to be reported twice annually as part of the evaluation
Mid-Term Outcome W: In the mid-term and/or long-term, more stringent mandatory and voluntary standards are adopted	Codes & Standards	New standards planned and/or adopted	Annually

As shown in Table 4-10, different metrics and information will be tracked and analyzed over different time frames. Efforts to explore and characterize the market to ensure an understanding of market potential and what products may be targeted will be assessed as needed based on when and with what frequency these analyses are conducted. PG&E interactions with potential participating

retailers and actions centered on recruitment will be reviewed once during the Trial (i.e., annually), or as new retailers are recruited. Interactions with standards-setting organizations and/or stakeholders (e.g., codes & standards program managers, ENERGY STAR, etc.) will also be evaluated once during the trial (i.e., annually). Finally, the evaluation team will review the incentive payment process and the amount of incentives paid to retailers twice during the trial: once to support the Mid-Study Progress Report, and again at the end of the trial. In general, we recommend similar frequencies for future evaluations, with a focus on assessing issues related to new program participants as they enter the program, and continued tracking and assessment on an annual basis.

5. EVALUATION TO INFORM SAVINGS CLAIMS

Since the primary performance objectives of the RPP Program are to increase sales of energy efficient products that will in turn affect net reductions in energy consumption for targeted product categories, the 2015-2016 RPP Program evaluation includes an evaluation to inform savings claims,[34] which will be aimed at accurately measuring:

- Total program-qualified unit sales for participating retailers, by retailer and product category/subcategory
- Program-qualified share (PQS), or the percentage of total unit sales that are program-qualified by retailer and product category/subcategory
- Gross program energy and demand savings
- Net program energy and demand savings

However, it is important to emphasize that the evaluation to inform savings estimates is complicated by the fact that it is a market transformation program.

During the first year that a retailer participates in the RPP Program, the main impacts on metrics such as the proportion of qualified units sold (i.e., qualified units sold divided by total units sold for a targeted product category) are likely to be relatively small. Retail buying cycles vary from product category to product category but typically involve several months lag time. That is, the purchasing decisions affecting the product assortment that is on the sales floor today were made several months earlier. Thus, a retailer that begins participating in the program in, say, August of 2015 will have already purchased their inventory several months earlier and will have limited ability to affect the product assortment in the short term. Thus, the main effects of the program in the first year will likely be limited to marketing strategies such price reductions, improved placement, and increased promotion. However, it is important to note that while retailers may make good-faith efforts to sell more program-qualified models—and may succeed very well in doing so—they are still profit-oriented businesses and will be promoting and selling non-qualified models as well. Thus, though they may sell more program-qualified units in a targeted product category in a given month due to program-related marketing efforts, they may also sell increased numbers of non-qualified models through other marketing efforts. Hence, metrics such as the proportion of qualified units sold will be relatively volatile over the short term and likely not powerful metrics of program impacts in the first year. However, substantive improvements are expected once retailers have an opportunity to begin to fully recognize the benefits of participating in the program and more aggressively alter their product assortment (likely after the initial year or two of participation). Once they have a greater proportion of program-qualified models on the sales floor (at the expense of less-efficient models), metrics are expected to begin to reveal more substantial program impacts.

[34] Note that this is not an impact evaluation *per se*, as the CPUC-ED will lead any official impact evaluation of the RPP Program. The "evaluation to inform savings" discussed herein is intended to serve as an early M&V effort aimed at assessing and informing savings estimation and attribution prior to any actual ED-led impact evaluations.

5.1 A Note on the Influence of Specifications and Codes and Standards

Voluntary specifications (i.e., ENERGY STAR specifications) as well as mandatory efficiency standards (i.e., federal or state codes and standards) play a part in the RPP Program. Not only do ENERGY STAR specifications help to define the incented models within targeted product categories, but for product categories that have them, codes and standards serve as baselines for estimating unit energy savings. Additionally, because of the influence that the RPP Program is expected to have on accelerating adoption of new voluntary specifications and mandatory codes and standards, some of the energy savings associated with these shifting specifications/standards will likely be attributable to the program. However, the evaluation of shifting codes and standards is a costly and complicated endeavor beyond the scope of this evaluation plan. If codes and standards for any of the RPP Program products do change, it is expected that a parallel evaluation effort aimed at assessing the impacts of these changes on unit energy consumption and savings will be needed – likely led by the CPUC-ED.

5.2 Savings Claim Estimation Data

Retailer Sales Data

As part of the contractual agreement between the participating retailer's and the utility, the retailer's agree to provide two main forms of data, including: (1) historical sales data, and (2) program-period sales data.

For all incented product categories, each participating retailer will provide *historical sales data* at a minimum covering the 12-month period immediately preceding their first month of participation in the RPP Program. Additionally, each participating retailer will also provide ongoing *program-period sales data* for the duration of their participation in the program. These data files will include all models sold within each targeted product category *regardless of whether it is an incented model or not*. At a minimum, the historical and program-period data files will include:[35]

- Model number
- Total monthly units sales
- Store ID

Each model appearing in the data will be coded as qualified or non-qualified based on the relevant qualifying efficiency specification that defines payment of incentives and is in effect at the start of the retailer's participation in the program (i.e., the ENERGY STAR qualified products list). Also, unit energy consumption (UEC) and, for qualified models, unit energy savings (UES) estimates will be assigned to each unit appearing in the sales data based on the methods described in the white paper, *Calculation Methodology for Unit Energy Consumption (UEC) and Unit Energy Savings (UES) for*

[35] It is worth emphasizing that if the participating retailers do not provide the historical and program-period sales data in the form discussed, the ability to evaluate the program using the methods presented herein will be compromised, and different approaches may be needed.

the Retail Plug-Load Portfolio (RPP) Program.[36]However, it is worth noting that the *Calculation Methodology* document focuses on methods for estimating *ex ante* UES values. From an *ex post* evaluation perspective, we will also assess the models sold to determine if any models meet more stringent specifications and use far less energy than the standard ENERGY STAR specification (i.e., meet or exceed the ENERGY STAR Most Efficient specification) and assign UEC values and estimate UES values for these models as needed.

Additional Data

Additional data will be needed to estimate mid- to long-term program impacts at the market level. The primary metric that will need to be tracked over time is program-qualified (i.e., energy efficient) market shares within the targeted product categories at the market level. For a given product, *market share* is defined as the percent of all models sold in a given year that meet or exceed the Tier I specification as it was defined in 2015 when the program launched. While program-qualified share for participating retailers can be reliably calculated based on the retailer sales data that was discussed above, getting reliable and accurate estimates of the program-qualified share *at the market level*—in order to assess the impacts the program may be having on the broader market and to help establish robust baselines—is more challenging.

The program and evaluation teams still are assessing what data are available and a final determination has not yet been made in terms of which data most accurately reflects market conditions at a level that can be effectively used to draw inferences of RPP Program impacts. Several data sources are being assessed to determine its usefulness and cost including: (1) Syndicated data purchased from The NPD Group, (2) *Appliance Magazine* market research reports, and (3) Association of Home Appliance Manufacturers (AHAM), and (4) Consumer Electronics Association (CEA). Data issues we are probing are:

- What level of disaggregation can we get data (i.e., model-level)?
- What service territory, state, regional, and/or national level of data is available?
- Can we request custom conditions for estimating energy efficient market share (i.e., will we be able to assess market share based on the ENRGY STAR specifications that were in effect in 2105 for all years moving forward)?
- At what type of frequency can we expect to get data?
- What would be the cost of the data?

Once we have greater clarity around these issues, the evaluation team will draft a brief memo and/or conduct a brief presentation with CPUC-ED staff and consultants to discuss the options and come to consensus on the best option for moving forward.

[36] Malinick, T., A. Salazar, T. Kisch, and R. Ridge. *Calculation Methodology for Unit Energy Consumption (UEC) and Unit Energy Savings (UES) for the Retail Plug-Load Portfolio (RPP) Program.* A white paper prepared for Pacific Gas and Electric Company, Engineering Services. January 30, 2015.

5.3 Product Sub-Categorization

In order to facilitate fair comparisons and derive meaningful energy consumption and savings estimates, each of the five broad RPP targeted product categories will be divided into subcategories. Within a product category, different features, characteristics, and/or sizes can affect energy consumption—and ultimately energy savings estimates—across models. For example, for air cleaners, models with a higher clean air delivery rate (CADR) use more energy than models with lower CADRs. Likewise, different sizes and form of freezers (e.g., chest versus upright) drive very different amounts of energy consumption and energy savings. Table 5-1 shows the product sub-categorization scheme for the products included in the 2015-2016 RPP Program Trial. Note that the Database for Energy Efficient Resources (DEER) classes will be used for targeted products that appear in DEER, which for the 2015-2016 Trial only includes freezers.

Table 5-1: RPP Program Trial Product Subcategories

Product	RPP Product Subcategories
Air Cleaners	1. <100 CADR 2. >=100 CADR
Home Theaters-in-a-Box (HTIBs)	1. HTIB 2. HTIB w/ Standard DVD 3. HTIB w/ Blu-Ray
Soundbars	Any sub-categorization for soundbars is yet-to-be-determined and will be based on the models in the participating retailers' assortment
Freezers	12 DEER classes
Electric Clothes Dryers	1. Vented, Standard (>= 4.4 ft^3 capacity) 2. Vented, Compact, (120V) (<4.4 ft^3 capacity) 3. Vented, Compact, (240V) (<4.4 ft^3 capacity) 4. Ventless, Compact (240V) (<4.4 ft^3 capacity)

5.4 Savings Estimation Metrics

An array of data will be collected, tracked, and analyzed as part of this evaluation effort. In accordance with the theory-driven evaluation paradigm, significant effort will be allocated to assessing the activities, outputs, and outcomes as denoted in the program logic model to validate program operations in support of estimating impacts and attribution.

Due to the extended timeframe associated with being a market transformation program, some metrics will be developed and analyzed to assess short-term effects (i.e., one or two years); other metrics will be developed to serve as mid-term (three to six years) and long-term (seven to ten years) baselines.

In accordance with recent efforts in California to build a policy framework for market transformation programs in the state, various metrics developed and collected in conjunction with these evaluation efforts—especially some of the mid- to long-term metrics—are meant to serve as indicators of market effects and market transformation. The final determinations regarding the appropriateness and applicability of these proposed market effects/market transformation indicators—as well as what entity or entities will be responsible for collecting and reporting these metrics in the future—

need to be made in collaboration with the CPUC. PG&E and the evaluation team look forward to the opportunity to collaborate with the CPUC staff and its consultants in examining these issues further in the coming months.

Table 5-2: Logic Model Components, Constructs, and Proposed Metrics to be Assessed Through the Evaluation to Support Savings Claims

Logic Model Component	Construct	Proposed Metrics	Data Source	Proposed Frequency
Short-Term Outcome J: Increased sales of energy efficient models within targeted product categories	Targeted product sales	Total sales volumes of targeted product categories by participating retailer	Participating retailer sales data	Baseline at start of program *for each participating retailer*; annually thereafter
Mid-Term Outcome N: Increased share of efficient models sold in targeted product categories among *participating* retailers	Program-qualified share	Percent of targeted product sales that are program-qualified (i.e., program-qualified share) by participating retailer	Participating retailer sales data	
Mid-Term Outcome O: Increased share of efficient models sold in targeted product categories among *nonparticipating* retailers	Targeted product sales/program-qualified share	Total sales volumes of targeted product categories at the market level	Secondary market data	Baseline at start of program; annually thereafter
		Program-qualified share at the market level	Secondary market data	
Short-, Mid-, and Long-Term Outcome P: Energy and demand savings and other environmental and non-energy impacts	kWh, kW (and potentially therm) impacts	Gross savings; net savings	Retailer sales data; Secondary market data; process evaluation results	Annually
	Sales of energy efficient products	Total sales volumes of targeted product categories at the market level	Secondary market data	Baseline at start of program; annually thereafter
	Market share	Program-qualified share at the market level	Secondary market data	
	Emissions benefits (tons of CO_2 valued at market price)	Program-qualified share at the market level	Secondary market data	
Long-Term Outcome T: Increase in market share of efficient models in targeted product categories	Shares of shipments within targeted technologies that are energy efficient	Percent of targeted product shipments/sales that are program-qualified	Secondary market data	

This section introduces some of the quantitative impact metrics that the evaluation team will be deriving and analyzing as part of the 2015-2016 RPP Program Trial savings estimation evaluation. These metrics will be used to validate and quantify an array of logic model components, as shown in Table 5-2, as well as estimate program energy and demand impacts.

Program-Qualified Share (PQS)

In addition to total units sales volumes, as part of the evaluation to assess savings claims for the RPP Program, the evaluation team will compute and track the *program qualified share (PQS),* or the proportion of total unit sales volumes within targeted product subcategories (p), over a specific time period (t), that are program-qualified, as shown in Equation 1:

$$PQS_{p,t} = Total\ Qualified\ Units\ Sold_{p,t}\ /\ Total\ Units\ Sold_{p,t} \qquad (1)$$

The PQS will be computed and tracked for individual participating retailers as a means of assessing short- to mid-term program effects, but will also be assessed at the market level over the longer-term to assess the market-transformative aspect of the program. In general, the expectation is that the retailer-specific PQS values will increase over time as the participating retailers increase sales of energy efficient models at the expense of less efficient models. Aggregate, market level effects should become evident over the longer term as the array of participating retailers (and potentially non-participating retailers) begin to not only promote program-qualified units, but also alter their stocking behaviors to carry a larger proportion of energy efficient models.

Notably, and as discussed elsewhere in this plan, the evaluation team does not expect substantial changes in the PQS in the short-term (initial year or two of participation). Retail seasonal buying patterns mean that in the first year of participation, retailers will likely have already made the stocking decisions. Thus, the first-year effects will likely be limited, and only result from promotional activities, which will be relatively smaller than the effects expected from assortment changes.

Total Sales Volumes of Targeted Product Categories

As part of the RPP Program evaluation to assess savings claims, the evaluation team will track the total sales volumes of models sold within targeted product categories for participating retailers. Regardless of the specific actions they implement to do so, the ultimate goal of the RPP Program is to motivate retailers to sell a greater quantity of more efficient products. Sales volumes will be the metric most sensitive to detecting any potential changes, and can be analyzed at the program, retailer, store, product category, or even model levels, depending on what research questions are being probed.

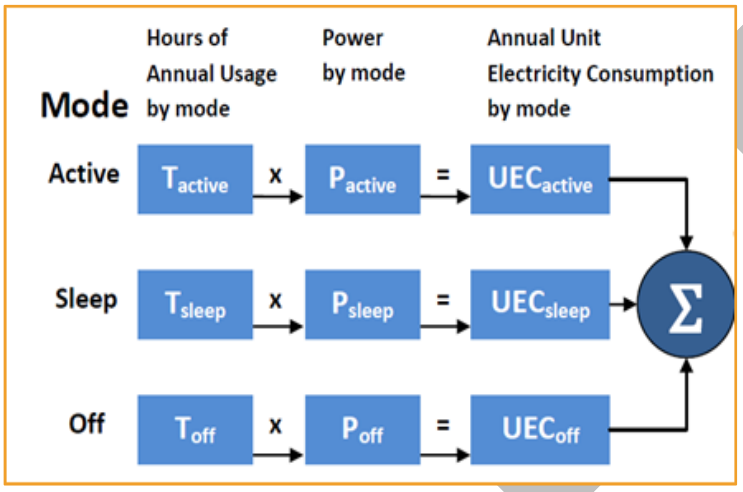
Unit Energy Consumption (UEC)

Unit energy consumption (UEC) is the average estimated annual electricity usage, in kilowatt-hours (kWh), for a specific product or device. Figure 5-1 shows the generalized method for computing UEC estimates. The estimate for annual hours of usage is multiplied by the measured power (in Watts) to derive the estimate for annual UEC in each of a device's operating modes. The UEC estimates for each mode are then summed to arrive at the estimate for total device UEC.[37,38] For products with a

[37] Roth, K. & K. McKenney. 2007. *Energy Consumption by Consumer Electronics in U.S. Residences*. Final Report to the Consumer Electronics Association (CEA) by TIAX, LLC. Retrieved from: http://www.ce.org/CorporateSite/media/Government-Media/Green/Energy-Consumption-by-Consumer-Electronics-in-U-S-Residences.pdf

single operating mode, the estimate for total UEC is simply the annual hours of usage multiplied by the device's power draw.

Figure 5-1: Generalized Unit Energy Consumption (UEC) Estimation Methodology



Unit Energy Savings (UES)

Though some details vary with regards to the final computation of UES estimates depending on the availability of data and the approach taken,[39] the basic premise is that the *unit energy savings (UES)*, in kilowatt-hours (kWh), for an energy efficient model within a particular subcategory (p) for a particular period of time (t) is the difference between the average UEC for the non-qualified models and the average UEC for qualified models. This calculation is shown in Equation 2:

$$UES_{p,t} = UEC_{Non-Qualified_{p,t}} - UEC_{Qualified_{p,t}} \quad (2)$$

Note that the time period (t) is incorporated to account for the fact that the UECs will change over time as either the retailers' product assortments change or the other sources of data (e.g., DEER) are updated. As a result, UES estimates will need to be recomputed periodically. We recommend that they be computed at the beginning of the Trial period based on the historical sales data that will be provided by the participating retailers, and held constant for a one-year period.

Also, as discussed earlier, we will also assess the models sold to determine if any models meet more stringent specifications and use far less energy than the standard ENERGY STAR specification (i.e., meet or exceed the ENERGY STAR Most Efficient specification) and assign UEC values and estimate UES values for these models as needed.

[38] In the example shown, active mode also includes when a product is no longer being used but remains in a high-powered state, often referred to as idle mode.

[39] For a complete description of details, see: Malinick, T., A. Salazar, T. Kisch, and R. Ridge. *Calculation Methodology for Unit Energy Consumption (UEC) and Unit Energy Savings (UES) for the Retail Plug-Load Portfolio (RPP) Program.* A white paper prepared for Pacific Gas and Electric Company, Engineering Services. February 6, 2015..

Ex Ante Gross Program Energy Savings

Ex ante gross program energy savings are derived by multiplying the UES, in kilowatt-hours (kWh), for a product subcategory (p) and time period (t) by the total number of units sold (Q) for that product subcategory and time period and then summing across all subcategories across all products, as shown in Equation 3.

$$Ex\ Ante\ Gross\ Program\ Energy\ Savings = \sum(UES_{p,t} \times Q_{p,t}) \quad (3)$$

Unit Demand Reduction (UDR)

In addition to energy savings, the RPP Program will also result in demand reductions that will be claimed by the IOUs. In order to estimate *unit demand reduction (UDR)*, peak coincident factors (CF) will be derived for each product subcategory (p) as well as the average kilowatt (kW) demand for non-qualified models and the average kilowatt (kW) demand for qualified models for the product subcategory for a specific time period (t). This calculation is shown in Equation 4.

$$UDR_{p,t} = (CF_p\ x\ kW_{Non-Qualified_{p,t}}) - (CF_p\ x\ kW_{Qualified_{p,t}}) \quad (4)$$

Ex Ante Gross Program Demand Savings

Ex ante gross program demand savings will be derived by multiplying the UDR, in kilowatts (kW), for a product subcategory (p) and time period (t) by the total number of units sold (Q) for that product subcategory and time period and then summing across all subcategories, as shown in Equation 5.

$$Ex\ Ante\ Gross\ Program\ Demand\ Reduction = \sum(UDR_{p,t} \times Q_{p,t}) \quad (5)$$

5.5 Analysis Methods

Because of the dynamic and complex nature of the RPP Program, and the added complexity resulting from non-program-related factors interacting with program-related effects, this evaluation will rely on multiple analyses to support conclusions regarding program performance, impacts, and attribution. This approach will utilize the concept of triangulation, or the attempt to get a fix on a phenomenon or measurement by approaching it via several independent routes, in order to converge on the most reliable and informed conclusions. The set of methods we propose include:

- Quasi-Experimental Approaches
  - Comparison Group-Based Designs
    - Retailer level
    - Market level
  - Participant-Only Designs
    - Quasi-experimental forecasted baseline to recorded data
    - Quasi-experimental pre-post segmented regression
- Non-Experimental Approaches
  - Non-experimental self-report

Though not presented as a specific method, one should not discount the value of visual inspection of the PQS/sales volume trends. Though wide confidence bands and uncertainty over the influence of factors such as future code changes will likely make the detection of program-induced differences difficult to detect from a strict statistical perspective, especially in the shorter-term, from a practical and longer-term perspective graphical representations will be quite helpful for detecting early trends that may not be significant now, but visual evidence might suggest could become statistically significant in the future. Through visual inspection, one often obtains an immediate and strong impression of the trend just by noting whether the series seems flat or moves generally up or down over time. As such, prior to conducting any of the more rigorous quantitative analyses or statistical models, as a first step, the EM&V team will also examine plots of the data to assess trends or highlight issues.

Quasi-Experimental Designs

A true experimental design is often considered the most rigorous of all research designs. A well-designed and correctly implemented experiment allows researchers to control for factors potentially affecting the outcomes of interest (i.e., PQS) by randomly assigning subjects to a treatment group (or in this case, the RPP Program) and to a control group that does not receive the treatment (i.e., nonparticipating retailers or nonparticipating stores for participating retailers). If designed well and certain constraints are upheld, any statistically significant differences in the PQS between the participating and nonparticipating retailers/stores at the end of the program should be attributable to the program.

However, the strength and validity of an experiment is highly dependent on certain design-related factors, the most important here being the ability to randomly assign retailers to treatment and control groups. In the case of the RPP Program, random assignment of retailers to treatment and control groups is not possible. i.e., retailers self-select into the program. Given that it is not possible to implement a *true* controlled experimental design, a variety of *quasi*-experimental designs are proposed that are still able to control for the effects of history. In this context, *history* refers to the possibility that some other event besides the program-related interventions might have caused some or most of the observed effects. One approach for reducing the effect of history includes a quasi-experimental design using a non-equivalent control group. When a suitable comparison cannot be formed, one can identify other points of comparison such as commercially available market-level data for relevant metrics such as sales or PQS. Both approaches are described in the following sections.

Comparison Group Designs

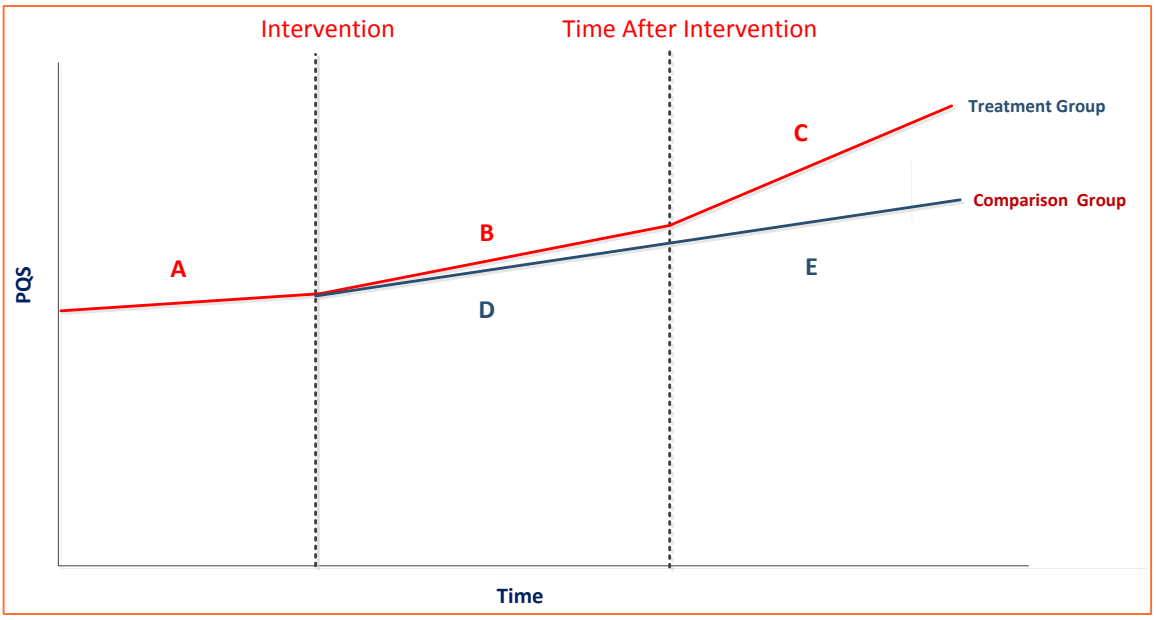
Identifying a suitable comparison group of retailers against which to compare retailers who self-selected into the RPP Program is challenging. We first considered randomly assigning stores of participating California retailers to treatment and control groups, but this was infeasible since retailers wanted *all* their California stores to participate (i.e., they are unwilling to withhold any of their stores so that they could serve as a comparison group). Another option of using California retailers who chose not to participate as a comparison group was also deemed infeasible since they are very likely unwilling to provide the detailed sales data necessary for our analysis. Yet another option that we are still exploring is to use the stores of participating retailers outside of California as a comparison group. We expect that they might be willing to release the detailed sales data for these

stores, which can be matched on key variables to participating stores. If this is possible, a segmented regression approach, discussed in the following section, will be used.

Retailer-Level Segmented Regression

Segmented regression analysis with a comparison group is a powerful statistical method for estimating intervention effects in interrupted time series studies.[40] This approach analyses the pre-intervention and post intervention of, for example, the PQS, for both a treatment group and a comparison group and attempts to compare the regression slopes at two or more points of intervention. Figure 5-2 illustrates this approach in which the analysis estimates the incremental impact of the RPP at different points in time such as the intervention itself and at some point after the intervention. The level of the PQS at the point of intervention with the RPP Program is hypothesized to be different than the level of the PQS without the RPP due to initial product placement and in-store advertising. Or, the trend in the PQS estimated at some point after the point of intervention with the RPP Program might be different than the trend in the PQS without the RPP Program due to later changes in assortment.

Figure 5-2: Illustration of Segmented Regression Approach with Treatment and Control Groups



Market-Level Analysis

If a suitable comparison group cannot be formed, other points of comparison such as commercially available market-level data for relevant metrics such as sales of program-qualified products or the PQS will be explored. For example, quarterly market share data could be purchased from NPD and/or the Association of Home Appliance Manufacturers (AHAM) and be used to compare to quarterly market shares for each product observed for participating retailers. The NPD data could even be incorporated into a segmented regression, described above.

[40] A more detailed description of segmented regression is provided later in this document.

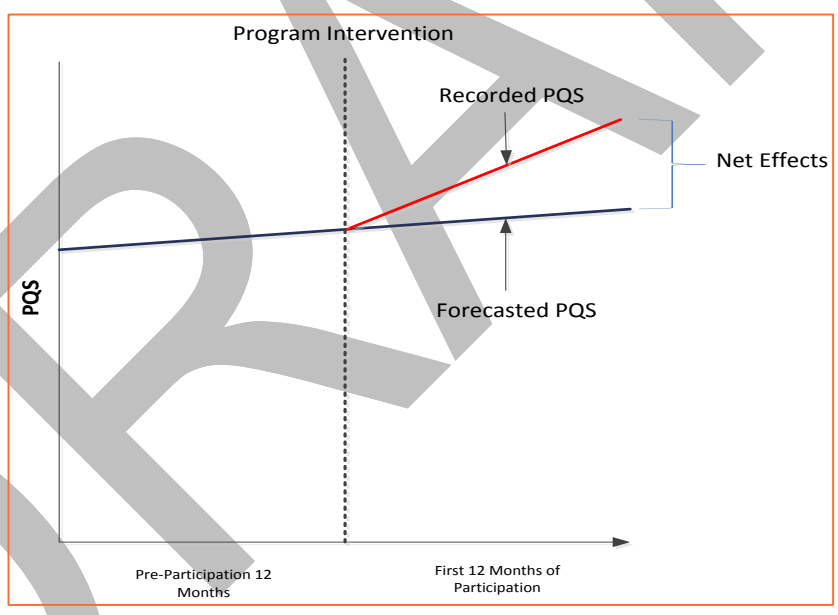
Participant-Only Designs

While comparison group-based designs offer the potential to derive the most reliable and accurate estimates of program impacts, the fact is that this is a complex program aimed at transforming the market for plug load products. Over the longer-term, the ultimate success of the program would be reflected in substantive changes to the product assortment of *both* participating *and* non-participating retailers. Further, because of the regional and even national level buying practices for many large retailers, coupled with the fact that there are plans to scale the RPP Program to the national level, means that defining a representative, unaffected set of retailers to use as a comparison group in the future will become increasingly difficult, if not impossible. As a result, the Evaluation Team also proposes participant-only designs that can be used to assess program impacts in conjunction with the other methods.

Quasi-Experimental (Pre-Post) Participant-Only Forecasted PQS/Sales Volume Baselines

The simplest quasi-experimental approach to assessing program effects involves using the 12-month historical data series for participating retailers to forecast a counterfactual PQS and sales volume baseline over a 12-month horizon. These forecasted baselines would then be compared to the actual program-period sales data post implementation. The difference between the program-period data and the forecasted baseline is the net effect of the program. Figure 5-3 illustrates this approach.

Figure 5-3: Forecasted Monthly PQS versus Recorded



Various statistical models will be used to develop the forecasted PQS/sales volume baseline using the historical sales data. For each product subcategory, the general model form that will be used to forecast the baseline over a 12-month period as a function of time is shown in Equation 6.

$$\hat{Y}_t = \beta_0 + \beta_1 \text{Time}_t + \varepsilon_t \qquad (6)$$

where:

$\hat{Y}_t$ = PQS/sales volume in month t

$Time_t$ = The number of months from the start of the series

β_0 = The intercept

β_1 = Change in Y_t for a one month change in time

Other possible models include various versions of an exponential smoothing technique, which is a procedure for continually revising a forecast in the light of more recent experience. One example is the exponential-smoothing method in Equation 7.

$$F_{T+1} = AX_T + (1 - A)F_T \quad (7)$$

where:

F_{T+1} = Forecasted value for the next period

A = Smoothing constant ($0 \leq A \leq 1$)

X_T = Actual value of series in period T

F_T = Average experience of series smoothed to period T or forecasted value for last period

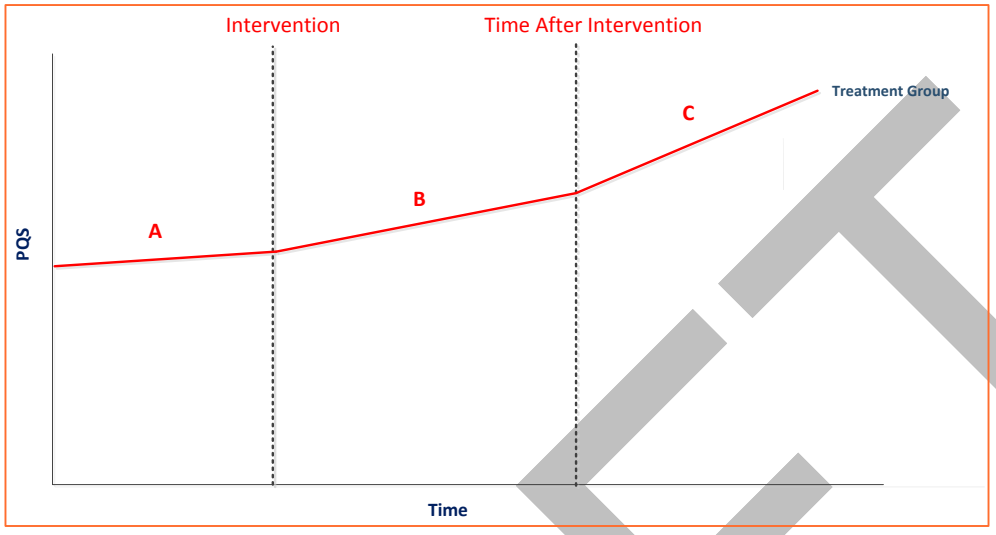
Numerous models will be tested to determine which one performs the best according to the Bayesian Information Criterion (BIC). Each forecast will be judged on its predictive accuracy. Overly complex models may fit the historic data well, but forecast poorly. The BIC rewards a good fit to the historic data but also penalizes model complexity. The smaller the BIC is the better. The BIC should not be used as an absolute measure of performance, but only as a means to compare different models from the same model family for the same data. The specific approach used may vary by product category since the historical series will likely vary with respect to variability or noise in the data.

Quasi-Experimental (Pre-Post) Participant-Only Segmented Regression

Another approach that will be used to assess the influence of the program on PQS and program-qualified sales volume is a quasi-experimental pre-post participants-only design using interrupted time-series (segmented or piecewise regression). Segmented regression analysis is a powerful statistical method for estimating intervention effects in interrupted time series studies.[41] This approach also uses the participating retailers as their own control and analyzes the pre- and post-intervention measurements of the PQS/sales volume and attempts to measure the change in the slopes of the pre and post periods. Figure 5-4 illustrates this approach.

[41] An autoregressive integrated moving average (ARIMA) model (Box and Jenkins, 1970), which employs only the past values of the series variable itself (e.g., PQS) and of its disturbance term as independent variables, was considered. The main advantage of such models over regression models is that they provide a nearly certain means of getting rid of autocorrelation, the presence of which violates a key assumption of ordinary least squares regression models. However, such models require more pre-intervention observations than will be available for this evaluation. At least 30, and generally closer to 50, observations are necessary to obtain reliable estimates (Veney and Luckey, 1982). Therefore, the ARIMA model option was rejected. Box, G. E. P. and G. M. Jenkins. 1970. *Time-Series Analysis: Forecasting and Control*. San Francisco: Holden Day. Veney, J.E. and J.W. Luckey. 1993. "A comparison of regression and ARIMA models for assessing program effects: An application to the mandated highway speed limit reduction of 1974." *Social Indicators Research*, 1983, Volume 12, Number 1, Pages 83-105.

Figure 5-4: Illustration of Segmented Regression Approach with Treatment Group Only



As shown in Figure 5-4, the evaluation team will attempt to determine whether Slope B and/or C differ from the baseline Slope A. For example, depending on the retailer's implementation strategy, Slope B may be different than Slope A due to initial product placement and in-store advertising; Slope C might be different than Slope A or B due to later changes in assortment.

The general form of the segmented regression model to be used for this evaluation is illustrated in Equation 8:

$$\hat{Y}_t = \beta_0 + \beta_1 \text{Time}_t + \beta_2 \text{Intervention}_t + \beta_3 \text{Time\_After\_Intervention}_t + \varepsilon_t \qquad (8)$$

Y_t= PQS/sales volume in month t

Time_t= Indicates the number of months from the start of the series

Intervention_t= A dummy variable taking the values 0 in the pre-intervention segment and 1 in the post-intervention segment

$\text{Time\_After\_Intervention}_t$= 0 in the pre-intervention segment and counts the months in the post-intervention segment at time t

β_0= Estimates the base *level* of the outcome at the beginning of the series

β_1= Estimates the base *trend*, i.e. the change in outcome per month in the pre-intervention segment

β_2= Estimates the change in *level* in the post-intervention segment

β_3= Estimates the change in *trend* in the post-intervention segment

ε_t= Estimates the error

Once the models are estimated, they will be evaluated *without* and *with* the program, using Equations 9 and 10, respectively:

Without Intervention:

$$\hat{Y}_t = \beta_0 + \beta_1 \text{Time}_t \quad (9)$$

With Intervention:

$$\hat{Y}_t = \beta_0 + \beta_1 \text{Time}_t + \beta_2 \text{Intervention}_t + \beta_3 \text{Time\_After\_Intervention}_t \quad (10)$$

The difference between Equations 9 and 10 is Equation 11, which represents the net reduction in the PQS/sales volume.

$$\hat{Y}_t = \beta_2 \text{Intervention}_t + \beta_3 \text{Time\_After\_Intervention}_t \quad (11)$$

The basic model in Equation 1 can be extended to add more time variables to also assess incremental change at various time points after program implementation. For example, two interventions could be incorporated, one in April 2015 at the time of RPP launch and one at April 2016 when program-qualifying models appear on the shelves. This could be helpful for assessing incremental change over time.

Non-Experimental Methods

In addition to the quasi-experimental approaches discussed above, the evaluation team also proposes including self-report as a method for assessing change in the PQS/qualified sales volumes, as well as assessing the overall influence of the RPP Program.

Self-Report Approach

In 1993, the recognition that methods involving comparison groups were not always feasible was first formalized in the energy efficiency field in California in the *Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management (DSM) Programs.*[42] Self-report approaches also have widespread acceptance as tools for assessing net-to-gross ratios.[43,44]For budgetary, timing, statistical, and research design issues, the more traditional designs and analyses must sometimes be replaced or supplemented with the self-report approach. The self-report approach can include both quantitative and qualitative information and can consist of data collection efforts such as surveys and in-depth interviews.

For the RPP Program Trial, various market actors, especially retailer purchasing, marketing, and store staff (and eventually manufacturers and codes & standards representatives) will be asked to report their assessments of changes in program-qualified sales as attributable to the program. These actors will also be probed in terms of likely behaviors absent the RPP intervention, the influence of the RPP Program Trial on their behaviors, as well as the extent to which the program trial was successfully implemented. Though the results will not be used on their own to make any claims of attribution, they will be used as another piece of evidence to support the more comprehensive and holistic assessment within the theory-driven evaluation framework.

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[42] http://www.calmac.org/events/PROTOCOL.pdf

[43] Ridge, R., K. Keating, L. Megdal, and N. Hall. 2007. *Guidelines for Estimating Net-To-Gross Ratios Using the Self-Report Approach*. Prepared for the California Public Utilities Commission.

[44] Ridge, R., P. Willems, and J. Fagan. 2012. *Framework for Using the Self-Report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers*. Prepared for the California Public Utilities Commission.

6. PROGRAM ATTRIBUTION

Due to the multifaceted and long-term nature of the RPP Program, an array of different evaluation methods has been proposed to assess the efficacy of the Program. It is also worth re-emphasizing the role that theory-driven evaluation will play in the overall evaluation of the Program and assessment of attribution.

Theory-driven evaluation will bring together the results of the process evaluation and the evaluation to assess savings claims. As discussed earlier, this approach generally involves operationalizing the key performance indicators associated with key causal linkages in the logic model (i.e., converting the performance indicators into quantifiable and measureable metrics). That is, the results of evaluation efforts will be combined and if the predicted steps between program activities, outputs and outcomes can be confirmed in implementation, then this matching of the theory to observed outcomes lends a strong argument for causality. As presented throughout this plan, the evaluation team will focus most of our attention on operationalizing the logic model and underlying program theory to develop measurable metrics that will be used to assess whether the RPP Program is functioning as intended. While some of these analyses will support reliable conclusions about short-term activities, outputs, and near-term outcomes, other, mid- to longer-term metrics will be base-lined to support comparisons with the results of future evaluations.

At various points throughout the life of the RPP Program, the preponderance of evidence will be systematically examined to assess the extent to which the program is on track to achieve its ultimate objectives. The data relevant to each hypothesized cause-and-effect relationship in the logic model will be analyzed to see whether each hypothesis can be rejected or accepted. The results of all of the hypotheses testing will be reviewed to determine the extent to which a case for attribution can be made. As Weiss states: "If the evaluation can show a series of micro-steps that lead from inputs to outcomes, then causal attribution for all practical purposes seems to be within reach."[45]

To be credible, the preponderance of evidence approach must be rule-based, transparent, and repeatable. For each causal hypothesis, an objective case for causality must be constructed based on all quantitative and qualitative data analyzed. Each case must include, at a minimum, a summary of the data collected and analysis approach and results, an assessment of the validity and reliability of the data, and a discussion of the level of uncertainty surrounding the conclusions (i.e., a presentation of the achieved levels of confidence and precision (either a quantitative assessment or a qualitative assessment).

Once the evidence for each hypothesis is presented, an assessment should be conducted as to whether all of the evidence warrants the conclusion that the entire network of cause-and-effect relationships depicted in the logic model have combined to achieve the ultimate objectives of the RPP Program. This assessment must be organized around a set of rules about how to combine these data into a coherent, internally consistent story about the efficacy of the program. During the 10-year

[45] Weiss, C.H. 1997. "Theory-based Evaluation: Past, Present and Future." *In*: D.J. Rog & D. Fournier (Eds.), *Progress and Future Directions in Evaluation: Perspectives on Theory, Practice and Methods* (pp. 41-55).

program period, the use of a Delphi panel,[46] conducted according to best practices, should be considered as a way around which to organize this assessment.

Finally, it is important to note that this evaluation will not slavishly adhere to the program theory and logic model but will also step outside the model to explore other competing hypotheses and unanticipated outcomes. Other local, state, regional, and national interventions that share many of the same objectives as the RPP Program will be examined and their effects accounted for.

[46] Linstone, H.A. and M. Turoff. 1975. *The Delphi Method: Techniques and Applications*. London: Addison-Wesley Publishing Company.

7. COST-EFFECTIVENESS ANALYSIS

In some earlier resource acquisition evaluations, cost-effectiveness analyses were typically conducted retrospectively as part of an impact evaluation. For market transformation interventions like the RPP Program, the assumptions of the prospective cost-effectiveness analysis will be reviewed and tested periodically and will be included in the market progress evaluation reports that will be prepared periodically over the ten years.

Not all cost-effectiveness assumptions include the same level of risk nor is the risk located in the same component. In a resource acquisition intervention, the level of risk lies primarily in whether the kWh savings per participant are reliable. The analysis, therefore, often focuses on savings and what would have been achieved with and without the intervention. In a market transformation intervention, the risk lies primarily in whether the market will respond at the anticipated level and in the expected time period.

In addressing cost-effectiveness issues for market transformation, infrastructure, and research and development interventions, the evaluation team will collect data to assess whether the prospective cost-effectiveness assumptions hold or need to be revised. Market transformation programs such as the RPP Program often assume 10-15 years for the ultimate indicators. This takes into account the duration of the program and the fact that some savings from the sale of energy efficient products will likely persist after the utilities exit the market. Therefore, a final cost-effectiveness analysis cannot be conducted for a long time. Relying on an approach to test assumptions provides an interim method for deciding if the intervention is meeting cost-effectiveness expectations.

Thus, the cost-effectiveness analysis will focus on testing market assumptions. As part of this analysis, the following metrics will be tracked: (1) program-qualified share (PQS) at the retailer level, (2) California market share, (3) national market share, (4) incremental costs, (5) UESs, (6) retailer implementation of their marketing plans, and (7) the NTGR. Periodically, these data will be used to modify key inputs of the extended Bass diffusion model and determine whether the RPP Program is on track to transform the market in a cost-effective manner. If necessary, based on these results, modifications will be made to the design and delivery of the RPP Program to increase its long-term cost-effectiveness.

8. REPORTING

Note that after 2015 and continuing through the next ten years, the ED-led impact evaluations will begin to assess progress on these mid- and long-term outcomes. Market progress evaluation reports (MPERs) can be used to track the progress of the RPP Program. MPERs will be conducted annually, or possibly less frequently, depending on the targeted product category, the resources available, and the criticality of the information for decision-making.

MPERs contain a variety of information and do not neatly fall into the process, cost-effectiveness, or impact categories common to resource acquisition evaluations. Each MPER for a given product will likely to contain common tracking information, but each will also include information unique to that reporting period based on the market stage of the intervention and the decisions that are pending. Because the reports track market progress, they will focus on timely and relevant information for intervention managers and decision makers.

Typically each MPER will include a review of findings, conclusions, and recommendations from previous MPERs, provide a description of the current progress of the intervention relative to the established criteria for success and progress indicators, compare market penetration to baseline, review cost-effectiveness assumptions, provide a best estimate of energy impacts, and provide a statement of attribution. Given the short duration of the RPP Trial, an MPER framework will be established for each product and only one MPER for each of the product will be prepared. These results will also be shared with the CPUC-ED in order to support ED-led ex post evaluation development, analyses, and reporting.

APPENDIX A

8.1 The RPP Program Theory and Logic Model

The RPP Program logic model in Figure 1-1 of the evaluation plan contains five program activities, five outputs, six short-term outcomes, four mid-term outcomes, and six long-term outcomes as well as their hypothesized cause and effect relationships represented by the 29 linkages.[47] Each activity, output, and outcome is described briefly below. The full logic model is presented so that the rationale for a scaled up version of the RPP Program can be fully appreciated.

Through in-depth discussions with program staff, we learned why they thought the particular set of activities would lead to certain outputs and outcomes. In addition, literature in the following social science arenas was reviewed as part of assessing the program theory for the RPP Program: marketing, retail analytics, retail merchandising, consumer behavior, social marketing, network science, communications, training, economics, and the diffusion of innovations. Theories that were found to be especially relevant are discussed below, with the theory discussion broken out by the key program activities presented in the logic model diagram. Particular attention was placed on those theories that may provide some suggestions for program refinement.

The discussion below is organized by program activities and their causal links to short-term, mid-term and long-term outcomes. In this way the reader can focus on specific program intervention activities and whether comparative program findings and/or theory literature provides support for the program theory or suggest concerns that might need to be tested in evaluation or addressed in future program refinement activities.

1.1. Activities and Outputs (A, B, C, D, E, F, G, H, U and V)

This section describes the activities that PG&E, its utility partners, and participating program retailers will engage in as part of the RPP Program. Additionally, this section describes the outputs that are expected to result eventually from these activities.

A. PG&E characterizes markets and estimate savings potential for candidate products

PG&E characterize the market for each candidate product, which includes understanding the annual sales in PG&E's service territory, the sales volume of participating and nonparticipating retailers, the number and size of each manufacturer, the nature of the retail supply chain, the currently estimated market share, and the estimated gross savings.

B. PG&E contacts utility partners regarding collaboration in program delivery

PG&E reaches out to potential partners in the delivery and implementation of the RPP Program. These utility partners could be the other California IOUs (SCE and SDG&E), municipal California utilities (SMUD, LADWP, etc.), or other regional utilities or utility alliances such as NEEA and the Energy Trust.

[4747] Outcome **P** is counted three times as a short-term, mid-term and long-term outcome. Outcome **W** is counted twice as a mid-term and long-term outcome.

C. Utility partners recruited

Utility partners interested in partnering with PG&E in the delivery and implementation of the RPP Program indicate their willingness to do so and formally sign a contract which specifies incentive levels, retailer reporting requirements, payment frequency, and roles and responsibilities of PG&E, PG&E partners such as SMUD, and participating retailers.

D. PG&E and utility partners determine which retailers to recruit

PG&E and its utility partners assess potential retailers to recruit into the RPP Program. Retailers will be evaluated for inclusion in the Program based on a variety of factors such as:

- Product offerings
- Energy savings potential
- Previous working relationships with PG&E and/or partner utilities

E. PG&E, utility partners, and identified retailers target product categories with energy savings potential

PG&E, utility partners, and retailers who have been recruited into the program identify product categories with energy savings potential. Key factors in identifying product categories with high energy-savings potential include the following:

- Category sales volume
- Range of energy consumption values within the category
- ENERGY STAR market share within the category
- Opportunities to introduce ENERGY STAR or new ENERGY STAR Specifications to retailer product offering.

U. PG&E and utility partners participate in meetings with and provide market data to staff of Energy Star and Code and Standards Programs regarding targeted product categories

There are three ways for utilities to get involved with standards.

- First, when there is no set standard for a product but a market exists, a utility can work with regulators to negotiate a market-sourced baseline and run programs that support the adoption of more efficient products by households. The utility can claim the incremental energy saving from utility run programs referenced against the market-sourced baseline.
- Second, utilities can work between final rule making and effective date of a new standard to help accelerate market adoption of high efficiency products and secure energy savings through a market transformation effort. In this approach, the new standard becomes the baseline and utilities can focus the market by incenting the purchase of higher than minimum efficiency products. In some cases, readily available high efficiency products will not pass cost-effectiveness tests and the utility will need to work with the product manufacturers.
- A third, and less common, approach is for utilities to work with a state agency, such as a standard setting energy office, to develop a standard for a product that is not federally covered. A recent example of this approach is the creation of new energy efficiency standards for color televisions in California.

The RPP Program will employ the second and third approaches and engage in such activities as:

- Holding meetings and working groups to target products ripe for new standards, and
- Increasing the market share of high efficiency products through incentives.

F. PG&E and utility partners determine incentive levels for program-qualified models within each product category, present them to retailers and sign contracts

PG&E and its partner utilities work with retailers to determine incentive levels for each program-qualified model sold[48]. Productive negotiations with retailers will be contingent on transparency and open communication between the utilities and retailers regarding retailer baseline conditions, utility savings potential, incentive availability, incentive calculation methods, the need for an effective marketing plan, and utility expectations of retailers. The program cost-effectiveness implications of incentive amounts will also be a major factor in the negotiation of retailer incentive levels. PG&E and the utility partners formally enter into contractual relationships with the retailers. In the contract, among other things, PG&E and its partners agree to pay retailers the agreed-upon incentive amounts for the sales of program-qualified models within each product category and to develop an effective marketing plan.

G. PG&E and partner utilities approve retailer marketing plans including sales forecasts of program-qualifying models within selected product categories.

Because the RPP Program does not prescribe any *single* strategy and tactics for retailers to sell program-qualified products, the contents of an individual retailer's plan may vary substantially from other retailers' plans and include a mix of strategies and tactics. The potential strategies could include the following:

- Changes in product assortment
- Changes in product placement
- Increased advertising and price promotion of specific energy efficient products
- Training sales staff
- General customer education about the benefits of energy efficiency

H. Retailers implement plans employing various strategies and update as necessary.

Retailers participating in the RPP Program implement their agreed-upon marketing plans with the goal of increasing the sales of program-qualified models within each product category and thereby producing energy and demand savings and environmental benefits.

A good faith implementation of the marketing plan reflects retailer willingness to overcome key market barriers such as: 1) low levels of awareness and knowledge among retail merchandizers regarding product specifications or differentiation regarding efficiency levels, and 2) products and services may be unavailable because manufacturers, distributors, and service providers have difficulty accurately predicting customer demand for their products/services, and may respond to this uncertainty in a risk-adverse manner, thereby limiting the availability of their products/services.

By working with the RPP Program implementers, retailers will become more aware of the fact that energy use is an important attribute of the different models that they sell. They might also be more willing to deviate from traditional buying and product placement practices and change the assortment and placement of the more energy efficient models, thereby increasing customer exposure to these products. Retailers could also make a greater effort to actively educate

[48] These incentives may be used by retailers in a manner they see fit. For example, incentives may be used to lower prices of the most energy efficient products to increase sales volume, reduce market barriers, promote energy efficient products through point-of-purchase and/or product placement activities, or to treat it as profit to mitigate risks of participating in the program.

customers regarding the energy efficient products through in-store promotions using point-of-purchase advertising, in-store broadcasts, and sales staff training and to reduce prices. Depending on the strategies employed, one short-term outcome is that market barriers faced by customers will be reduced.

V. PG&E and utility partners provide input on proposed energy efficient model specifications to staff of Energy Star and Code and Standards Programs.

The RPP Program will employ the second and third approaches and engage in such activities as:

- Developing technical reports on the feasibility, costs, and benefits of candidate technologies for standards consideration,
- Developing standards testing practices and evaluation tools, and
- Providing expert witness testimony in regulatory hearings and assisting with consumer and regulator education efforts.

1.2. Short-Term Outcomes (I, J, K, L, M and P)

I. Reduction in customer market barriers to purchase products that are more energy efficient.

Depending on the strategies retailers choose to pursue, one short-term outcome of the program may be an increase in awareness, knowledge, attitude, and behavior (AKA-B) of the participating retailer's customers with respect to more energy efficient products. This will likely be the case if retailers pursue program strategies that explicitly target customer AKA-B. Examples of these strategies include increased promotion of energy efficient products, sales staff education, and general customer education about the benefits of energy efficiency. A secondary outcome of any retailer strategy that targets customer AKA-B could be increased customer awareness of programs offered by PG&E and its utility partners.

Note that retailers are not required to implement program strategies that explicitly target customer AKA-B. As noted earlier, retailers may choose to instead focus on "behind the scenes" strategies such as changes in product assortment or product price reductions which will reduce the information/search and first-cost barriers for customers. If retailers choose to implement only "behind the scenes" strategies, a change in customer AKA-B towards more energy efficient products *would not* necessarily be an expected program outcome.

J. Increased sales of energy efficient models within targeted product categories

Whether retailers choose to pursue strategies that target customer AKA-B or "behind the scenes" strategies such as product assortment or product price reductions, or some combination of these, an expected short-term outcome of the RPP Program is that customers will purchase more energy efficient products at participating retailers than they did before the program.

K. Retailers receive incentives from PG&E and utility partners

For each program-qualified model sold, the retailer will receive an incentive which will improve their profit margin.

L. Increased retailer engagement

Incentives to retailers will keep them engaged in the faithful implementation of their strategic marketing plans. .

M. Additional retailers join program

Nonparticipating retailers see the benefit of participating in the RPP Program and decide to join.

P. Short-term energy and demand savings and other environmental and non-energy benefits

The purchase of these program-qualifying products will result in energy and demand savings for PG&E and its partner retailers as well as associated environmental benefits such as reductions in CO_2 and carbon and other non-energy benefits such as increased customer comfort.

1.3. Mid-Term Outcomes (N, O and P)

N. Increased share of efficient models sold in targeted product categories among participating retailers.

Over time, through customer purchases of more energy efficient products at their stores, participating retailers will increase their sales and market share of program-qualified models within each product category.

Although not explicitly illustrated in the logic model, it is also possible that, in the mid-term, PG&E, NEEA and utility partners will participate in C&S and Energy Star meetings (Output **U**) and provide evidence of increasing market shares for targeted products (due to the combined efforts of participating and nonparticipating retailers) to support more stringent mandatory and voluntary standards leading to the eventual adoption of more stringent mandatory and voluntary standards (Mid-Term Outcome **V**[49]). Increased market shares of targeted products or the adoption of efficiency standards for one or more of these targeted products causes manufacturers to increase production of efficient models leading eventually to long-term, sustainable energy and demand savings and environmental and other non-energy benefits.

Although not explicitly illustrated in the logic model, it is also possible that the success of these participating stores might motivate merchandizers/buys for participating retailers to change the assortment of all stores in region/states outside of California and the NEEA catchment area resulting in an increase in their regional or national market share of program-qualified models within each product category. This would be expected for any participating retailers who make assortment decisions at a regional (or even national) level instead of assorting high-efficiency products at only the participating store locations within PG&E and partner utility service territory.

O. Increased share of efficient models sold in targeted product categories among nonparticipating retailers.

The success of participating retailers in selling these more efficient products could motivate nonparticipating retailers to adopt similar marketing strategies even though they would not receive

[49] Outcome V could occur in the mid-term or long-term. This is illustrated in the logic model by allowing Outcome **V** to straddle the mid-term and long-term periods.

any incentives. That is, non-participating retailers might adopt some of the same marketing strategies used by participating stores as a way of increasing sales and profits.

P. Mid-term energy and demand savings and other environmental and non-energy benefits

The purchase of these program-qualifying products will result in energy and demand savings for PG&E and its utility partners as well as associated environmental and other non-energy benefits such as reductions in CO_2 and carbon and other non-energy benefits such as increased customer comfort.

1.4. Long-Term Outcomes (Q, R, S, T, P and W)

The increase in the sales of program-qualifying products and their share of all products sold within a given product category at the regional/national level will eventually be sufficient to shift the demand curve for the *program-qualifying products*. In response, manufacturers will shift production (perhaps permanently) to these more efficient targeted products. This will result in an increase (perhaps permanent) in the availability (and eventually market share) of more energy efficient product among participating and nonparticipating retailers and eventually to long-term energy and demand savings as well as environmental and other non-energy benefits.

Throughout the duration of the RPP Program, PG&E and its utility partners also provide data and stakeholder support regarding targeted product categories to the Energy Star and Code and Standards Programs. PG&E and utility partners will participate in C&S and Energy Star meetings and provide evidence of increasing market share for targeted products to support more stringent mandatory and voluntary standards leading to the eventual adoption of more stringent mandatory and voluntary standards that affect the efficiency of the products manufactured. Increased market shares of targeted products along with efficiency standards for one or more of these targeted products leads to long-term, sustainable energy and demand savings and environmental and other non-energy benefits.

1.5.Overlapping Programs

The evaluation team identified a number of residential sub-programs PG&E programs operating within the California Statewide Program for Residential Energy Efficiency (CalSPREE) Program. CalSPREE is comprised of the Energy Advisor, Plug Load and Appliances (PLA), Multi-Family Energy Efficiency Rebates (MFEER), Whole Home Upgrade (WHU), Residential Heating, Ventilation, and Air Conditioning (HVAC), and Residential New Construction (RNC) subprograms. Any estimates of RPP savings must adjust for any overlap with other PG&E and EEPS programs.

1.6. External Influences

There is wide variety of external factors that can also influence the program at all levels and time frames. These factors include:

- Existing awareness of PG&E among market actors
- ENERGY STAR® policies and requirements
- Changes in political priorities
    - Codes and standards
    - State and local action & requirements (including local energy commissions)
- Weather and associated impacts on customer actions and energy bills
- Broad economic conditions that affect capital investment and energy costs (rapidly changing economic conditions)

    - Energy prices and regulation (changes in fuel and energy prices)
    - Perceptions of the value of being "green"
- Costs, performance and availability of more efficient technologies
- Competition
    - Competition among target market actors and contractors that affect willingness to promote energy efficiency
    - Other service organizations investments and commitments to energy efficiency
- Competing demands for capital and resources
    - Internal – demand-side customers competing priorities
    - External – broad market and demand for provisions and supply of technologies and services
- Activities of non-PG&E funding public and institutional energy efficient programs
    - Awareness of and enthusiasm for ENERGY STAR®
    - Other utility programs promoting and providing incentives for energy efficiency
- Knowledge, and awareness of climate change and actions that can be taken to mitigate or adapt to climate change

The research designs should attempt to control for these external factors so that any impacts of the RPP can be observed.