PUBLIC UTILITIES COMMISSION
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May 31, 2019

Advice Letter
PG&E 4071-G/5487-E

Erik Jacobson
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c/o Megan Lawson
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Dear Mr. Jacobson:

The Energy Division approves PG&E's Advice Letter 4071-G/5487-E ("Request for Authority to Continue the Retail Products Platform Pilot within PG&E's Residential Energy Efficiency Plug-Load and Appliances Sub-Program"), effective March 5, 2019.

Background

PG&E's Retail Products Platform (RPP) is a mid-stream program with overaraching market transformation objectives. The program uses brick-and-mortar retailers as its primary market leverage point. Retailers are given incentives for sales of qualified products, which are defined to align with Energy Star specifications, and are expected to promote qualified product sales through marketing, training, and shelf stocking practices. In addition to promoting market uptake of qualified products via incentives, RPP also utilizes sales data provided by retailers to advance Energy Star, Federal, and California code adoption. RPP differentiates itself from other mid-stream programs through its provisions that offer unprecedented access to retailer sales data. The program is unique in having partnerships with national retailers collaborating to promote qualified products. PG&E is one of 16 program sponsors that make up the national Energy Star Retail Products Platform (ESRPP). PG&E's RPP budget is counted as part of their overall EE portfolio budget and PG&E has not yet claimed savings due to insufficiently robust tracking and evaluation mechanisms.

Within the energy efficiency proceeding (R13-11-005) the Commission is considering the adoption of a market transformation framework. Although the RPP program is generally considered to have elements of market transformation, and to be market transformation-esque, the RPP is not a pilot program for the MT framework under consideration. There are potentially important fundamental differences in the design requirements and processes between RPP and any future potential 'market transformation program' approved under any future adopted framework.

On March 5, 2019, PG&E filed Advice Letter 4071-G/5487-E, seeking Commission approval to continue the Retail Products Platform (RPP) pilot program within its Energy Efficiency Plug-Load and Appliances Sub-Program for a fourth year (2019). PG&E describes the pilot as an "innovative and strategic effort established to overcome barriers for residential customers to adopt energy efficient products through a dedicated market transformation program design." RPP is intended to "produce sustainable changes in retail markets for plug-loads and appliances by reducing barriers to the manufacture, distribution, sale and installation of energy efficient products."

The advice letter filing provides an overview of RPP progress at the conclusion of year three; the program evaluation conducted by EMI; a revised program logic model; and the baseline approach used by PG&E. RPP is expected to continue submitting annual advice letters outside of the Business Plan Annual Budget Advice Letter (ABAL) because RPP is seen by the Commission as currently having an insufficiently robust tracking mechanism for determining program attribution, and also is seen as an important opportunity to properly structure a market transformation program just as the Market Transformation Framework is still being developed.

In approving the Advice Letter, this disposition:

- Addresses PG&E's filing of Advice Letter 4071-G/5487-E on March 5, 2019;
- Summarizes responses to the advice letter from the Northwest Energy Efficiency Alliance (NEEA) and the Natural Resources Defense Council (NRDC) and subsequent follow up discussions between Energy Division and these parties;
- Specifies minimum activities PG&E will need to undertake in 2019 in order for subsequent RPP advice letters to be considered for approval by the CPUC in 2020 and beyond.

Protests

No protests were filed in response to Advice Letter 4071-G/5487-E.

Responses

NEEA

On March 14, 2019, NEEA filed its response to PG&E's Advice Letter 4071-G/5487-E. In its response, NEEA provides the following support for RPP continuation in California:

- As one of the two largest sponsors of the national Energy Star Retail Products Platform (ESRPP) program, which has participation from program administrators that cover a combined 18% of the US market, PG&E's continued support is critical to delivering significant savings over the next 10 years in addition to continuing to support national Energy Star specification changes and the development of testing protocols in California and beyond;

- The update to the logic model is consistent with best practices in market transformation;
- The baseline approach is consistent with best practices in market transformation.

As part of its advice letter review, Energy Division asked for clarification of the last bullet, the outcome of which is discussed in the "Additional Discussion with Responding Parties" section below.

NRDC

On March 25, 2019, NRDC filed its response to PG&E's Advice Letter 4071-G/5487-E. In its response, NRDC expresses support for PG&E's request to continue the RPP Pilot and highlights recommendations for updating the RPP program. These include the following:

- Use existing data and best practices (e.g., NEEA's approach) whenever possible to set baselines and evaluate progress, relying on robust Delphi panels only after exhausting existing data channels;
- Set market progress indicators and/or metrics that can be measured, based on leverage points and overall market characteristics;
- Apply any updates to policies pending the forthcoming Commission decision on establishing a California market transformation framework, such as a market transformation cost-effectiveness methodology;
- Pursue expansion of the program throughout California as soon as feasible.

As part of its advice letter review, Energy Division asked for clarification of NRDC's response, the outcome of which is discussed in the "Additional Discussion with Responding Parties" section below.

Additional Discussion with Responding Parties

Energy Division met with both NEEA and NRDC for additional clarification of their respective comments and general discussion on PG&E's proposed approach for year four of the RPP pilot.

NEEA

Energy Division asked NEEA to clarify the following comment from NEEA's response to PG&E's Advice Letter 4071/5487-E:

- The baseline approach is consistent with best practices in market transformation.

NEEA clarified that it has experienced problematic outcomes using Delphi panels in similar applications in the past, specifically due to participating subject matter experts (SMEs) who provide divergent

predictions of market adoption, resulting in an average that was not precise, accurate, nor useful in evaluating program performance. Other questions brought up for discussion include:

- Are enough SMEs available in each RPP produce category to staff a successful Delphi panel, considering a typical need for seven to fifteen members?
- Should there be two baselining approaches - one for product categories with a sufficient number of SMEs, and another for product categories without?
- What happens if we get enough SMEs, but reach divergent conclusions?
- Should divergent Delphi panel results be processed through a technical advisory committee, such as the California Technical Forum?
- Are Delphi panels more effective when commenting on established baselines, as opposed to establishing initial baselines?
- What should be the criteria for selecting SMEs and for identifying an adequate number of SMEs while not sacrificing expertise?
- How can the biases known to exist between industry insiders and energy efficiency (EE) experts be addressed?
- Are non-industry EE experts generally disqualified because they may lack understanding of industry trends?

NRDC

Energy Division asked NRDC to clarify the following recommendation from NRDC's response to PG&E's Advice Letter 4071-G/5487-E:

- Use existing data and best practices (e.g., NEEA's approach) whenever possible to set baselines and evaluate progress, relying on robust Delphi panels only after exhausting existing data channels.

NRDC stated that its primary recommended baseline development approach is based on existing industry forecasts. In the case where such forecasts are not available, a robust Delphi panel would be recommended. Although "robust" can be defined in a range of ways in the context of Delphi panels, NRDC specified that at a minimum it should include a larger number of SMEs than were employed by PG&E to develop its baseline approach and should have several rounds of input from and feedback to the SMEs, as opposed to the single round employed by PG&E.

Energy Division staff and NRDC also discussed the possibility that Delphi panels can produce divergent opinions resulting in an imprecise average. NRDC agreed that this problematic result would be less likely in a context where an established baseline was provided for SMEs to comment on, as opposed to having SMEs contribute to establishing an initial baseline.

Lastly, Energy Division and NRDC also discussed how SMEs may comprise a technical advisory group akin the "Independent Review Committee" (IRC) recommended in the *California Energy Efficiency Coordinating Committee (CAEECC) Market Transformation Working Group Final Report*.

Commission Analysis

The Commission approved the first year of the RPP pilot on February 12, 2016, when it issued a disposition on PG&E Advice Letter PG&E 3668-G/4765-E (and supplemental). In that disposition, the Commission directed PG&E to file an annual advice letter for approval of the subsequent year of RPP implementation. In doing so, the Commission sought a balance between supporting nascent program efforts and ensuring the prudent use of ratepayer funds on programs with measurable results.

Specifically, the disposition directed PG&E to "file these advice letters as a matter of course as a means of safeguarding ratepayer funds based on accurate estimates of pilot performance to date. To that end, Commission staff will work with PG&E to track pilot performance and share ongoing results with a broad set of stakeholders in order to enable adequate pilot review and sound advice letter filings."[1]

In 2018, PG&E's Advice Letter 3935-G/5227-E requested an additional year of pilot program funding (year 3) for RPP and was approved with additional and clearly outlined requirements to be delivered before the next (i.e. 2019) funding cycle. Although PG&E made progress, some of these required items were not delivered or lacked a satisfactory level of rigor.[2] In response, Commission staff created the "RPP Deliverables Schedule" (Attachment B) as part of this disposition, which outlines meeting and deliverable dates for the rest of 2019 and into early 2020. The RPP Deliverables Schedule outlines RPP deliverables in 2019 that will address the insufficiencies outlined in Attachment A as well as additional items deemed critical in order to evaluate RPP and determine program effects. Upon completion of all deliverables outlined in Attachment B to Commission staff's satisfaction, Commission staff will reconsider the feasibility of evaluating RPP and the possibility of future claiming savings. Energy Division analysis in support of Attachment B deliverables is discussed below.

PG&E Advice Letter 4071-G/5487-E asks the Commission to approve $4.71 million in ratepayer funds for a fourth year of RPP implementation in 2019[3]. To demonstrate program progress, PG&E refers to the results of the Pacific Gas & Electric Energy Star Retail Products Platform (ESRPP) Program Pilot Early Evaluation Report conducted by EMI Consulting. Although the EMI evaluation identifies areas in which RPP has established critical program foundational structure and qualified products are gaining traction in the market, Energy Division disagrees with the central premise that program-wide influence is shown with any confidence. The study finds that "based on statistical modeling of retailer sales data, the evaluators observe short-term sales increases for five of the eleven product tiers currently targeted by

[1] See Commission disposition of PG&E AL PG&E 3668-G/4765-E, dated February 12, 2016.
[2] See the "PG&E Advice Letter Tracking" document (Attachment A) for details.
[3] PG&E conceived RPP as a 10-year pilot. Annual advice letter filings are intended to safeguard ratepayer money by complementing evaluation work and allowing the Commission and stakeholders to determine whether the pilot would continue in any subsequent year.

PG&E's RPP Pilot" and that "the evaluators also observe corresponding upward trends in program-qualified model assortment share on retailer shelves for five of seven categories."[4]

However, this uptake could easily be interpreted as being caused by natural market uptake or external influence from factors such as Energy Star or incentive programs in other states. Because the EMI evaluation does not fully address the impacts of other market forces, it is difficult to infer the actual influence of RPP on its targeted markets. Considering that some of the qualified products have experienced a decrease in market share, it is even less clear that RPP's leverage point is having any affect beyond random market shifts. The fact that baselines were not established using industry insider market adoption predictions or a robust Delphi panel approach and instead employed an approach that utilized an insufficient number of SMEs who received an insufficient amount of background material and participated in just a single round of inputs calls the baselines themselves into question. Despite NEEA's reluctance to support a Delphi panel approach in this context, the Commission agrees with NRDC's suggestion that a Delphi panel approach should be used in the absence of access to existing industry forecasts, such as in the current RPP context. To properly determine whether RPP is influencing the targeted markets, the following additional steps need to occur:

- A baseline needs to be established using a robust Delphi panel approach, when possible;
- Additional Market Performance Indicators (MPIs) must be added;
- All MPIs must be consistently tracked and evaluated to show market barrier breakdown;
- Third-party data must be used to compare RPP sales data against broader market trends;
- External factors, which have not been considered to date, must be analyzed to distinguish program influence/intervention from outside incentives and understand natural market baseline trends; and,
- A holistic analysis using these components in conjunction must be completed.

Furthermore, these events should continue to occur as part of regular program evaluation, to facilitate program and evaluation adjustments in real-time on an as-needed basis. As mentioned in the "Background" section of this document, failure to meet the requirements listed above and in the relevant attachments (refer to the following documents: ESRPP Advice Letter Tracking and Additions, RPP Deliverables Schedule) will cause the Commission to consider elimination of the RPP program upon submission of future RPP advice letters.

Effective market transformation program implementation requires a mechanism for recognizing and reacting to unexpected results or market changes. Room air conditioners (room ACs) provide an excellent example of this in the current program iteration. Between 2015-2016, EnergyStar v4 room ACs were predicted by the program baselines to increase from zero to seven percent market share, but instead leapt from zero to 69 percent market share, followed by a drop back to 34 percent market share in 2017 (still 20 percent above the predicted baseline). An unexpected shift like this should trigger an investigation into any and all market factors that caused this result, followed by a baseline adjustment.

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[4] See PG&E Advice Letter 4071-G/5487-E "Request for Authority to Continue the Retail Products Platform Pilot within PG&E's Residential Energy Efficiency Plug-Load and Appliances Sub-Program", pp. 4.

The EMI evaluation and related program data contain additional similar examples; there may also be a variety of other unexpected incoming data or evaluation results to which program baselines, approaches, leverage points, MPIs, and other elements will need to adjust. An established, yet flexible, mechanism needs to be in place to initiate the required investigation and adjustment.

Energy Division agrees with NRDC's recommendation to "apply any updates to policies pending the forthcoming Commission decision on establishing a California market transformation framework, such as a market transformation cost-effectiveness methodology." Although the Commission's Market Transformation Framework is not yet established, it will be available in the future.

To ensure that the issues described above will be resolved adequately and in a timely fashion, Commission staff have created an RPP Deliverables Schedule. The Commission also points out that following through with the requirements of the RPP Deliverables Schedule would likely put RPP in compliance with the Commission's future Market Transformation Framework. RPP may be best suited for implementation within that framework and should therefore be considered for transition out of Resource Acquisition programs and into the Market Transformation framework as the opportunity arises.

RPP 2019 Deliverables Schedule

The RPP Deliverables Schedule (Attachment B) lists specific deliverables PG&E must provide, working with Energy Division, through 2019 to bring the RPP pilot to a satisfactory point in terms of meaningful evaluation, with associated sub-deliverables, descriptions, and dates. The primary deliverables are as follows:

Deliverable	Activities	Due Date and Deliverable Type
New Baseline Creation	Develop a baseline using a robust Delphi Panel approach in lieu of access to industry forecast data when a sufficient number of SMEs for a given product category can be identified; otherwise leverage individual in-depth interviews and an expert panel (i.e. CPUC Staff/Consultants & PG&E Staff/Consultants)	SME list and materials to be finalized by end of May. Baseline consensus/ creation completed by September 2019.
Critical Thresholds	Identify critical points where market penetration, price point, or other factors shown by MPIs may begin to influence market actors or code change	To be finalized through consensus along with baselines by September 2019.
MPIs Tracking and Additions	Tracking plans for existing MPIs that are not currently being tracked should be developed, and additional MPIs added and tracked as needed to	Additional MPIs and tracking plans to be finalized by end of June

	provide context	2019. Monthly MPI tracking meetings in 2019, with final results presented in end of year report.
Third Party Data Plan	A new scan of available third-party data sets will be undertaken and Association of Home Appliance Manufacturers (AHAM) and any other data deemed necessary to measure the market will be purchased and processed	PG&E to purchase third-party data by May 2019. Present preliminary findings in September 2019 and finalize in end of year report.
External Rebate Analysis	An analysis will be undertaken of external rebates and other factors influencing RPP qualified product market uptake in CA	Present preliminary findings in September 2019 and finalize in end of year report.
Holistic Analysis Approach	All relevant RPP data inputs will be compiled and used to triangulate program influence	Present preliminary findings in November 2019 and finalize in end of year report.
Market Transformation Adjustment Mechanism Development	A mechanism will be developed to initiate investigation and make program adjustments in response to unexpected results and market changes	PG&E and CPUC will reach consensus on these mechanisms by November 2019.
General/Overarching items	A final report to be delivered by end of 2019, with possible additional ad-hoc presentations if the need to discuss program elements arises.	Final report containing all new items with draft by December 27, 2019 and finalized by January 20, 2020.

Please contact Sasha Merigan of the Energy Division staff at 415-703-3303 (alexandersasha.merigan@cpuc.ca.gov) if you have any questions.

Sincerely,

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March 5, 2019

Advice 4071-G/5487-E
(Pacific Gas and Electric Company ID U 39 M)

Public Utilities Commission of the State of California

Subject: **Request for Authority to Continue the Retail Products Platform Pilot within PG&E's Residential Energy Efficiency Plug-Load and Appliances Sub-Program**

Purpose

Pacific Gas and Electric Company (PG&E) requests authorization to continue the Retail Products Platform (RPP) pilot in 2019 by this Tier 1 Advice Letter, per the Disposition to PG&E Advice 3668-G/4765-E and Supplemental PG&E Advice 3668-G-A/4765-E-A. This pilot resides within PG&E's Residential Energy Efficiency Program's Plug-Load and Appliances (PLA) sub-program. This request includes a proposed budget of $4.71 million for the fourth year of the RPP pilot, after which at PG&E's discretion or via third party solicitation, the pilot may convert to an offering within PLA as outlined and approved in PG&E's original Advice Letter launching the RPP pilot.[1]

PG&E's Request

PG&E is requesting the following:

- Approval for the fourth year of the RPP pilot, with a budget of $4.71 million;
- Adoption of the revised program logic model[2] which reflects the findings and recommendations of the early evaluation;
- Adoption of the forward-looking baselines recommended in the report from Energy Solutions[3]; and
- To pause the incentives for sound bars and air cleaners while specification work continues for these products.

[1] PG&E Advice 3668-G/4765-E, pg.1
[2] For more information, see Attachment A, p. F-4.
[3] For more information, see Attachment B.

Background

PG&E's RPP pilot[4] is an innovative and strategic effort established to overcome barriers for residential customers to adopt energy efficient products through a dedicated market transformation program design. This design aims to produce sustainable changes in retail markets for plug-loads and appliances by reducing barriers to the manufacture, distribution, and sales of energy efficient products. By moving the focus from products to markets, PG&E believes RPP can best help California meet the aggressive goals related to voluntary standards and specifications for residential appliances[5] set forth in Senate Bill 350 (SB 350)[6]. Because many of the plug load devices that are the focus of RPP are used in residential settings during hours of occupancy, they contribute disproportionately to California's growing evening ramp and peak characteristic of the "Duck Curve."[7]

The RPP program is in a unique position as California's only current dedicated energy efficiency market transformation program design in advance of an established market transformation framework.[8] PG&E appreciates Energy Division's early commitment to the RPP market transformation effort and the ongoing collaboration between PG&E, the California Public Utilities Commission (CPUC), and stakeholders as the RPP pilot has evolved throughout the pilot phase. The CPUC's support of RPP has enabled PG&E to be a leading voice in building a national coalition of RPP program sponsors[9] and retail partners.[10]

Through the success of RPP, California has developed relationships and industry partnerships that can be leveraged for future market transformation efforts. Through a strong partnership with the Environmental Protection Agency's Energy Star, the Northweast Energy Efficiency Alliance (NEEA), and many other national collaborators, what started as a pilot in PG&E's service territory has now become the Energy Star Retail Products Platform (ESRPP). ESRPP is comprised of a diverse group of national

[4] PG&E is one program sponsor in the national Energy Star Retail Products Platform (ESRPP).
[5] For more information, see "Senate Bill 350: Doubling Energy Efficiency Savings by 2030," NORESCO, p.27, https://efiling.energy.ca.gov/GetDocument.aspx?tn=221631
[6] SB 350 requires the Energy Commission to develop and establish statewide targets that lead to a cumulative doubling of energy efficiency savings from all retail electric and natural gas end-users by 2030. http://www.energy.ca.gov/sb350/timeline.pdf.
[7] PG&E 2018-2025 Business Plan, Residential Programs (Chapter 2)
[8] See Administrative Law Judge's Ruling Seeking Comment on Market Transformaion Staff Proposal, 2018.
[9] Since the inception of the RPP program, the following utilities (listed with their respective states) have joined as program sponsors; PG&E and SMUD (CA), Xcel Energy (CO, MN), Eversource CT, UIL Holdings (CT), NEEA (ID, MT, OR, WA), BGE, PEPCO, SMECO, Delmarva Power, Potomac Edison-First Energy (MD), DTE (MI), Con Edison (NY), Efficiency Vermont (VT), and Focus on Energy (WI).
[10] As of February 2019, retail partners include Best Buy, Home Depot, Lowe's, Sears/Kmart, and Nationwide Buying Group (the largest independent buying group in the United States).

stakeholders, including the Environmental Protection Agency (EPA), energy efficiency program administrators (PA), and major retailers with the common goal of supporting markets for energy efficient plug load and appliance products. The ESRPP continues to expand, giving California a foothold in national markets and a network of partners with the reach to drive efficiency advancements at a broader scale. This nationwide offering, with a focus on midstream program delivery that moves the portfolio away from incentive dependency, is directly in line with PG&E's stated goals and interventions in the 2018-2025 Business Plan[11], which was approved by the Commission in May 2018.[12] With RPP nearing the completion of its pilot phase, the national platform now available to address plug load and appliance efficiency can be an attractive option for other utility and third party programs. In the longer term, conversion of RPP to a full program signals a necessary commitment to industry partners whose supply chains RPP intends to permanently transform.[13]

PG&E provides here an early evaluation of the RPP program (Attachment A), which documents a number of program achievements, and identifies opportunities for further improvement. PG&E agrees with the recommendations in the early evaluation and is implementing the following changes in response: proposing streamlined product tiers to coordinate with retail buyers more efficiently, discontinuing incentives for soundbars and air cleaners, researching third party data sources to assist with program evaluation, continuing to actively work with the EPA to recruit more program sponsors, and proposing an updated logic model.

Also included with this submittal (Attachment B) are forward-looking baseline projections for all product categories and tiers that will enable impact evaluation and savings claims for RPP going forward.

Overview of RPP Progress

To improve the program and advance its learnings, PG&E engaged EMI Consulting to conduct an evaluation of the RPP pilot's accomplishements to date. That evaluation identified program outcomes impacting both California and national markets. The evaluation findings confirm the RPP pilot's influence to increase the availability of in-store energy efficient products, and influence over the ENERGY STAR specification process, which provide more efficient product choices for California residents in the short and long term, respectively.

[11] PG&E 2018-2025 Business Plan, Portfolio Overview (Chapter 1)
[12] D.18-05-041
[13] See Comments of Pacific Gas and Electric Company (U 39-M) on the Administrative Law Judge's Ruling Seeking Comments on Market Transformation Staff Proposal, p. 17 - 19

The recent evaluation of RPP by EMI Consulting was designed, per the RPP Research Plan,[14] to evaluate the effectiveness and impacts of the pilot program activities in 2016 and 2017. The key findings of the evaluation include:

- PG&E's RPP Pilot processes are generally working well, though there are some areas where improvements could be made.
- All activities outlined by program theory have been successfully implemented, including the payment of incentives to participating retailers and the subsequent collection and tracking of sales data.
- PG&E has coordinated with the national ESRPP collaborative to select an optimal set of participating retailers and to recruit new program sponsors, though it may be necessary to add more program sponsors going forward (in order to achieve greater program scale).
- The definition of product eligibility tiers is one area where program processes could be improved, as interviewees reported some challenges related to how the national ESRPP should define the appropriate product tier levels.
- There is evidence that PG&E's participation in activities related to voluntary specifications, codes, and standards is working and leading to the intended outputs.
- Results show the PG&E RPP Pilot is leading to short-term and mid-term impacts as expected by program theory, though the results differ by product category.
- Based on statistical modeling of retailer sales data, the evaluators observe short-term sales increases for five of the eleven product tiers currently targeted by PG&E's RPP Pilot.
- The evaluators also observe corresponding upward trends in program-qualified model assortment share on retailer shelves for five of seven categories.
- Interviews with national-level retail staff show that ESRPP incentives have some influence on retailer decision-making, and interviews with external collaborators show that ESRPP is facilitating the development of ENERGY STAR specifications.
- The national scope of ESRPP, coupled with the lack of availability of third-party market data outside of ESRPP, continues to present challenges to accurately assessing program impacts.

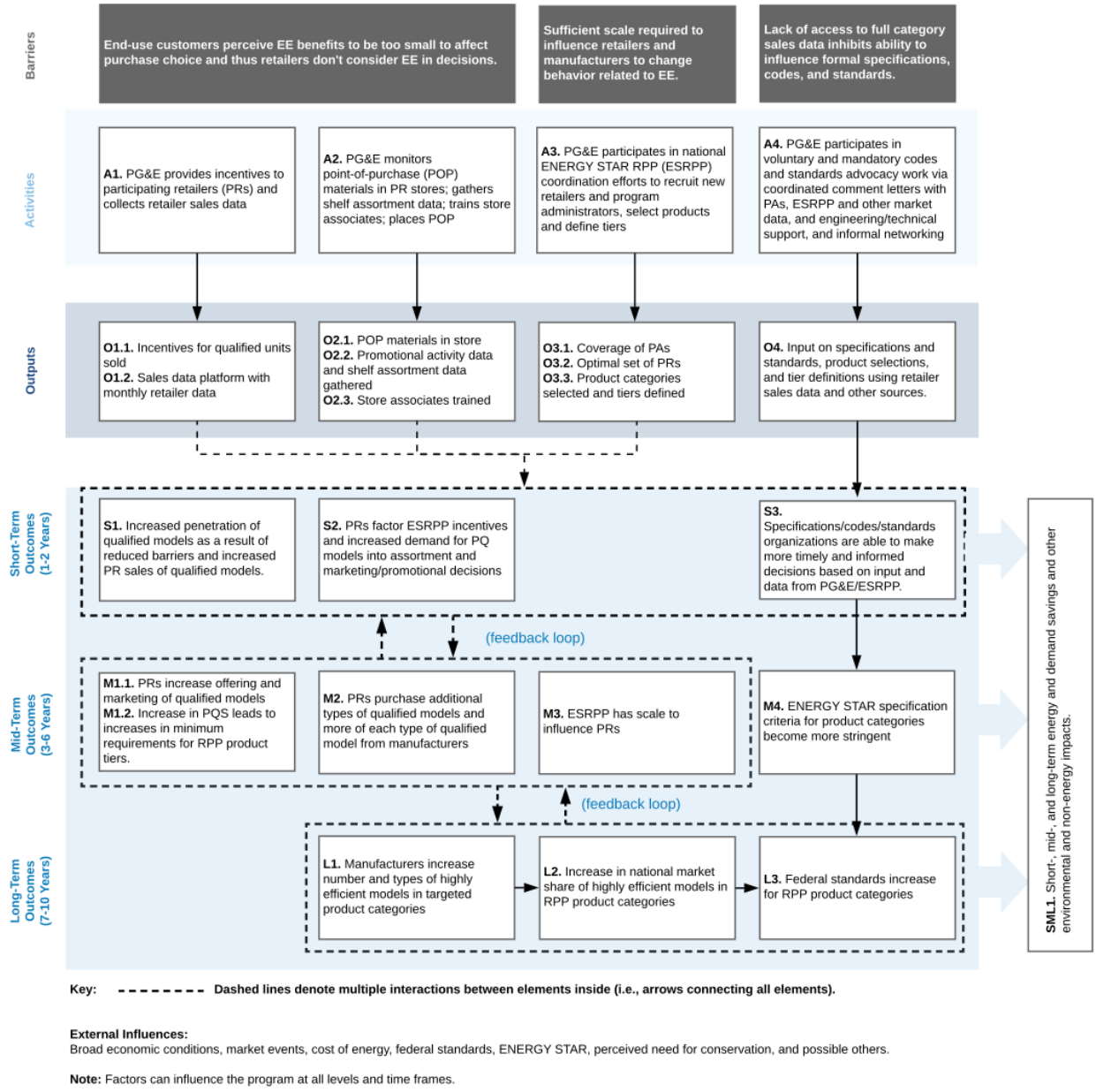
Revised Program Logic Model:

As part of their evaluation, EMI documented where the current pilot aligns and differs from the existing logic model. A deliverable of the evaluation is a revised logic model[15] that more accurately depicts the activities and outputs of RPP. PG&E requests to adopt this updated logic model, shown below, going forward.

[14] For more information, see Advice Letter 3668-G/4765-E, Appendix G.

[15] For more information, see Attachment A, p. F-4.

Table 2: Revised Logic Model



Baselines:

Like any other program, RPP must establish an appropriate baseline in order to estimate the program's impact on the market. There is not yet an established method in California to develop baselines for market transformation programs, so the RPP program team worked with EMI to develop a robust baseline for the current evaluation, and with Energy Solutions (a contracted advisor to the PG&E and EMI teams) to develop long-term baselines to be used in future evaluations. With guidance from Energy Solutions,

EMI calculated baselines using program data, including one year of pre-program sales and the full category sales data provided by retailers. However, this approach is not appropriate for a long-term baseline, as data becomes less relevant over time and fails to reflect ongoing market changes. PG&E worked with Energy Solutions to develop long-term product baselines, with the following objectives:

- Market-based: The baseline rationale should be based on real events and outcomes forecasted for a product category.
- Transparent: The timing and impact of these market events should be clear and easily identifiable in the model. For example, if there is a major market event that will impact the baseline in 2020, it should be easy to identify that impact in both the model input framework as well as the resulting baseline charts.
- Flexible: Forecasts are inherently based on a best estimate of market conditions and may require modifications over time to update and reflect the current reality. For example, a federal standards specification being accelerated or delayed one year could have significant impacts on a baseline forecast, and thus would need to be adjusted to reflect current understanding.
- Logical: Because these forecasts are inherently uncertain, at minimum their outputs should be within the bounds of a logical conclusion or should otherwise be adjusted.

The resulting long-term baselines are detailed in the attached baseline report (Attachment B) which lays out forecast market baselines over 15 years for each product category and tier. This work is based heavily on the NEEA Approach. NEEA is widely regarded as a leader in market transformation policy and practice and has been implementing and refining this savings claims method over two decades.

PG&E selected this NEEA-based method over a modified Codes and Standards method, particularly due to its transparency, clear correlation with real market events, and ability to integrate changes over time.

Updated Measures:

PG&E is not proposing any new measures for the RPP pilot year beginning April 1, 2019 and is proposing the same incentives as in 2018, with two product exceptions described below.

The National ESRPP Products Task Force is pausing incentives for air cleaners, soundbars and dehumidifiers (not in PG&E portfolio) for the 2019 program cycle, as air cleaner and soundbar ENERGY STAR specifications are underway. This change sought to streamline program operations, reduce administrative costs, increase leverage with retailers, and allow air cleaner and soundbar specifications to develop.

PG&E is therefore proposing that RPP incentives for air cleaners and soundbars be set at $0 while they are not actively incented in the National ESRPP program. PG&E staff

will continue to work with other Program Sponsors and ENERGY STAR to revise the specifications and reevaluate incentives at a future date.

Table 3 presents the product categories, tiers, and historic retailer incentive levels, along with those proposed for 2019. These products and specifications were established via collaboration with the EPA and other PAs across the country. PG&E plans to offer the incentive levels shown in Table 1 starting April 1, 2019.

Table 3: Product Categories, Tiers and Incentives to Retailers

Product Category	RPP Tier	Current RRP Standard or Specification*	2016 PG&E Unit Incentive	2017 PG&E Unit Incentive	2018 PG&E Unit Incentive	2019 PG&E Unit Incentive
Sound bars	Basic	ENERGY STAR v3 +15%	$10	$0	$0	N/A
	Advanced	ENERGY STAR v3 +50%	$20	$20	$15	N/A
Air cleaners	Basic	ENERGY STAR v1.2 +30%	$30	$20	$15	N/A
	Advanced	ENERGY STAR v1.2 +50%	N/A	$30	$25	N/A
Freezers	Basic	ENERGY STAR v5	$20	$20	$15	$15
	Advanced	ENERGY STAR v5 +5%	$50	$50	$50	$50
Room air conditioners	Basic	ENERGY STAR v4	$20	$20	$15	$15
	Advanced	ENERGY STAR v4 + connectivity	N/A	$20	$20	$20
Electric clothes dryers	Basic	ENERGY STAR v1.1	$50	$30	$10	$10
	Advanced	ENERGY STAR Most Efficient 2019	N/A	$250	$250	$250
Gas clothes dryers	Basic	ENERGY STAR v1.1	$50	$30	$10	$10
	Advanced	ENERGY STAR Most Efficient 2019	N/A	$250	$250	$250
Clothes washers	Basic	ENERGY STAR v8	N/A	$0	$0	$0
	Advanced	ENERGY STAR Most Efficient 2019	N/A	$20	$20	$20
Refrigerators	Basic	ENERGY STAR v5+8%	N/A	$0	$0	$0
	Advanced	ENERGY STAR Most Efficient 2019	N/A	$20	$20	$20

*ENERGY STAR levels are the versions effective as of January 1, 2019

Updated Retailers:
PG&E is not proposing adding any retailers until new product categories are added in future years.

Sears Corporation is currently undergoing significant transition and it is currently unclear how this will affect their participation in RPP. The RPP team will monitor the situation as it develops.

Protests

Anyone wishing to protest this filing may do so by letter sent via U.S. mail, facsimile or E-mail, no later than March 25, 2019, which is 20 days after the date of this filing. Protests must be submitted to:

CPUC Energy Division
ED Tariff Unit
505 Van Ness Avenue, 4th Floor
San Francisco, California 94102

Facsimile: (415) 703-2200
E-mail: EDTariffUnit@cpuc.ca.gov

Copies of protests also should be mailed to the attention of the Director, Energy Division, Room 4004, at the address shown above.

The protest shall also be sent to PG&E either via E-mail or U.S. mail (and by facsimile, if possible) at the address shown below on the same date it is mailed or delivered to the Commission:

Erik Jacobson
Director, Regulatory Relations
c/o Megan Lawson
Pacific Gas and Electric Company
77 Beale Street, Mail Code B13U
P.O. Box 770000
San Francisco, California 94177

Facsimile: (415) 973-3582
E-mail: PGETariffs@pge.com

Any person (including individuals, groups, or organizations) may protest or respond to an advice letter (General Order 96-B, Section 7.4). The protest shall contain the following information: specification of the advice letter protested; grounds for the protest; supporting factual information or legal argument; name, telephone number, postal address, and (where appropriate) e-mail address of the protestant; and statement that the protest was sent to the utility no later than the day on which the protest was submitted to the reviewing Industry Division (General Order 96-B, Section 3.11).

Effective Date

PG&E requests that this Tier 1 advice letter submittal become effective upon submittal on March 5, 2019.

Notice

In accordance with General Order 96-B, Section IV, a copy of this advice letter is being sent electronically and via U.S. mail to parties shown on the attached list and the parties on the service list for R.13-11-005. Address changes to the General Order 96-B service list should be directed to PG&E at email address PGETariffs@pge.com. For changes to any other service list, please contact the Commission's Process Office at (415) 703-2021 or at Process_Office@cpuc.ca.gov. Send all electronic approvals to PGETariffs@pge.com. Advice letter filings can also be accessed electronically at: http://www.pge.com/tariffs/.

/S/
Erik Jacobson
Director, Regulatory Relations

Attachments

cc: Service List R.13-11-005

California Public Utilities Commission

ADVICE LETTER SUMMARY

ENERGY UTILITY

MUST BE COMPLETED BY UTILITY (Attach additional pages as needed)

Company name/CPUC Utility No.: Pacific Gas and Electric Company (ID U39M)

Utility type:
☑ ELC ☑ GAS ☐ WATER
☐ PLC ☐ HEAT

Contact Person: Yvonne Yang
Phone #: (415)973-2094
E-mail: PGETariffs@pge.com
E-mail Disposition Notice to: Yvonne.Yang@pge.com

EXPLANATION OF UTILITY TYPE
ELC = Electric GAS = Gas WATER = Water
PLC = Pipeline HEAT = Heat

(Date Submitted / Received Stamp by CPUC)

Advice Letter (AL) #: 4071-G/5487-E

Tier Designation: 1

Subject of AL: Request for Authority to Continue the Retail Products Platform Pilot within PG&E's Residential Energy Efficiency Plug-Load and Appliances Sub-Program

Keywords (choose from CPUC listing): Energy Efficiency

AL Type: ☐ Monthly ☐ Quarterly ☐ Annual ☑ One-Time ☐ Other:

If AL submitted in compliance with a Commission order, indicate relevant Decision/Resolution #:

Does AL replace a withdrawn or rejected AL? If so, identify the prior AL: No

Summarize differences between the AL and the prior withdrawn or rejected AL:

Confidential treatment requested? ☐ Yes ☑ No

If yes, specification of confidential information:
Confidential information will be made available to appropriate parties who execute a nondisclosure agreement. Name and contact information to request nondisclosure agreement/ access to confidential information:

Resolution required? ☐ Yes ☑ No

Requested effective date: 3/5/19

No. of tariff sheets: N/A

Estimated system annual revenue effect (%): N/A

Estimated system average rate effect (%): N/A

When rates are affected by AL, include attachment in AL showing average rate effects on customer classes (residential, small commercial, large C/I, agricultural, lighting).

Tariff schedules affected:

Service affected and changes proposed[1]: N/A

Pending advice letters that revise the same tariff sheets: N/A

[1]Discuss in AL if more space is needed.

Clear Form

Protests and all other correspondence regarding this AL are due no later than 20 days after the date of this submittal, unless otherwise authorized by the Commission, and shall be sent to:

CPUC, Energy Division
Attention: Tariff Unit
505 Van Ness Avenue
San Francisco, CA 94102
Email: EDTariffUnit@cpuc.ca.gov

Name: Erik Jacobson, c/o Megan Lawson
Title: Director, Regulatory Relations
Utility Name: Pacific Gas and Electric Company
Address: 77 Beale Street, Mail Code B13U
City: San Francisco, CA 94177
State: California Zip: 94177
Telephone (xxx) xxx-xxxx: (415)973-2093
Facsimile (xxx) xxx-xxxx: (415)973-3582
Email: PGETariffs@pge.com

Name:
Title:
Utility Name:
Address:
City:
State: District of Columbia Zip:
Telephone (xxx) xxx-xxxx:
Facsimile (xxx) xxx-xxxx:
Email:

Clear Form

Advice 4071-G/5487-E
March 5, 2019

Attachment A

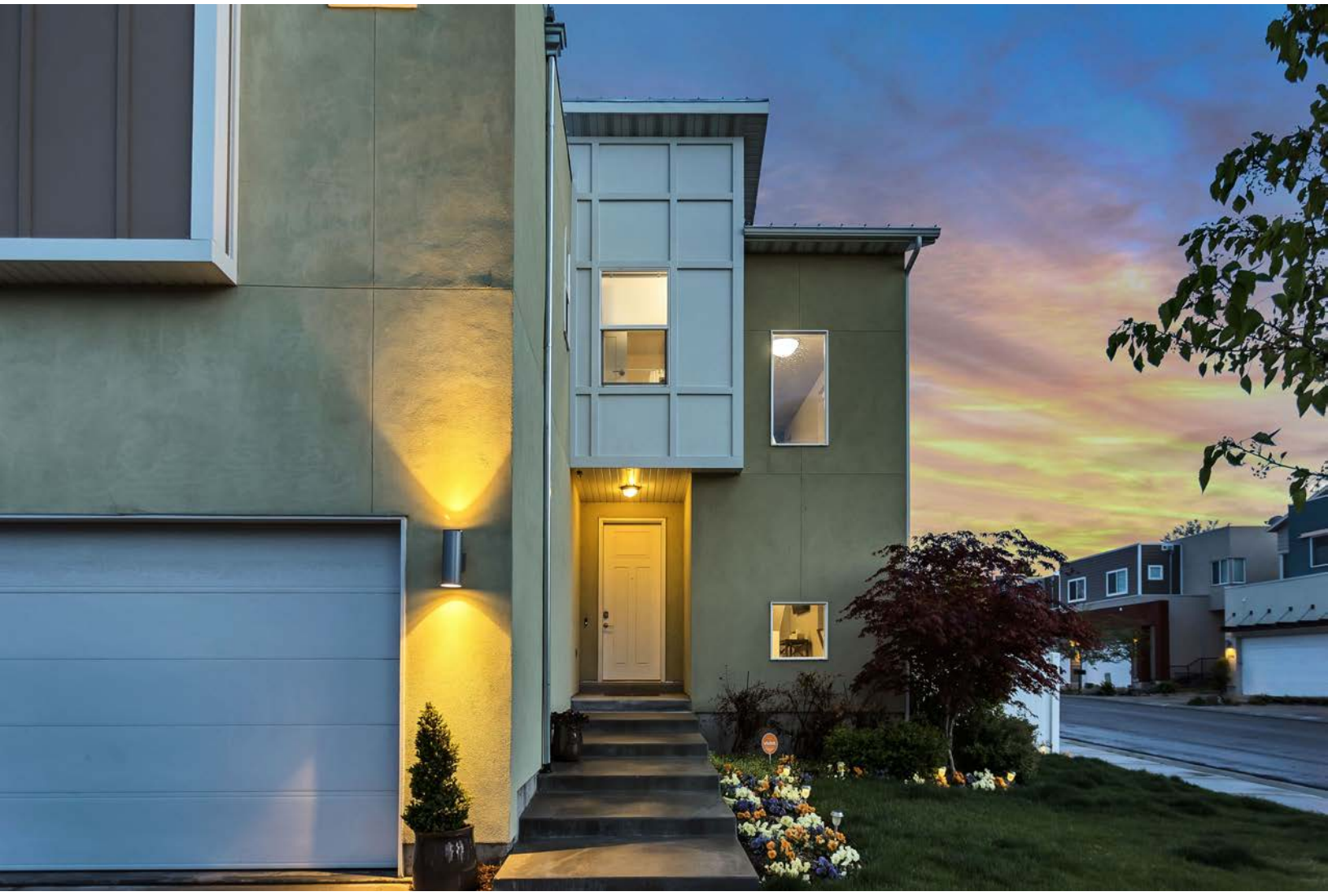
Program Pilot Early Evaluation

PACIFIC GAS & ELECTRIC ENERGY STAR RETAIL PRODUCTS PLATFORM (ESRPP)

PROGRAM PILOT EARLY EVALUATION

Final Report

January 18, 2019



PRESENTED TO:

Doreen Caruth
Evaluation, Measurement and Verification
Pacific Gas & Electric
245 Market Street, N4Q
San Francisco, CA 94105

PRESENTED BY:

Brett Close, PhD
Managing Research Consultant
EMI Consulting
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Seattle, WA 98104

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Executive Summary

PG&E ENERGY STAR Retail Products Platform (ESRPP) Program Pilot Early Evaluation

Introduction

This executive summary presents key findings from EMI Consulting's early evaluation of the PG&E ENERGY STAR Retail Product Platform (ESRPP) Program Pilot, covering the period 2016 through March 2018.

The PG&E ESRPP Program Pilot launched in March of 2016. It is a leading implementation of a larger national effort coordinated by program sponsors across the US. The Pilot aims to transform the market for select product categories of home appliances and consumer electronics towards higher efficiency by (1) influencing retailers to stock, sell, and demand more energy-efficient models in these product categories, and (2) collaborating with organizations to define more stringent specifications and standards.

Process evaluation objectives included: (1) Assessing and informing implementation of the program, (2) Validating key components of program theory, and (3) Providing data and information to aid the assessment of attribution, including information related to PG&E efforts to drive ENERGY STAR specifications.

Impact evaluation objectives included: (1) Measuring total program-qualified unit sales for participating retailers by product category/subcategory, (2) Measuring program-qualified share (PQS), or the percentage of total unit sales that are program-qualified by product category/subcategory, and (3) Computing program energy and demand savings.

Methods

- Program data review
- Interviews with PG&E staff and subcontractors (n=16 over two rounds)
- Interviews with external collaborators from collaborating organizations (n=8)
- Review of retailer implementation data
- Statistical modeling of retailer sales data
- Statistical modeling of in-store shelf assortment data

Program Period Covered:
March 2016 – March 2018

Summary of Findings

Process Findings: At this point in time, PG&E ESRPP Program Pilot processes are generally working well, though there are some areas where improvements could be made.

- All activities outlined by program theory have been successfully implemented, including the payment of incentives to participating retailers and the subsequent collection and tracking of sales data.
- PG&E has coordinated with the national ESRPP collaborative to select an optimal set of participating retailers and recruit new program sponsors, though it may be necessary to add more program sponsors going forward (in order to achieve greater program scale).
- The definition of product eligibility tiers is one area where program processes could be improved, as interviewees reported some challenges related to how ESRPP should define the appropriate levels.
- PG&E's participation in advocacy and outreach activities related to voluntary specifications (i.e., ENERGY STAR) is seen as impactful.

Impact Findings: Results show the PG&E ESRPP Program Pilot is leading to short-term and mid-term impacts as expected by program theory, though the results differ by product category and tier.

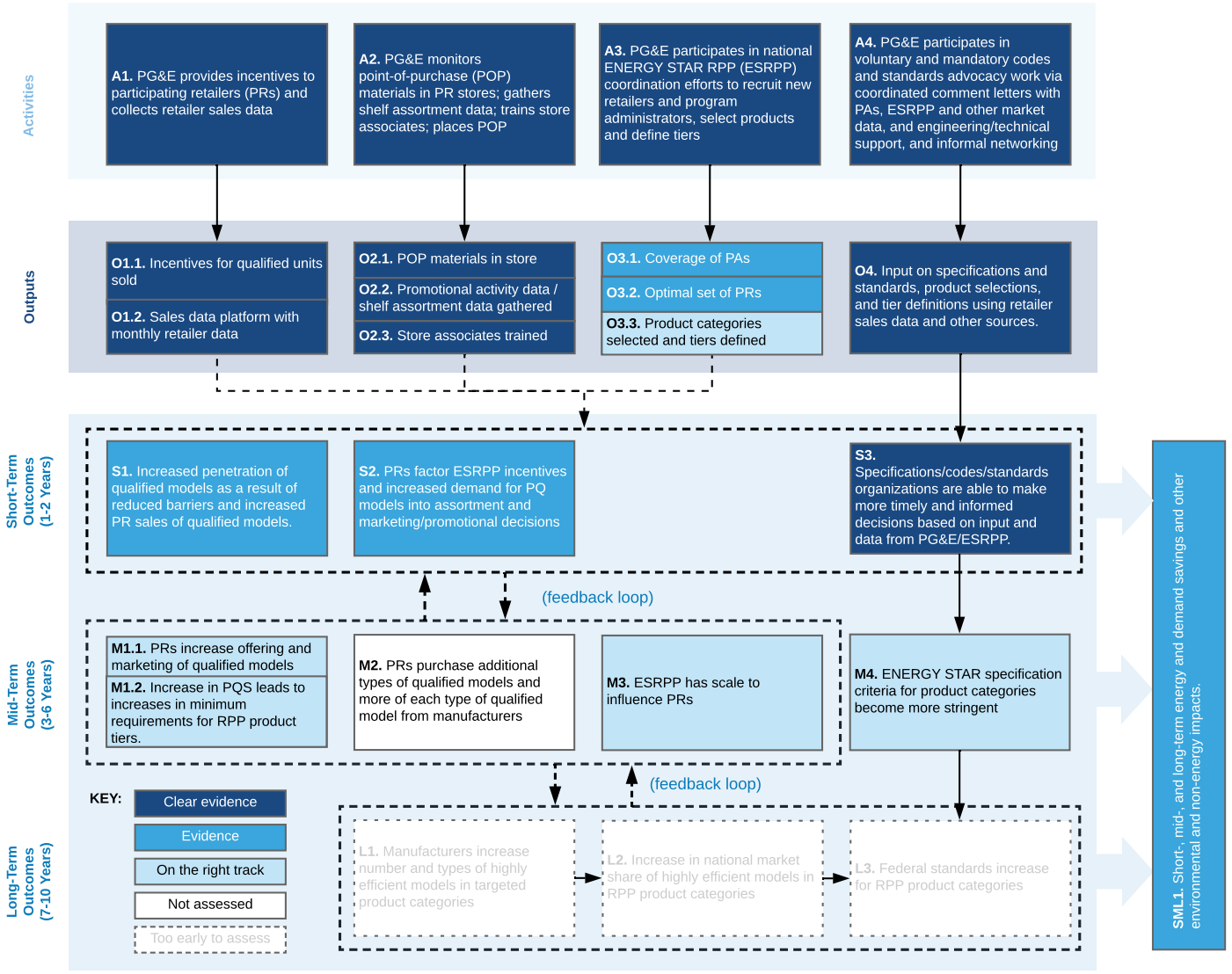
- Based on statistical modeling of retailer sales data, we observe short-term sales increases for 5/11 product tiers currently targeted by PG&E ESRPP.
- We also observe corresponding upward trends in program-qualified model assortment share on retailer shelves for five of seven categories.
- Interviews with national-level retail staff show that ESRPP incentives have some influence on retailer decision-making, and interviews with external collaborators show that ESRPP is facilitating the development of ENERGY STAR specifications.
- The national scope of ESRPP, coupled with the lack of availability of third-party market data outside of ESRPP, continues to present challenges to accurately determining program impacts.

PG&E ENERGY STAR Retail Products Platform (ESRPP) Program Pilot Early Evaluation

Logic Model Assessment

As part of the early evaluation, EMI Consulting worked with PG&E and its subcontractors to define a program logic model that clearly represents program activities and outputs, and maps them to desired short-, mid-, and long-term outcomes. This PG&E ESRPP logic model (shown below), highlights the importance of ESRPP contributions to the development of ENERGY STAR specifications and standards, and also highlights the complex, fluid nature of interactions between program outcomes.

Assessment of PG&E ESRPP Program Pilot Logic Model



Dashed lines denote multiple interactions between elements inside (i.e., arrows connecting all elements).

External Influences:
Broad economic conditions, market events, cost of energy, federal standards, ENERGY STAR, perceived need for conservation, and possible others.

Note: Factors can influence the program at all levels and time frames.

PG&E ENERGY STAR Retail Products Platform (ESRPP) Program Pilot Early Evaluation

Selected Impact Results

Results from the sales data regression modeling show increases for at least one tier for the following product categories: dryers, freezers, refrigerators, and soundbars. Results from the shelf survey analysis show preferential retailer treatment for all tiers except advanced freezers and advanced soundbars. Shelf survey analysis also shows upward trends in model assortment share for dryers, freezers, refrigerators, room air conditioners, and washers. In addition to stocking and assortment, program theory indicates that availability of incentives will lead retailers to provide qualified products with preferential treatment in their internal promotion decisions. Using model-level data collected from 403 individual store visits across 288 retail locations between January and August 2018, we calculated the percentage of models that were placed in a preferential location (anything other than simply in the aisle), the percentage of models that were currently discounted relative to the regular price, and the average discount amount among discounted products by product group and tier. Results indicate at least one type of preferential product treatment by retailers for 9 of 11 tiers currently incented by PG&E.

Summary of Impact Results

Product Category	Tier	Years Incented		Evidence of Preferential Treatment by Retailers?	Increase in Sales Above Baseline?	Increase in Availability of Program-Qualified Models on Shelves?
		PY 2016	PY 2017			
Air Cleaners	Basic	Yes	Yes	Yes	No	No
	Advanced	Yes	Yes	Yes	No	
Air Conditioners	Basic	Yes	Yes	Yes	Indeterminate	Yes
	Advanced	No	Yes	Yes	Too few sales	
Dryers	Basic	Yes	Yes	Yes	Yes	Yes
	Advanced	Yes	Yes	Yes	Yes	
Freezers	Basic	Yes	Yes	Yes	Yes	Yes
	Advanced	Yes	Yes	No	Too few sales	
Refrigerators	Basic	No	No	No	No	Yes
	Advanced	No	Yes	Yes	Yes	
Soundbars	Basic	Yes	No	Yes	No	No
	Advanced	Yes	Yes	No	Yes	
Washers	Basic	No	No	Yes	Yes	Yes
	Advanced	No	Yes	Yes	No	

Challenges and Limitations

The program pilot faced some major early hurdles related to data tracking and availability. Initially, challenges with the processing of retailer sales data made it difficult to perform thorough analysis of qualified models over time. This was more problematic for certain product categories where third-party data on the operating characteristics for individual models did not exist (air cleaners and soundbars). This processing has since become substantially more refined. Another early challenge was related to marketing plans that retailers were required to submit to the ESRPP program detailing their marketing plans for the upcoming program year. The idea is that these "retailer implementation plans" would enable evaluators to tie changes in sales back to specific activities undertaken by retailers and serve as evidence of attribution. However, in the course of early program development, it became clear that retailers were unable to provide this information in a format that would allow for the necessary analyses (likely because such marketing and promotional activities are not planned a year in advance). Instead, the program evaluation had to rely on in-store field data collected by a PG&E subcontractor to better understand what retailers were doing to promote and market program-qualified models.

Conclusions and Recommendations

The 2016-2018 PG&E ESRPP Program Pilot Evaluation research resulted in the following key conclusions and recommendations:

Conclusion 1: The PG&E ESRPP Program Pilot has implemented key activities necessary for the program to operate effectively, but impacts vary by product category. This reinforces the need for the program to have product category-specific strategies and goals that can be tracked and periodically reevaluated. It also suggests that not all product categories may be suitable to include in the ESRPP program.

> **Recommendation 1.1**: Continue to develop product category-specific strategies and targets that are tailored to each product. Additionally, for product categories where an increase in market share is not the primary objective, make sure that another objective has been identified and is clearly documented. For instance, there may be products where the primary objective is to help advance ENERGY STAR specifications. In these cases, there should be a specific need that ESRPP can address (for instance, by providing full-category sales data). To ensure that credit is given to PG&E, it is critical to document the impacts that these data have on subsequent developments for specifications, codes, or standards.
>
> **Recommendation 1.2**: Product categories for which we have not yet observed an increase in sales or assortment share should be closely monitored to ensure they are making reasonable progress toward the objective for that product category. For some product categories, the value of obtaining full category sales data from retailers may provide substantial benefit to PG&E efforts to advance specifications, codes, and standards. In these cases, there is an argument for keeping these product categories in the program, assuming that the relevant sales data can be used to advance voluntary or mandatory requirements (see Recommendation #1.1 above). It may be prudent to make downward adjustments to the incentive amounts for these product categories to reflect this strategy.

Conclusion 2: Analysis of sales data shows short-term increases in the sales share of program-qualified models for 5/11 product tiers, or 4/7 product categories currently targeted by PG&E ESRPP. At the same time, we observed preferential retailer promotional efforts and assortment increases for many of these same product categories. Collectively, this provides evidence that the core ESRPP program mechanism is working for these product categories/tiers. Our analysis indicates that the ESRPP intervention is linked to a statistically-significant increase in sales for dryers (basic and advanced), freezers (advanced), and soundbars (advanced). Additionally, we see a small but statistically-significant upward trend in the shelf assortment of program-qualified models on store shelves—a mid-term outcome which is expected to follow increases in program-qualified sales. Collectively these findings provide supporting evidence that, for some product categories, the core ESRPP intervention is having some effect.

Conclusion 3: National ESRPP program processes could be improved by adopting a simplified approach for defining tiers within a product category and, to the extent possible, aligning these tiers with ENERGY STAR requirements. An important feature of the ESRPP program design is the ability to "ratchet up" tier requirements as program-qualified share increases for these product categories. To date, the ESRPP collaborative has used a flexible method in which tier eligibility requirements are aligned annually with ENERGY STAR specifications except in cases where the market share for that product category is already high. In these cases, the tier requirements have been set to "ENERGY STAR + XX%" (where the precise percentage varies based on the current program-qualified market share). This is a necessary adjustment for the program to make. However, in some cases it has caused logistical difficulties for the program and for retailers because it becomes more difficult to determine which models actually qualify for each tier.

> **Recommendation 3.1:** In the future, PG&E should work with other program sponsors to explore simplifying the qualifying requirements used for the national ESRPP program and, to the extent possible, keeping these qualifying requirements aligned with ENERGY STAR definitions. For instance, ESRPP could choose to align qualifying requirements with ENERGY STAR Most Efficient (ESME) in categories where there is such designation. In categories that lack ESME, there may be value in working with the EPA to establish such a designation.

Conclusions and Recommendations (continued)

Conclusion 4: The full category sales data provided by participating retailers are a valuable tool, particularly for facilitating the development of specifications, codes, and standards. Interviews with external collaborators indicate that these data have already been used to facilitate the development of ENERGY STAR specifications. Further research has revealed that these data do not exist anywhere outside of the ESRPP efforts, making it an even more valuable resource.

> **Recommendation 4.1:** Given the long-term program goals of changing mandatory and voluntary specifications, PG&E should continue to work with regulatory bodies to provide data and analysis to accelerate the adoption of these rules.

Conclusion 5: PG&E's ESRPP program pilot is highly influential within the national ESRPP collaborative effort. Interviews with external collaborators provide evidence that PG&E is considered by other program sponsors and collaborating agencies to be one of two primary drivers of the national ESRPP effort, the other driver being the Northwest Energy Efficiency Alliance (NEEA). In particular, it appears that PG&E and NEEA are driving much of the codes and standards advocacy work.

Conclusion 6: As the PG&E ESRPP Program Pilot continues to operate moving forward, the current baseline approach (i.e., a pre/post model averaging baseline) will become less useful as the pre-period sales data become outdated. Therefore, it will become increasingly important to use a baseline approach that is able to account for new developments and external changes in the market.

> **Recommendation 6.1:** Moving forward, the PG&E ESRPP Program Pilot should adopt a baseline approach similar to that employed by NEEA to help understand and assess market transformation effects due to the ESRPP program. There are several benefits of using a baseline approach similar to that utilized by NEEA: (1) the approach has already been in use for some time, (2) it is transparent and flexible, and (3) using such an approach would facilitate evaluation consistency across two of the most important ESRPP program sponsors.

1. INTRODUCTION

Pacific Gas and Electric Company's (PG&E's) ENERGY STAR Retail Product Platform (ESRPP) Program Pilot aims to transform the market for select product categories of home appliances and consumer electronics towards higher efficiency by (1) influencing retailers to stock, sell, and demand more energy-efficient models in these product categories, and (2) collaborating with organizations to define more stringent specifications and standards.[1] The PG&E ESRPP Program Pilot is one of the first implementations of a larger national effort coordinated by program sponsors across the US.

This evaluation report provides the results of an early evaluation of the PG&E ESRPP Program Pilot by EMI Consulting, covering 2016 through March 2018. This introduction includes background information relevant to the PG&E ESRPP Program Pilot and the evaluation.

1.1 ESRPP PROGRAM HISTORY

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,"[2] and recommended that utilities "continue equipment efficiency incentive programs" and "aggressively promote equipment efficiency regulations at the state and federal level."[3]

The RPP concept was initially tested in a trial with a single participating retailer in 24 of its 41 stores located in the PG&E and SMUD service territories that took place

[1] California 2016-2019 Retail Products Platform Pilot Evaluation Plan. October 16, 2015.

[2] 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

[3] Ibid. p. 51.

from November 2013 to December 2014.[4] The 2013-2014 RPP 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.

1.2 CURRENT STATUS OF ESRPP

Starting in March 2016, the RPP Program became a national effort under the auspices of ENERGY STAR (henceforth referred to as ENERGY STAR RPP, or ESRPP). As of 2018, the participating retailers are Best Buy, The Home Depot, Sears/Kmart, Nationwide,[5] and Lowe's.

Utilities and energy efficiency organizations[6] ("program sponsors") across the US have partnered with each other to develop and implement ESRPP. Each participating program sponsor pays participating retailers per-unit incentives for every program-qualified unit sold during the program period. The program intent is to enlist additional program sponsors over time. As of March 2018, there were seven program sponsors.[7] With the addition of seven new program sponsors in mid-2018, the ESRPP program now covers roughly 18% of the total U.S. residential population.[8]

Within each product category, program-qualified models are divided into basic and advanced tiers based on efficiency levels set by the program sponsors. The models in the basic tiers meet or exceed the minimum ENERGY STAR specification; advanced tiers consist of more efficient models for which retailers receive higher

[4] A copy of the RPP Trial evaluation report is available here: https://www.etcc-ca.com/reports/pacific-gas-and-electric-company-retail-plug-load-portfolio-rpp-trial. The evaluation of the trial found roughly a 5% lift in qualified sales due to promotional activities tied to the intervention.

[5] Participating retailers are contractually obligated to provide sales data as part of the ESRPP program. Nationwide provides unit shipment data instead of unit sales data.

[6] Examples of non-utility program sponsors include Efficiency Vermont and the Northwest Energy Efficiency Alliance (NEEA).

[7] Program sponsors as of March 2018 included PG&E, the Northwest Energy Efficiency Alliance (NEEA), Sacramento Municipal Utility District (SMUD), Con Edison (New York), Focus on Energy (Wisconsin), Xcel Energy (Colorado and Minnesota), and Efficiency Vermont.

[8] New program sponsors onboarding in 2018 include four Maryland utilities (First Energy, Pepco, SMECO, and BGE) and two Connecticut utilities (Eversource and United Illuminating). Source: https://www.energystar.gov/sites/default/files/asset/document/ESRPP_1pager_08-29-18_508_0.pdf)

per-unit incentives.[9] The program theory holds that by increasing the sales of energy-efficient models over less efficient models, ESRPP will generate energy and demand savings for utility customers in the short-, mid-, and long-terms through participating retailers, while also transforming the overall market towards higher efficiency in the long-term.

For the 2016 national ESRPP Program cycle (March 2016 through March 2017),[10] Sponsors of the ESRPP Program incented five product categories: air cleaners, clothes dryers (both electric and gas), freezers, room air conditioners, and sound bars. For the 2017 program cycle (April 2017 through March 2018), two additional product categories were added to the program (clothes washers and refrigerators).[11]

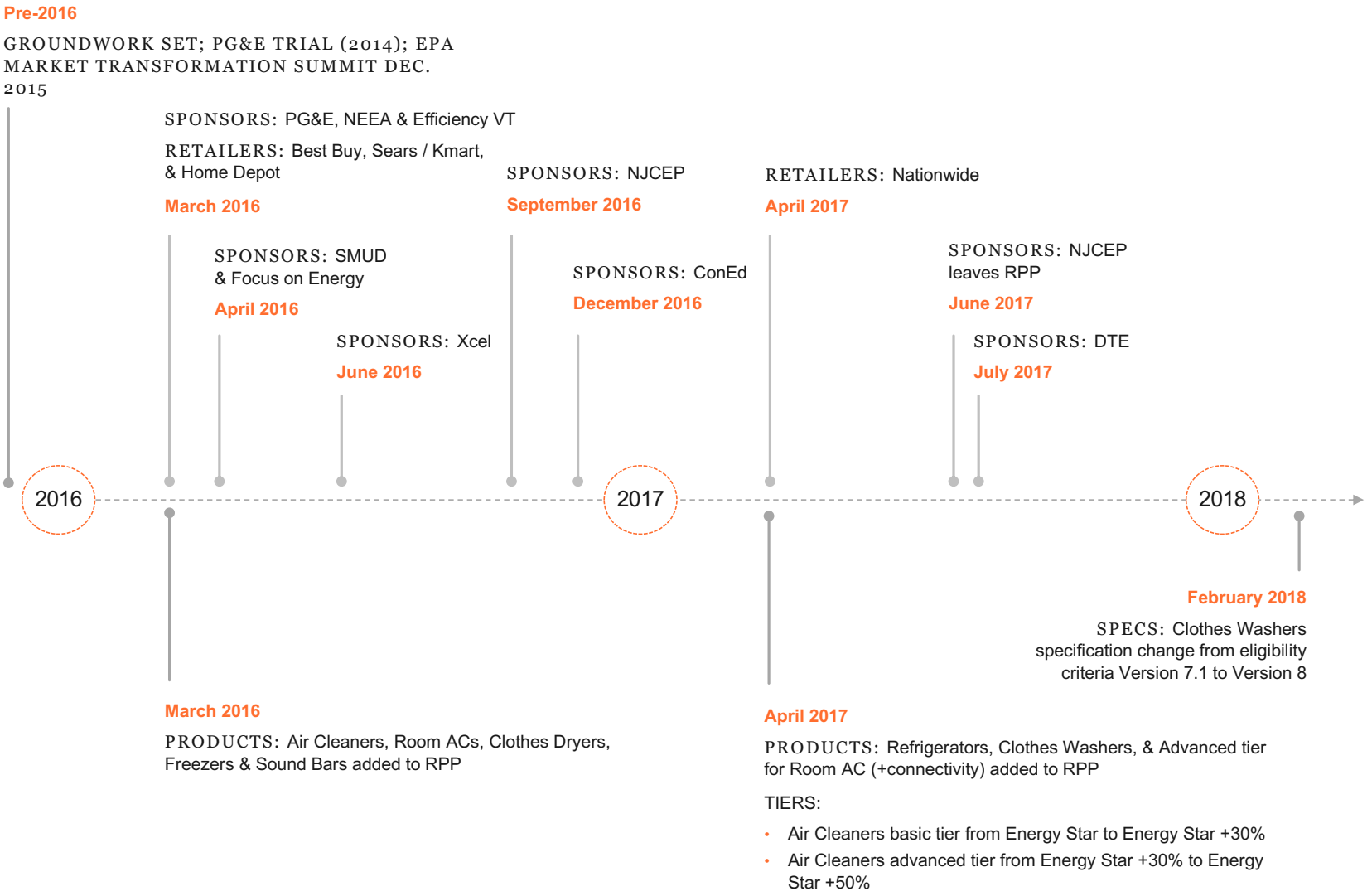
Figure 1-1 below provides a timeline of key ESRPP developments.

[9] The precise eligibility requirements for basic and advanced tiers vary by product category and are based on each product's unique set of efficiency metrics (e.g., clean air delivery rate for air cleaners).

[10] The national program cycle runs from April through March, though the first-year started in March 2016; new retailers or program sponsors can join at any time.

[11] Dehumidifiers were added as a national-level product category in April 2018 but are not included in the scope of this evaluation.

Figure 1-1. National ESRPP Timeline, March 2016-March 2018



PG&E IMPLEMENTATION OF ESRPP

As one of the first and largest ESRPP program sponsors, PG&E manages a portfolio of seven product categories. Each product category is divided into a basic and advanced tier, though PG&E does not incent all tiers. As shown below in Table 1-1, each tier has an associated incentive value. From the 2016-2017 program cycle to the 2017-2018 program cycle, the tier requirements changed for air cleaners, dryers (advanced tier), refrigerators (advanced tier), room ACs (advanced tier), and washers (advanced tier). PG&E additionally adjusted its incentive amounts for dryers, refrigerators (advanced tier), and washers (advanced tier).

Table 1-1. PG&E ESRPP Product Categories, Tiers, and Incentives, 2016-2018

Product	RPP Tier	2016		2017	
		Spec	Incentive	Spec	Incentive
Air Cleaners	Basic	ES v1.2	$20	**ES v1.2 +30%**	$20
	Advanced	ES v1.2 +30%	$30	**ES v1.2 +50%**	$30
Clothes Dryers	Basic	ES v1.0	$50	ES v1.0	**$30**
	Advanced	ES ET Award (electric only)	$250	**ESME 2017**	$250
Freezers	Basic	ES v5	$20	ES v5	$20
	Advanced	ES v5 +5%	$50	ES v5 +5%	$50
Refrigerators	Basic	-	-	ES v5	$0
	Advanced	-	-	**ESME 2017**	**$20**
Room Air Conditioners	Basic	ES v3.1	$20	ES v4	$20
	Advanced	-	-	**ES v4 + conn.**	$20
Soundbars	Basic	ES v3 +15%	$10	ES v3 +15%	$0
	Advanced	ES v3 +50%	$20	ES v3 +50%	$20
Washers	Basic	-	-	ESME 2017	$0
	Advanced	-	-	**ESME 2017 +5%**	**$20**

Note: Tiers or incentives that changed in the second year of program operations are in bold.

1.3 EVALUATION OBJECTIVES

Because the PG&E ESRPP Program Pilot concept is one of the first programs of its type aimed at longer-term market transformation in the State of California,[12] the evaluation has assessed various program processes in addition to identifying and measuring performance and market transformation indicators.

The objectives of the **process evaluation** of the PG&E ESRPP Program Pilot include:

- Assessing and informing the implementation of the program
- Validating key components of the program theory
- Providing data and information to aid the assessment of attribution, including the degree to which PG&E collaborates with other organizations to define more stringent specifications and standards

Since the primary performance objectives of the PG&E ESRPP Program Pilot are to increase sales of energy-efficient products that will, in turn, affect reductions in energy consumption for targeted product categories, the PG&E ESRPP Program Pilot evaluation includes an **impact evaluation** to inform savings claims,[13] which will be aimed at accurately:

- Measuring total program-qualified unit sales for participating retailers by product category/subcategory
- Measuring program-qualified share (PQS), or the percentage of total unit sales that are program-qualified by product category/subcategory
- Computing gross program energy and demand savings

To the extent possible, the evaluation of the ESRPP Program Pilot complies with the California Energy Efficiency Evaluation Protocols: Technical, Methodological, and

[12] The PG&E ESRPP Program Pilot is a larger-scale version of the PG&E RPP Phase I Trial, which took place between 2013-2014. The Phase I Trial followed the Business and Consumer Electronics (BCE) program, which took place in 2010-2012.

[13] 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 impact evaluation as 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.

Reporting Requirements for Evaluation Professionals[14] and The Program Evaluation Standards: A Guide for Evaluators and Evaluation Users.[15] However, because of the diversity of evaluation objectives that exist for the ESRPP Program, no single methodology is suitable for assessing all objectives. Some objectives are more qualitative in nature and involve assessing and evaluating operational activities and processes to ensure that the program is being implemented as planned and functioning as expected. Other objectives are more quantitative in nature and involve defining, measuring, and analyzing specific indicators of program progress, attribution, and/or success. Also, since this is a novel program concept aimed at market transformation, an additional objective of the evaluation includes assessing the array of potential approaches to evaluating the program to identify the most effective, informative, and feasible approaches to apply, should the program be further scaled up in ensuing years.

Because the California Public Utilities Commission's Energy Division (CPUC-ED) is responsible for conducting *ex post* impact evaluations in California, this evaluation of the PG&E ESRPP Program Pilot should be viewed as an Early EM&V effort, as permitted for pilot programs in California. This evaluation also incorporates lessons learned from leading the evaluation of the initial 2013-2014 RPP Program Trial,[16] as well as lessons learned from the first two years of pilot program operations. As such, it should also be viewed as a second-phase developmental evaluation.[17] Additionally, the results of this evaluation may be used to assist other Program Administrators and ENERGY STAR in the development and implementation of the multi-region evaluation efforts.

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

[15] 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.

[16] Malinick, T. and Ridge, R. 2015. Pacific Gas and Electric Company Retail Plug-Load Portfolio (RPP) Trial: Evaluation Report. April 24, 2015.

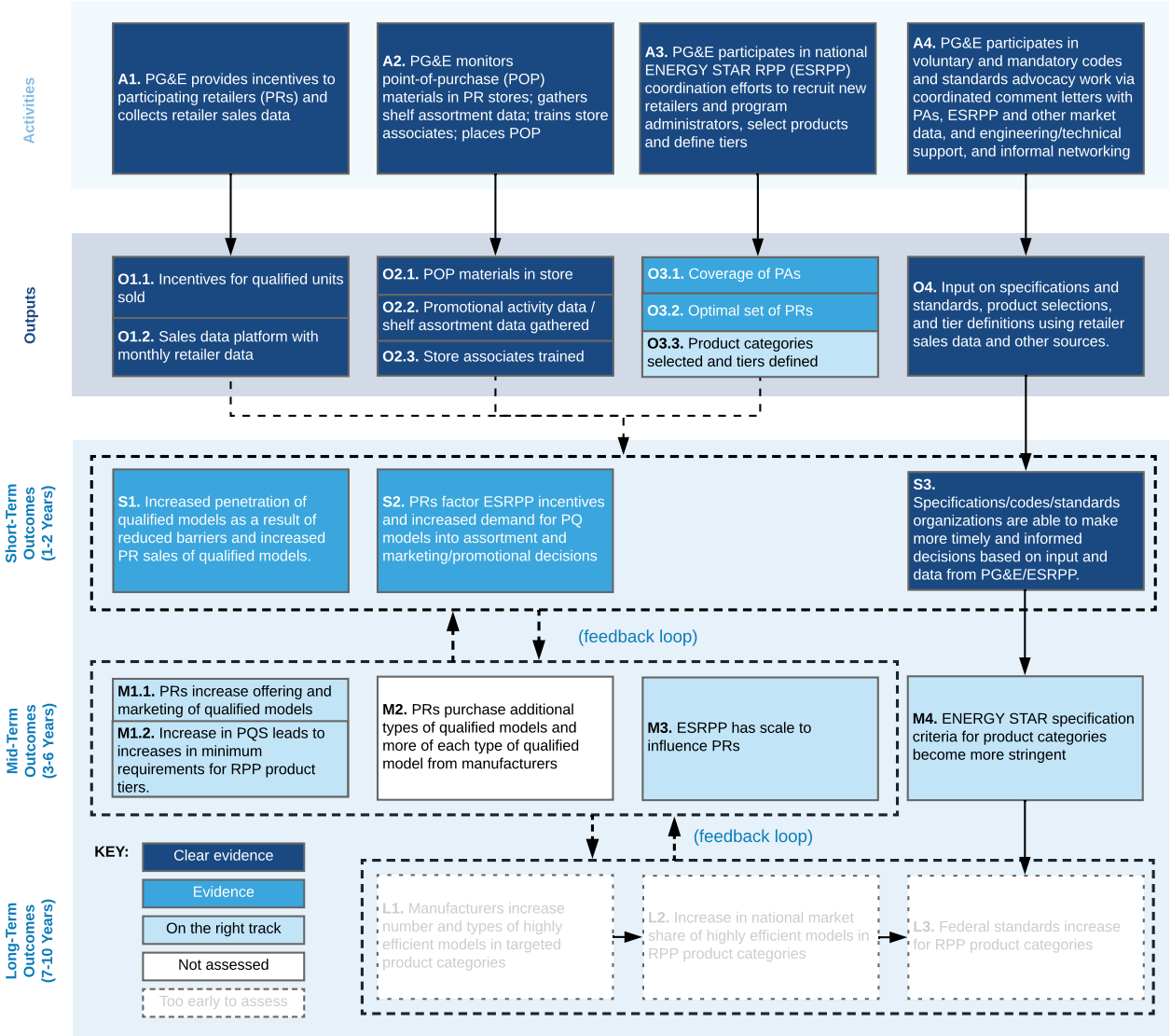
[17] Patton, M.Q. 2010. Developmental Evaluation. Applying Complexity Concepts to Enhance Innovation and Use. New York, NY: Guilford Press.

1.4 KEY FINDINGS

In this section we provide key findings from the process and impact evaluations of the PG&E ESRPP Program Pilot. An overall summary graphic is provided below as Figure 1-2.[18] We then discuss key process findings and key impact findings.

[18] This graphic represents a set of proposed revisions to the existing program logic model. More information on these revisions is provided in Appendix F.

Figure 1-2. Graphical Summary of PG&E ESRPP Program Pilot Evaluation Results



KEY PROCESS FINDINGS

The PG&E ESRPP program pilot faced some major early hurdles related to data tracking and availability. Initially, challenges with the processing of retailer sales data made it difficult to perform thorough analysis of qualified models over time. This was more problematic for certain product categories where third-party data on the operating characteristics for individual models did not exist (air cleaners and sound bars). This processing has since become substantially more refined. Another early challenge was related to marketing plans that retailers were required to submit to the ESRPP program detailing their marketing plans for the upcoming

program year. The idea was that these "retailer implementation plans" would enable evaluators to tie changes in sales back to specific activities undertaken by retailers and serve as evidence of attribution. However, in the course of early program development, it became clear that retailers were unable to provide this information in a format that would allow for the necessary analyses (likely because such marketing and promotional activities are not planned a year in advance). Instead, the program evaluation had to rely on in-store field data collected by a PG&E subcontractor to better understand what retailers were doing to promote and market program-qualified models.

At this point in time, PG&E ESRPP Program Pilot processes are generally working well, as reported by staff and external collaborator interviewees. As shown in the graphical PG&E ESRPP logic model above in Figure 1-2, all activities and outputs are occurring as intended. The incentive payments to participating retailers and the subsequent collection of sales data—collectively the core "engine" of ESRPP—are occurring (logic model elements A1 and O1). Similarly, the collection of in-store field data and placement of ESRPP signage by PG&E has been successfully implemented (logic model elements A2 and O2). PG&E has successfully coordinated with the national ESRPP collaborative to recruit new program sponsors and select an optimal set of participating retailers, though some interviewees believe that the addition of more program administrators is necessary going forward (in order to achieve greater program scale, which would bring more leverage, and thereby greater transformation). The definition of product eligibility tiers (logic model element O3.3) is one area where program processes could be improved, as interviewees reported some challenges related to how ESRPP should define the appropriate levels. Lastly, there is clear evidence that PG&E's participation in activities related to voluntary specifications, codes, and standards (logic model elements A4 and O4) is working well and leading to the intended outputs.

KEY IMPACT FINDINGS

Early evaluation results provide evidence that the PG&E ESRPP program is leading to short-term and mid-term impacts as expected by program theory, though the results differ by product category. Based on statistical modeling of retailer sales data, we observe short-term sales increases (logic model element S1) for four of the seven product categories currently targeted by ESRPP, and corresponding upward trends in program-qualified model assortment share on retailer shelves for five categories (logic model element M1.1). At the same time, interviews with national-level retail staff show that ESRPP incentives have some influence on retailer decision-making (logic model element S2), and interviews with external collaborators show that ESRPP is facilitating the development of ENERGY STAR specifications (logic model element S3). At this point in time, it is premature to assess the long-term outcomes included in the logic model.

There are also a number of shortcomings identified in the program pilot's ability to achieve its desired short-term and mid-term outcomes.

- In looking at short-term outcomes, we do not see statistically-significant increases in sales across *all* product categories and tiers receiving incentives (logic model element S1).[19]
- Secondly, although retailers do indicate that ESRPP incentives have factored into their decision-making (logic model element S2), it remains difficult to understand exactly how the ESRPP incentives are considered by retailers relative to other considerations (e.g., manufacturers competing for shelf space).
- Lastly, at this stage, much of PG&E ESRPP's advocacy efforts have been aimed at ENERGY STAR, with limited activities aimed at other standards-setting bodies (logic model element S3).

In looking at mid-term outcomes, we see several additional shortcomings.

- While our analysis of shelf survey data shows increases in model assortment share for 5 of 7 product categories, an additional two product categories are either flat (air cleaners and soundbars) or have a decreasing trend in model assortment share. The reasons for this are unclear. PG&E has identified that the primary objective for these categories is to facilitate the advancement of ENERGY STAR specifications through the provision of market data, making the lack of increasing market share for these categories less critical.
- In the mid-term, increasing market share is designed to lead to a "ratcheting up" of program requirements. In many cases this requires setting an efficiency level based on ENERGY STAR but does not map directly to an existing designation such as ENERGY STAR Most Efficient. This new level instead takes the form of "ENERGY STAR + XX%" and makes it difficult for retailers (and potentially customers) to easily understand which models are program-qualified without looking at the official qualified products list.

In the next chapter, we outline the methods used as part of this evaluation.

[19] As noted elsewhere in this report, for some product categories/tiers, increasing sales of program-qualified models was not the primary objective.

2. METHODS

This chapter includes a summary of methods used to complete the evaluation research. Research activities included:

- A review of PG&E ESRPP Program documentation
- Interviews with PG&E ESRPP program staff and external collaborators
- A review of interviews conducted with national-level retail staff [20]
- A review of retailer-provided implementation plans
- Regression analysis using sales data provided by participating retailers
- Shelf survey analysis using field data collected by PG&E

Table 2-1 below indicates the timeline showing when each of these research activities was conducted.

[20] These interviews were conducted by Cadmus as part of the national ESRPP program efforts.

Table 2-1. Timeline of Evaluation Research Activities

Research Activity		Timeframe	General or Product Category-Specific?
Review of PG&E Program Documentation		EMI Consulting has reviewed program strategy documents at several points throughout 2018.	Mainly general. Some documents did have category-specific information.
In-Depth Interviews with PG&E ESRPP Staff and External Collaborators	Interviews with PG&E ESRPP Staff	EMI Consulting initially conducted a round of interviews with PG&E ESRPP staff in late 2016 (n=8). EMI Consulting conducted a second round of interviews with PG&E ESRPP staff in mid-2018 (n=8). The second round of interviews included some but not all of the staff from the first round.	General
	Interviews with External Collaborators	EMI Consulting conducted eight in-depth interviews with "external collaborators" in mid-2018. These collaborators mainly represented entities involved with specification development, as well as other ESRPP program sponsors. These interviews also included two manufacturing suppliers.	General
Interviews with National-Level Retailer Staff		Year 1 Interviews were conducted by Cadmus in late 2016 and early 2018. The results of these interviews were then provided to EMI Consulting.	Mainly general
Review of Retailer Implementation Plans		Plans were provided by retailers at the beginning of PY 2016 and PY 2017. EMI Consulting reviewed these plans at that time.	Plans were intended to be product category-specific but the documents provided only allowed a more general analysis.
Regression Analysis of Retailer-Provided Sales Data		EMI Consulting conducted a regression analysis of retailer-provided sales data in late 2018.	Product-category specific
Analysis of In-Store Field Data Collected by PG&E		EMI Consulting conducted an analysis of in-store field data in late 2018.	Product-category specific

In Table 2-2 below, we map the research activities to the evaluation objectives of this study.

Table 2-2. Mapping of Research Activities to Evaluation Objective

Objective	Evaluation Activity					
	Program documentation review	Interviews with staff and external collaborators	Review of national retailer interviews	Review of retailer implementation plans	Sales data analysis	Shelf survey analysis
Assess and inform the implementation of the program	●	●	●	●	●	●
Validate key components of the program theory	●	●	●	●	●	●
Provide data and information to aid the assessment of attribution	●	●	●	●	●	●
Measure total program-qualified unit sales for participating retailers by product category/subcategory					●	
Measure program-qualified share by product category/subcategory					Program-qualified sales share	Program-qualified model assortment (shelf) share
Compute program energy and demand savings					●	

2.1 PROGRAM DATA REVIEW

As part of the ESRPP Program Pilot, PG&E engages Energy Solutions to formulate and implement strategies for each product category, with the goal of maximizing program influence and understanding how efficiency requirements should be set (i.e., at what level). The evaluation team reviewed documentation of these product strategies (called "Product Strategy decks") provided by Energy Solutions to better understand how the PG&E ESRPP Program Pilot is designed to influence product categories.

PG&E also engages with ICF International, which serves as the retail data aggregator for the national ESRPP effort. ICF International receives retailer data from retailers and processes this data to determine which model sales are qualified vs. non-qualified, and to assign them to the appropriate tier, bin, and any other subcategories as needed. ICF International then makes this processed data available to program sponsors and evaluators via an online data portal. Retailer sales data is subject to a number of restrictions designed to ensure a degree of anonymity. For example, retailer names are not attached to sales of non-qualifying models.

2.2 INTERVIEWS WITH PROGRAM STAFF AND EXTERNAL COLLABORATORS

As part of the implementation of the ESRPP Program, Program Administrator (PA) staff and the implementation team are expected to network with different organizations, such as:

- Internal PG&E Codes & Standards program staff
- Staff from other ESRPP PAs
- EPA/ENERGY STAR staff, and
- Staff from agencies involved with setting codes and standards

As part of the PG&E ESRPP Program Evaluation, EMI Consulting conducted eight PG&E ESRPP staff interviews and eight external collaborator interviews. The program staff interviewees included four PG&E program staff and four subcontractor staff. The external collaborator interviews included two other ESRPP Program Administrators (i.e., not PG&E); three staff members of government agencies working with specifications, codes, and standards; and two upstream suppliers that provide components to manufacturers. Interviews were conducted over the phone and typically lasted between 45 minutes and 1 hour.

The specific research topics/questions for this task included the following:

- What does communication look like within the PG&E ESRPP Program Pilot?
- What are the lessons learned from the development and implementation of the pilot? What have been the greatest successes? What have been the greatest challenges?
- Are the program processes appropriate and scalable?
- What is the level of effort PG&E staff is putting towards program activities? According to external collaborators, how influential is the program pilot?
- What is the level of satisfaction with PG&E ESRPP?
- What are recommendations for change and improvements to the program moving forward?

Based partially on the results of these interviews, as well as on a review of program operations and discussions with program staff, EMI Consulting designed a revised logic model to better represent program operations moving forward.

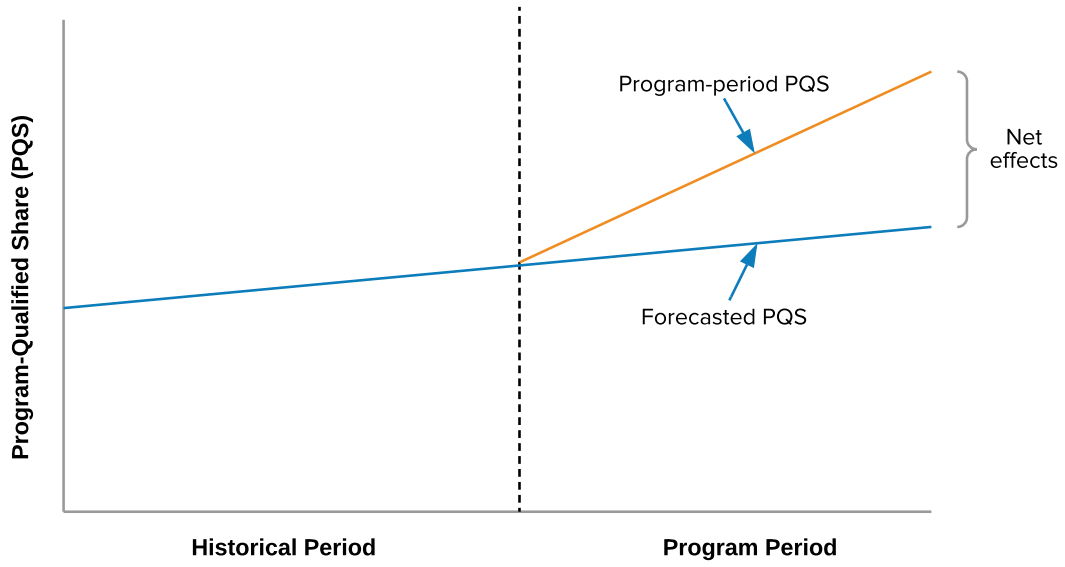
2.3 REVIEW OF RETAILER INTERVIEWS AND RETAILER-PROVIDED IMPLEMENTATION DATA

As part of the national ESRPP evaluation effort, Cadmus conducted 60-minute interviews in late 2016 with retail merchants (responsible for retailer purchasing decisions), marketing staff, and sustainability specialists from Best Buy, Sears/Kmart, and The Home Depot. The interviews addressed all product categories targeted at that time: air cleaners, room air conditioners, sound bars, clothes dryers, and freezers. Cadmus performed follow-up interviews with national retailers in early 2018, covering many of the same topics addressed in the first round of interviews. EMI Consulting reviewed the results of both sets of interviews as part of this evaluation. Additionally, EMI Consulting reviewed retailer implementation plans (RIPs) provided by participating retailers.

2.4 SALES DATA REGRESSION ANALYSIS

EMI Consulting estimated changes in unit sales for ESRPP product groups through the use of a pre/post model-averaging baseline comparison. This analysis involved creating a statistical model of sales in the pre-program period, using this statistical model to predict sales during the program period, and then comparing the predictions to the observed sales. This is depicted graphically below in Figure 2-1.

Figure 2-1. Simplified Depiction of Pre/Post Modeled Baseline Approach



EMI Consulting adjusted the data for seasonal variation using the observed seasonal patterns over time to smooth out the variation and adjust for different likely sales volumes during different parts of the year. Then, for each product group and classification tier, we developed three statistical models of baseline sales behavior that incorporate different assumptions about how the program affects qualified product sales and how the baseline sales behavior changes. Each of these models allow for "naturally occurring" pre-program trends in sales or market share and is evaluated on the pre-program sales data. The three statistical models are detailed below:

- **Sales Model**: This model uses monthly sales values, assuming that the effect of the program is to increase the sales of program-qualified products. This model explicitly allows qualified and non-qualified sales to vary separately.

- **Market Share Model**: This model uses monthly penetration rates, assuming that the effect of the program is to increase the market share. This model combines the qualified and non-qualified model sales and relies on changes in the ratio over time.

- **Probit Model**: This model uses a transformation of the market share used in the Market Share Model. It assumes that the effect of the program would have a smaller absolute impact on the market share if it is extreme (either very small or very large), but a larger absolute impact if the market share is modest.

For each product group, we combined the three models into an 'Averaging Model' to predict sales levels during the program period.

- **Averaging Model**: This model combines the three models above, based on how well the models predicted actual sales for the pre-program period, to develop a predicted sales value for each program group. This allows the model to incorporate the different assumptions in the three previous models to be combined in a way that fits the data best.

The weights for combining the models are selected using a numerical optimization routine to minimize a statistical measure called the leave-one-out cross validation criterion, which is a measure of how well the model fits each observation if it does not include that observation in the data it uses.[21] We estimated increases in qualified product sales as the difference between the observed sales and the predicted sales. If observed sales were larger than predicted sales, then that constituted an increase in the qualified product sales level during the program period. We then determined if the predicted increases were statistically significant with at least 90% confidence. Because the increase is relative to the baseline market behavior before the program started, we consider the increase attributable to the program.

ESTIMATING PER-UNIT ENERGY SAVINGS

To calculate energy savings, EMI Consulting relied on the per-model savings estimates in the ICF data portal.[22] For each product category we calculated the weighted average of the electric unit energy savings (kWh), electric unit demand reduction (kW), and gas unit energy savings (therms). We then took the weighted average savings for all qualified models sold in a given product category during the program period and multiplied this average value by the sales increase to determine overall savings for that category. The total energy savings and demand reductions are the product of the sales increase and the unit energy savings or demand reduction. We treated unit energy savings and unit demand reduction values as fixed, rather than uncertain, so that the uncertainty in the final savings

[21] This method of model averaging is known as Hansen-Racine Jackknife Model Averaging: Hansen, Bruce E. and Jeffrey S. Racine. "Jackknife model averaging." *Journal of Econometrics*, 167 (2012) pp. 38-46.

[22] EMI Consulting performed a comprehensive check on these values in mid-2017 to ensure that the values in the portal matched the values in the appropriate PG&E workpaper.

estimates is based on the uncertainty in the program-induced sales increase, and not the uncertainty in the energy savings values.

CHALLENGES AND LIMITATIONS

The primary challenge of estimating sales increase is lack of data in the pre-program period. Because product groups have between 12 and 25 months of pre-program sales data, adjustments for seasonality and pre-existing trends in qualified product sales require making assumptions about the underlying seasonality and trend behavior, albeit based on the observable patterns in the data. For example, if there are two observations from the month of June and those observations are high, we assume that those are June seasonal effects and not random fluctuations or due to some other cause. And because no comparison group data are available, the only comparison we can make is based on using the pre-program period to inform what we think would happen to sales in the absence of the program intervention. The approaches taken by EMI Consulting are described briefly below and in more detail in Appendix A.

For any program like ESRPP, data quality is an ongoing challenge. While data quality improved markedly over the course of the first two years of program operations, earlier versions of the data portal did not always classify models consistently over time (as might be needed by evaluators). EMI Consulting conducted an initial quality assurance/quality control (QA/QC) review of the data provided via the data portal and posed questions to the data aggregator, where applicable. Following these discussions, EMI Consulting operated under the assumption that the sales data downloaded from the data portal were correct in terms of sales numbers, program-qualified status, and energy savings.

A broader challenge likely to affect future ESRPP evaluations is that the program design is based only on in-store sales and does not consider the effects of online sales of models in program-eligible product categories. Online sales are becoming increasingly important as more customers make purchases online (at least for some product categories, such as soundbars). It will be important for staff to understand how the program is affected by this channel.

Lastly, it is important to note that the modeling performed as part of this evaluation does not factor in efforts by PG&E and other IOUs over the past few decades to advance energy efficiency through a number of different programs. It is difficult to

estimate the precise impacts that these many programs had on efficiency levels for ESRPP products, though it is possibly quite large.[23]

2.5 SHELF SURVEY ANALYSIS

Through in-store field visits at participating retail locations, PG&E has gathered data on product assortment. Data collected during these in-store visits include information on which models were stocked on store shelves at each retail location on a monthly basis. In our analysis of shelf-survey data, we identified the number of unique models (within a product category) that were program-qualified (by tier) and the number that were non-qualified. This activity allowed us to look at changes in the proportion of distinct models in retailer assortments that are program-qualified over time.

2.6 SYNTHESIS

Throughout this research, the evaluation team relies on a theory-driven evaluation approach[24] to bring together the results of the process evaluation and the impact evaluation. This approach involves operationalizing the key performance indicators associated with key causal linkages in the logic model (i.e., converting the performance indicators into quantifiable and measurable indicators). 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 report, the logic model and underlying program theory have guided the evaluation in order to understand whether the PG&E ESRPP Program Pilot is functioning as intended. While some of these analyses will support reliable conclusions about short-term activities, outputs, and short-term outcomes, an assessment of other mid- and long-term outcomes must be supported through comparisons with the results of future evaluations.

[23] For example, see: "Energy Efficiency Portfolio Report." California Public Utilities Commission. May 2018. Available: http://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/About_Us/Organization/Divisions/Office_of_Governmental_Affairs/Legislation/2018/13-15%20Energy%20Efficiency%20Report_Final.pdf

[24] For more information on theory-driven evaluation see: 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).

3. PG&E ESRPP PROGRAM THEORY

In this chapter we first provide a brief primer on the theory underlying the PG&E ESRPP Program Pilot, including a discussion on how this theory has changed over time. We also provide a detailed explanation of the main levers that ESRPP uses to impact the market.

3.1 PG&E ESRPP PROGRAM THEORY

There are two important aspects of the ESRPP program design:

- **ESRPP is national in scope.** Program sponsors across the US strive for a consistent portfolio of qualifying products in home appliance and consumer electronics categories and coordinate implementation across regions.
- **ESRPP uses a mid-stream delivery mechanism as leverage to influence manufacturers and accelerate the development of specifications, codes, and standards**. Per-unit incentives are paid to participating retailers, with the goal of influencing manufacturers. Additional activities are aimed at influencing development of specifications, codes, and standards.

ESRPP program theory is based on the notion that collective incentives create scale to motivate retailers to assort and sell more qualified models, eventually leading to more orders of energy-efficient models to manufacturers. Specifically, this series of reactions will lead to:

- **Energy and demand savings** for utility customers in the short-, mid-, and long-terms.
- **Market transformation** that grows the customer energy savings opportunity in the long-term as increased sales impacts manufacturing and higher market penetration creates more stringent ENERGY STAR specifications and federal codes and standards.

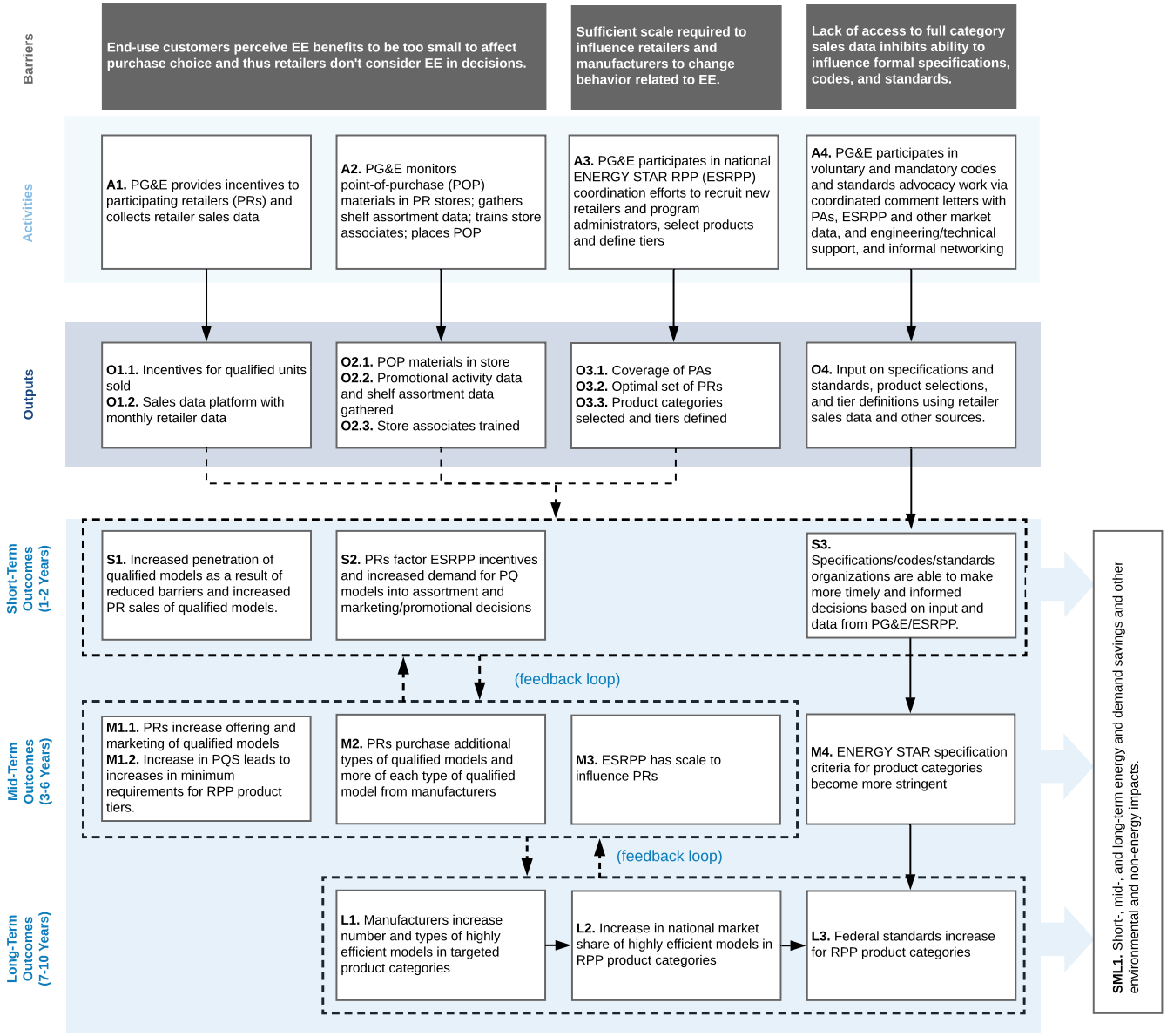
The evaluation team created a revised PG&E ESRPP logic model (presented below as Figure 3-1) to help guide subsequent research activities and frame the overall evaluation using the program theory. According to this program logic model, outcomes of the program are expected to evolve as the program increases in size and maturity:

- In the short-term (1-2 years), the program should gain sufficient scale to influence participating retailers' stocking and marketing, leading to increased sales of program-qualified models in participating store locations. At the same time, program delivery will be improved through the use of sales data and other information being tracked by program staff.

- In the mid-term (3-6 years), participating retailers should increase the proportion of qualified products in their assortment, begin to require more qualifying models from manufacturers, and favor program-qualified models in their marketing efforts. Program theory also suggests that energy efficiency criteria for qualifying products will increase, resulting in a "ratcheting up" of program eligibility requirements.
- In the long-term (7-10 years), manufacturers should increase the number and variety of energy-efficient models in targeted product categories, leading to a permanent increase in the availability of these models in retail stores, an increase in national market share for these models, and lastly, leading to more stringent federal standards for these product categories.

Validating the activities, outputs, outcomes, and linkages in this logic model allows us to assess the performance and efficacy of the program. Ultimately, this approach also allows us to inform estimates of program attribution. In Chapter 4, we provide a detailed assessment of program processes represented by the activities and outputs of the program logic model. In Chapter 5, we provide a detailed assessment of the short-, mid-, and long-term impacts.

Figure 3-1. Revised PG&E ESRPP Program Pilot Logic Model



Key: - - - - - - - **Dashed lines denote multiple interactions between elements inside (i.e., arrows connecting all elements).**

External Influences:
Broad economic conditions, market events, cost of energy, federal standards, ENERGY STAR, perceived need for conservation, and possible others.

Note: Factors can influence the program at all levels and time frames.

EVOLUTION OF PROGRAM THEORY

There have been several lessons learned since the PG&E ESRPP Program Pilot began operating in 2016. These lessons have altered the evaluation approach, and

informed the creation of the revised logic model shown above in Figure 3-1.[25] We discuss several of these lessons below.

- Overall program operations have been more fluid than initially envisioned, with a number of interactions occurring between elements in the program logic model. In the revised logic model (shown above as Figure 3-1) used for this evaluation research, these interactions are depicted by placing elements within dotted lines, rather than creating arrows from each element to the other. This depiction represents that within a dotted box, each element may potentially impact all other elements, resulting in a non-linear set of effects.
- During the early phases of program design, participating retailers were expected to commit to creating and implementing Retailer Implementation Plans ("Plans") for increasing the sales of energy-efficient models in the targeted product categories. These Plans would then serve as a tool to understand how retailers were using incentive dollars to drive sales of program-qualified units. In the course of this evaluation, it became clear that the Plans provided by retailers did not contain the level of detail initially expected by evaluators, and that there is no mechanism to obtain more-specific Plans. To address this, the evaluation approach has shifted slightly to place more weight on data collected from retailer store locations during in-store field visits by the PG&E ESRPP field services team.
- While the importance of the full category sales data collected from participating retailers has always been recognized, this pathway of influence within the program theory has become even more critical as our research has shown that such data simply does not exist elsewhere for the majority of the product categories included in ESRPP. As a result, the revised logic model more clearly emphasizes the importance of this data to the program's ability to facilitate the development of specifications, codes, and standards.

In the next section we provide a detailed explanation of the main levers that ESRPP uses to impact the market.

3.2 MAIN LEVERS OF ESRPP

In this section we provide clarification on the three main program levers of ESRPP: (1) the ability of ESRPP to work with participating retailers to connect

[25] Additional details showing how the revised logic model maps to the original logic model are provided in Appendix F.

manufacturers (further up the supply chain) with end-use customers (further down the supply chain), (2) the ability of ESRPP to collect and aggregate sales data from retailers, and (3) the ability of ESRPP to influence the development of codes, standards, and specifications. We discuss each of these points in more detail below.

RETAILERS ARE A CONDUIT CONNECTING MANUFACTURERS AND CUSTOMERS

While the PG&E ESRPP Program Pilot works with retailers to alter the market for energy-efficient models in select product categories, in the ESRPP program design, retailers are considered to be a conduit that connects manufacturers and end-use customers. By intervening in the middle of the supply chain, ESRPP seeks to overcome a "Catch-22" scenario whereby end-use customers do not consider the benefits of energy efficiency in their purchase decision, and thus retailers do not choose to stock or promote energy-efficient models. The effect of a $20 incentive paid to an end-use customer is likely insufficient to sway one's decision to purchase an energy-efficient model (as opposed to a standard efficiency model); however, when these incentives are paid to retailers *at scale*, program advocates believe that ESRPP can utilize retailers to alter customer decision-making through a number of possible mechanisms (including, but not limited to, activities that retailers do on a regular basis: advertising, assortment, product placement in stores, offering sale prices, and training employees to promote energy-efficient models).[26] A key long-term goal of ESRPP is to facilitate this movement towards greater efficiency, ultimately allowing the signal to be transmitted from end-use customers, through retailers, up to the manufacturers and suppliers responsible for producing the models.

FULL CATEGORY SALES DATA ARE A UNIQUE RESOURCE FOR BOTH EVALUATION AND ADVOCACY

In conducting research on sources of third-party market data with which to compare ESRPP sales data, the evaluation team determined that model-level sales data was unavailable for all but one product category (soundbars) currently included in the ESRPP portfolio. Some third-party data—such as the Association of Home and Appliance Manufactures (AHAM) shipment data used in this research—do provide total shipment data for some product categories at the monthly level. However, without model-specific values, it is impossible to compute program-

[26] It is important to note that in this program design, the end-use customer may be unaware that his or her purchase decision was altered through one of these mechanisms.

qualified share, which is one of the key metrics associated with gauging ESRPP progress toward market transformation.[27] This reality has added complications to any long-term evaluation of ESRPP, but it has also reinforced the importance of the full category sales data obtained by ESRPP sponsors from participating retailers. As discussed in more detail later in this report, this data is highly valued by entities like ENERGY STAR and has the potential to be very useful in advancing voluntary specifications for ESRPP product categories.

PG&E ESRPP CONTRIBUTIONS TO SPECIFICATIONS, CODES, AND STANDARDS ADVOCACY

Voluntary specifications (i.e., ENERGY STAR specifications), as well as mandatory efficiency standards (i.e., federal or state codes and standards), play a critical role in the ESRPP Program. Not only do ENERGY STAR specifications help to define the incented models within targeted product categories, mandatory codes and standards serve as baselines for estimating unit energy savings (for categories that are regulated by state or federal bodies). Additionally, because of the influence that the ESRPP 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. If codes and standards for any of the ESRPP 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.

In the following section of this report, we provide an assessment of PG&E ESRPP Program Pilot processes.

[27] In discussions with AHAM in November 2018, it became apparent that AHAM is reevaluating the types of shipment reports it will publish, as one major manufacturer decided to no longer report shipment sales.

4. ASSESSMENT OF PG&E ESRPP PROCESSES

Through a program documentation review and interviews with both program staff and external collaborators, the evaluation team assessed key PG&E ESRPP program processes. In this chapter we provide an assessment of PG&E ESRPP Program Pilot processes. We first provide a high-level summary of this assessment, and then discuss results by individual activity and output. A detailed list of Program Performance Indicators is provided in Appendix D.

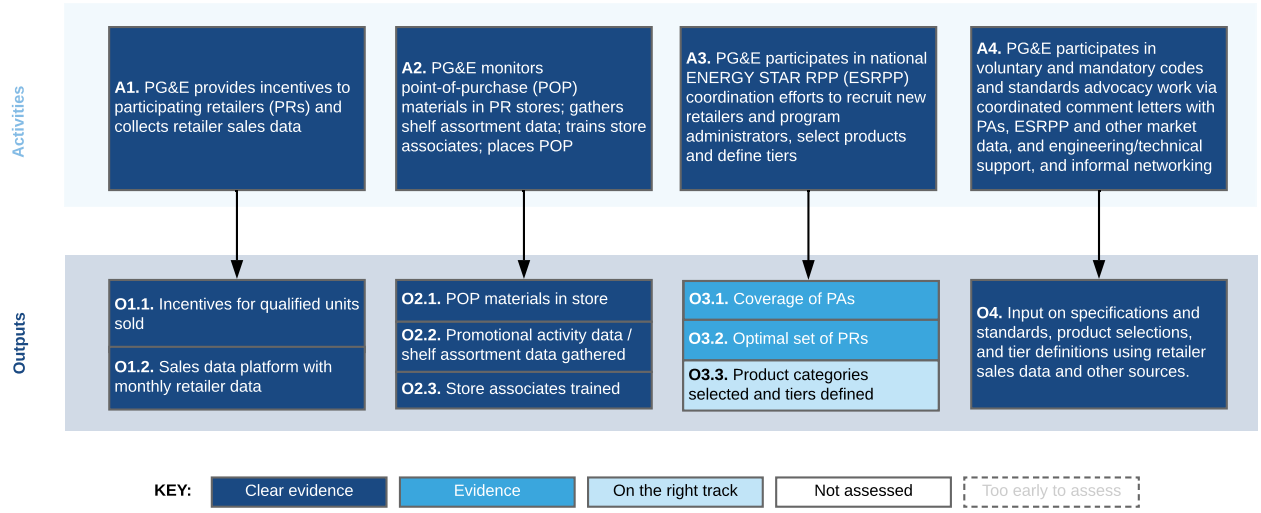
4.1 SUMMARY

The program pilot faced some major early hurdles related to data tracking and availability. Initially, challenges with the processing of retailer sales data made it difficult to perform thorough analysis of qualified models over time. This was more problematic for certain product categories where third-party data on the operating characteristics for individual models did not exist (air cleaners and soundbars). This processing has since become substantially more refined. Another early challenge was related to marketing plans that retailers were required to submit to the ESRPP program detailing their marketing plans for the upcoming program year. The idea is that these "retailer implementation plans" would enable evaluators to tie changes in sales back to specific activities undertaken by retailers and serve as evidence of attribution. However, in the course of early program development, it became clear that retailers were unable to provide this information in a format that would allow for the necessary analyses (likely because such marketing and promotional activities are not planned a year in advance). Instead, the program evaluation had to rely on in-store field data collected by a PG&E subcontractor to better understand what retailers were doing to promote and market program-qualified models.

At this point in time, PG&E ESRPP Program Pilot processes are generally working well, as reported by staff and external collaborator interviewees. As shown in the color-coded revised logic model shown in Figure 4-1, all activities and outputs are occurring as intended. The incentive payments to participating retailers and the subsequent collection of sales data—collectively the core "engine" of ESRPP—are occurring (logic model elements A1 and O1, as shown in Figure 4-1). Similarly, the collection of in-store field data and placement of ESRPP signage by PG&E has been successfully implemented (elements A2 and O2). PGE has successfully coordinated with the national ESRPP collaborative to recruit new retailers and select an optimal set of participating retailers, though some interviewees believe that the addition of more program administrators is necessary going forward (in order to achieve greater program scale). The definition of product eligibility tiers (element O3.3) is one area where program processes could be improved, as interviewees reported some challenges related to how ESRPP should define the appropriate levels. Lastly, there is clear evidence that PG&E's participation in activities related to specifications, codes, and standards (elements A4 and O4) is working well and leading to the intended outputs.

Staff interviewees indicated that they are satisfied with the ESRPP program because it has (1) gained recognition for its innovative approach to market transformation, (2) shown progress and results, and (3) received broad support from market actors. Some interviewees expressed dissatisfaction in the amount of progress related to measuring market transformation savings and progress toward achieving greater program scale, as well as lack of sufficient communication to all market actors so they can understand program developments.

Figure 4-1. Graphical Assessment of Activities and Outputs



In Table 4-1, we provide a high-level summary of the activities includes in the PG&E ESRPP logic model. We then provide a more detailed assessment of each activity.

Table 4-1. Summary of Evidence for Activities and Outputs

Logic Model Element	Summary
A1. PG&E provides incentives to participating retailers (PRs) and collects full-category retailer sales data	**SUPPORTING EVIDENCE:** Program data shows that PG&E is paying incentives to participating retailers on time and is successfully collecting and aggregating the resulting sales data. **SHORTCOMINGS:** Processing of retailer sales data is inherently difficult and must be carefully monitored.
A2. PG&E monitors point-of-purchase (POP) materials in PR stores; gathers shelf assortment data; trains store associates; places POP	**SUPPORTING EVIDENCE:** Field reports from PG&E's field services subcontractor detail efforts by PG&E to monitor POP materials placed by retailers, to gather shelf stocking/assortment data, train store employees, and place additional POP on program-qualified models. Staff interviews indicate that on the whole, these processes are operating smoothly. The evaluation team confirmed the field staff trained a total of 20,128 store associates from May 2016 - March 2018, with an increasing number of associates trained each quarter.
A3. PG&E participates in national ENERGY STAR RPP (ESRPP) coordination efforts to recruit new retailers and program administrators, select products and define tiers	**SUPPORTING EVIDENCE:** PG&E staff take frequent part in national coordination efforts through periodic conference calls, in-person meetings, and other forms of direct communication. PG&E staff also actively represent ESRPP's outreach efforts at conferences and industry trade shows. Along with the Northwest Energy Efficiency Alliance (NEEA), PG&E is considered by external collaborators to be highly influential within the ESRPP national effort. **SHORTCOMINGS:** The selection of products and the definition of qualifying tiers across all sponsors at the national level is a challenging aspect of the pilot program. Navitas (for PG&E) is working on creating a product portfolio and optimizing that portfolio. PG&E put together strategy documents for deciding when it makes sense to bring in a new product, but since product decisions are made at the national level, PG&E has limited ability to control this process.
A4. PG&E participates in voluntary and mandatory codes and standards advocacy work via coordinated comment letters with PAs, ESRPP and other market data, and engineering/technical support, and informal networking	**SUPPORTING EVIDENCE:** Overall, interview results show that while ESRPP is a national, collaborative program between many sponsors, PG&E is seen by external collaborators as a driving force behind the program. External collaborators also stated that overall ESRPP program success should be attributed to Program Administrators that were involved early on in the ESRPP program (of which PG&E was one). One external collaborator interviewee went as far as to say the fact EPA is supporting ESRPP is entirely due to PG&E, and now the program is a priority initiative at the EPA. Qualitative evidence from suppliers interviewed as part of this research suggests that the market actors are aware of and tracking ESRPP developments. **SHORTCOMINGS:** Careful documentation is required to show that voluntary standards/specification advocacy work is attributable to ESRPP and not other PG&E efforts.

4.2 ACTIVITIES AND OUTPUTS

In this section we provide additional details on findings that support our assessment of PG&E ESRPP Program Pilot activities and outputs. It is important to note that these analyses were designed to account for the fact that ESRPP operates on individual product categories. At the same time, we looked across product categories when providing an overall assessment of ESRPP program processes. These descriptions are organized by logic model element. A more detailed list of program performance indicators is provided in Appendix D.

PG&E PROVIDES INCENTIVES TO PARTICIPATING RETAILERS AND COLLECTS RETAILER SALES DATA (A1)

The process of paying incentives to retailers and collecting sales data generally works well, though there is some evidence that specific subprocesses could be fine-tuned. PG&E staff are currently working to develop program guidelines that can be shared with all ESRPP Program Administrators to help standardize some of the administrative processes that occur (e.g., payments to retailers). Interviewees included in this evaluation research noted that not all program administrators pay incentives at the same time, which could present a longer-term headache for participating retailers. One recommendation for standardization is for the administrators to not reconcile sales down to each store before paying retailers, since this practice can cause delays. PG&E currently reconciles retroactively and has facilitated prompt incentive payments.

Sales data continues to be a critical piece of ESRPP. Interviewees noted that it was due to one PG&E staff member's relationship with the participating retailers that enabled ESRPP to obtain highly sensitive full category sales data. External collaborators concurred that the full category sales data provided by retailers as part of the ESRPP program requirements was a notable achievement. Interviewees noted their satisfaction with participating retailers' support, especially given they now provide that full category sales data.

PG&E MONITORS POINT-OF-PURCHASE (POP) MATERIALS IN PARTICIPATING RETAILER STORES; GATHERS SHELF ASSORTMENT DATA; TRAINS STORE EMPLOYEES; PLACES POP (A2)

Based on PG&E staff interviews, PG&E program staff work closely with subcontractors to perform several key field activities in participating retail stores, including the collection of shelf survey data and the placement of point-of-purchase (POP) materials. The subcontractor field staff visit participating retail stores in PG&E service territory each month to place POP materials and conduct "baseline" shelf surveys on a subset of store visits. Field staff reported that while these surveys

were initially conducted using pen and paper, they had transitioned to a digital version which helped speed up the process.

PG&E subcontractors mentioned they are communicating essential program knowledge in the field, such as the field subcontractor providing training on program qualified products to sales representatives and another subcontractor communicating feedback and installation guidance on marketing collateral.

PG&E PARTICIPATES IN NATIONAL ESRPP COORDINATION EFFORTS TO RECRUIT NEW RETAILERS AND PROGRAM ADMINISTRATORS, SELECT PRODUCTS, AND DEFINE PRODUCT TIERS (A3)

Evaluation research shows that PG&E staff actively represent ESRPP's outreach efforts through multiple forms. Staff report presenting at conferences, sitting on professional panels, and attending trade shows to discuss and promote the ESRPP program in an effort to recruit new program administrators.[28] Nationally, ESRPP currently has 14 utilities in 15 states, representing roughly 18% coverage of the US population; however, the program is still short of its goal of 30% national coverage.

According to external collaborators interviewed as part of this evaluation, ESRPP has had a smooth retailer recruitment process overall. Currently, the program is not looking to add any new retailers until an evaluation occurs. However, PG&E has identified additional retailers who are potentially interested in participating in the near future.

External collaborators interviewed as part of this evaluation also reported that PG&E is considered to be highly influential within the ESRPP national effort, along with the Northwest Energy Efficiency Alliance (NEEA).

One difficult aspect of implementing the ESRPP program is the selection of products and the definition of qualifying tiers across all sponsors at the national level. While documentation for these processes does exist, each product category is unique in some way, making it difficult to standardize the process across the entire portfolio of products. There are several important aspects to this:

- PG&E and other program administrators must decide when it makes sense to either bring a new product into the program or remove an existing product from the program. For instance, ESRPP makes significant decisions on target product categories, such as postponing including TVs in the program. PG&E and other sponsors look at market penetration of different

[28] A more detailed list of PG&E ESRPP outreach and advocacy efforts is included as Appendix E.

levels of ENERGY STAR and ENERGY STAR Most Efficient, as well as how many products are available to incent.

- Program sponsors also determine what level of incentive, per product, will incentivize the retailers to ask manufacturers to provide more of them.

There is some disagreement between interviewees regarding the national ESRPP approach to setting program qualifications requirements, with some interviewees indicating that the program requirements should be simplified while other interviewees supported the current program approach to setting tiers that are higher than current ENERGY STAR specification levels (e.g., ENERGY STAR + 50%). ***(It is important to note that product selection decisions are made at the national level, and thus PG&E has limited ability to control this process.)*** Multiple interviewees mentioned that ESRPP may want to reconsider the way it currently sets tiers above the existing ENERGY STAR specification level for products with relatively high market share of qualified models.

The initial impetus for this adjustment was the need to "ratchet up" requirements for product categories where the base ENERGY STAR level had already achieved a substantial share of the market. But while interviewees felt this was the correct approach in theory, it was logistically problematic, as retailers have a difficult time understanding what is qualified and what is not qualified. One recommendation was to use an obvious feature or functionality to determine eligibility instead of an "ENERGY STAR + X %" requirement. Staff mentioned the possibility that paring down the number of product categories and/or tiers may help streamline program processes moving forward.

PG&E PARTICIPATES IN VOLUNTARY AND MANDATORY CODES AND STANDARDS ADVOCACY WORK VIA COORDINATED EFFORTS (A4)

Overall, interview results show that while ESRPP is a national, collaborative program between many sponsors, PG&E is seen by external collaborators as a driving force behind the program, particularly for efforts aimed at advancing voluntary specifications. Specific supporting evidence includes the following:

- One external collaborator interviewee went as far as to say the fact EPA is supporting ESRPP is entirely due to PG&E and now the program is a priority initiative at the EPA.
- Multiple external collaborators reported that the full category sales data has been an important tool in specification-setting efforts and has allowed them to drive specifications higher than they otherwise would have been able to do.
- One external collaborator interviewee noted that ESRPP has "provided good conversations" around qualifying product levels and national analysis of market share. In particular, this interviewee stated the work so far has "pushed the envelope on efficiency standards" by supplying supporting data

collected from retailers and noted, as an example, that the EPA put out a discussion guide on air cleaners that was prompted by ESRPP's market data.

- One interviewee was quoted saying, "Specification-setting runs the risk of not having a balanced pool if utilities are not accounted for. [ESRPP] helps EPA defend against pushback from manufacturers and others."

PG&E ESRPP program staff work with PG&E's internal Codes and Standards group to communicate with mandatory codes and standards-setting organizations such as the California Energy Commission (CEC) and DOE. Interviewees reported that it is important for the different teams at PG&E to coordinate internally to make sure the messaging is consistent across these efforts and that the same data is being used where appropriate. However, the boundaries between ESRPP and other codes and standards efforts become fuzzy in some of these instances, making it more difficult to clearly delineate the role of ESRPP.

A more detailed documentation of PG&E ESRPP outreach and advocacy efforts is included in Appendix E.

5. ASSESSMENT OF PG&E ESRPP IMPACTS

Impacts for a market transformation program like ESRPP take different forms. The primary impacts examined as part of this early evaluation effort included:

- Increases in sales and program-qualified market share among participating retailers (logic model element S1)
- Increases in the proportion of program-qualified models on store shelves (logic model element M1.1)
- Improvements in the ability of organizations working on specifications, codes, and standards to make better decisions based on inputs from ESRPP (logic model element S3)

These analyses were designed to account for the fact that ESRPP operates on individual product categories. At the same time, we looked across product categories when providing an overall assessment of ESRPP program impacts.

In this chapter we provide an assessment of PG&E ESRPP Program Pilot impacts to date. We first provide a high-level summary of this assessment, and then discuss results by time period (short-, mid-, and long-term). A more detailed list of market transformation indicators is provided in Appendix D.

5.1 SUMMARY

Early evaluation results provide evidence that the PG&E ESRPP program is leading to short-term and mid-term impacts as expected by program theory, though the results differ by product category, and results are not uniformly positive. Based on statistical modeling of retailer sales data, we observe short-term sales increases for 5 of 11 tiers (covering 4 of 7 product categories) currently targeted by ESRPP (logic model element S1). At the same time, interviews with national-level retail staff show that ESRPP incentives have some influence on retailer decision-making, and interviews with external collaborators show that ESRPP is facilitating the development ENERGY STAR specifications. At this point in time, it is premature to assess the long-term outcomes included in the logic model.

There are also a number of shortcomings identified in the program pilot's ability to achieve its desired short-term and mid-term outcomes.

- In looking at short-term outcomes, we do not see statistically-significant increases in sales across *all* product categories and tiers receiving incentives (logic model element S1).[29]
- Secondly, although retailers do indicate that ESRPP incentives have factored into their decision-making (logic model element S2), it remains difficult to understand exactly how the ESRPP incentives are considered by retailers relative to other considerations (e.g., manufacturers competing for shelf space).
- Lastly, at this stage, much of PG&E ESRPP's advocacy efforts have been aimed at ENERGY STAR, with limited activities aimed at other standards-setting bodies (logic model element S3).

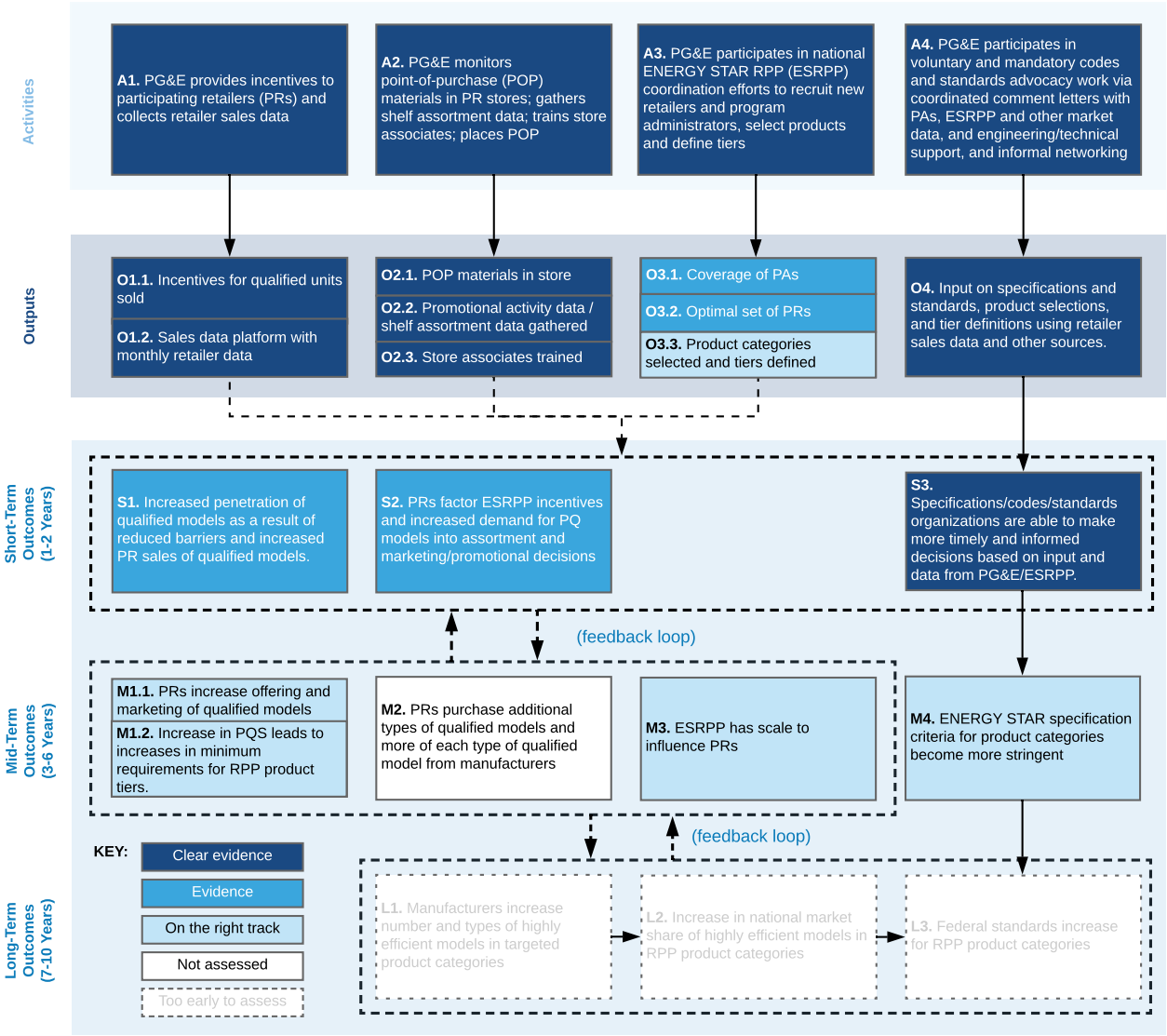
In looking at mid-term outcomes, we see several additional shortcomings.

- While our analysis of shelf survey data shows increases for 5 of 7 product categories, an additional two product categories are either flat (air cleaners and soundbars) or have a decreasing trend in model assortment share. The reasons for this are unclear. However, because PG&E has identified that the primary objective for these categories is to facilitate the advancement of ENERGY STAR specifications through the provision of market data, the lack of increasing market share for these categories becomes less important.
- In the mid-term, increasing market share is designed to lead to a "ratcheting up" of program requirements. In many cases this requires setting an efficiency level based on ENERGY STAR, but does not map directly to an existing designation such as ENERGY STAR Most Efficient. This new level instead takes the form of "ENERGY STAR + XX%" and makes it difficult for retailers (and potentially customers) to easily understand which models are program-qualified.

We provide a graphical depiction of progress toward expected outcomes below in Figure 5-1.

[29] As noted elsewhere in this report, for some product categories/tiers, increasing sales of program-qualified models was not necessary an objective.

Figure 5-1. Graphical Summary of PG&E ESRPP Impacts



In the following sections we provide additional details on findings that support our assessment of PG&E ESRPP Program Pilot impacts. We first discuss short-term outcomes, then mid-term outcomes, and finally long-term outcomes.

5.2 SHORT-TERM OUTCOMES

In the short-term (1-2 years), the PG&E ESRPP Program Pilot is expected to result in three key outcomes:

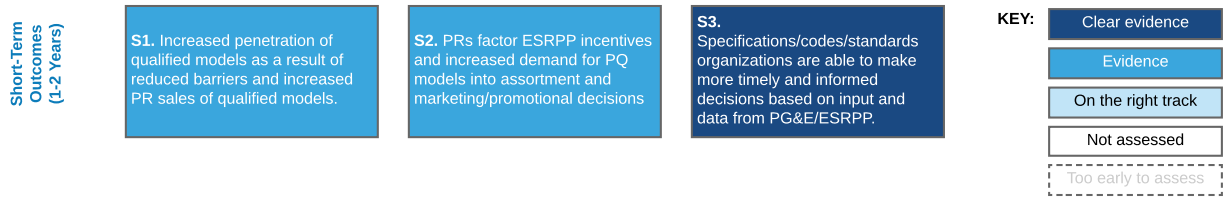
- Sales of program-qualified models should increase for participating retailers, leading to a corresponding increase in program-qualified market share (logic model element S1).

- Participating retailers should begin to consider this sales increase in their marketing and promotional decisions (logic model element S2).
- Organizations responsible for creating specifications, codes, and standards should be able to make more timely and informed decisions (largely due to the availability of the full category sales data obtained through ESRPP) (logic model element S3).

There is evidence from the evaluation research that the PG&E ESRPP Program Pilot has made significant progress toward all three of these short-term outcomes in the program logic model. As shown in Figure 5-2, there is evidence of increased sales and program-qualified market share for some product categories (logic model element S1). There is also evidence from retailer interviews that the ESRPP incentives have been factored into retailer decision-making (logic model element S2). Lastly, there is clear evidence from interviews with external collaborators that ESRPP has empowered programs like ENERGY STAR to improve their decision-making regarding specification revisions for product categories includes in ESRPP.

There are also a number of challenges associated with the short-term outcomes. For one, we do not see statistically-significant increases in sales across all product categories and tiers receiving incentives.[30] Secondly, although retailers do indicate that ESRPP incentives have factored into their decision-making, it remains difficult to understand exactly how the ESRPP incentives are considered by retailers relative to other considerations (e.g., manufacturers competing for shelf space). Lastly, at this stage, much of PG&E ESRPP's advocacy efforts have been aimed at ENERGY STAR, with limited activities aimed at other standards-setting bodies.

Figure 5-2. Short-Term Outcomes



In the sections below we highlight specific evidence for this assessment of short-term outcomes.

[30] As noted elsewhere in this report, for some product categories/tiers, increasing sales of program-qualified models was not necessary an objective.

Table 5-1. Summary of Assessment of Short-Term Outcomes

Logic Model Element	Summary
S1. Increased penetration of qualified models as results of reduced barriers and increased PR sales of qualified models	**SUPPORTING EVIDENCE:** Results from the sales data modeling show a statistically significant increase in sales for 5 of the 11 tiers (or 4 of the 7 product categories) incented by PG&E ESRPP. **SHORTCOMINGS:** Increases in sales share are not detectable in all product categories/tiers incented. In some cases it is not readily apparent why the intervention works for some categories but not others. For some categories, limitations in modeling present difficulties when estimating the baseline, particularly for seasonal categories like room air conditioners.
S2. Participating retailers factor incentives and increased demand for program-qualified models into assortment and marketing/promotional decisions	**SUPPORTING EVIDENCE:** Senior management at participating retailers believe the ESRPP program influences their pricing decisions to some degree; however, for ESRPP to be a primary driver in decision-making, they believe the program needs to "scale up." **SHORTCOMINGS:** Despite this feedback from retailers, it remains difficult to directly gauge ESRPP's level of influence on retailer decision-making. In a highly-competitive industry with slim margins and quickly-changing customer preferences, retailers are hesitant to provide any information related to promotional or marketing strategies. This is particularly true for the requested retailer implementation plans, which did not contain sufficient detail to track marketing activities. Thus the program has had to rely more on in-store data collection activities rather than rely on retailer marketing plans.
S3. Specifications/Codes/Standards Organizations are able to make more timely and informed decisions based on input and data from ESRPP	**SUPPORTING EVIDENCE:** External collaborators indicated that the full category sales data provided by retailers as part of the ESRPP program requirements was a notable achievement. EPA staff reported that these data have been an important piece in specification-setting efforts and have allowed them to drive specifications higher than they otherwise would have been able to do. External collaborators noted that PG&E has been able to leverage its own internal resources to address technical testing needs related to two ESRPP products (soundbars and air cleaners) and that the results of this testing have also aided specification-setting efforts. **SHORTCOMINGS:** The majority of PG&E ESRPP's direct influence appears to be on EPA/ENERGY STAR. Additional influence on other codes/standards bodies (such as DOE) is significantly less, at least at this stage. The relationship with federal bodies is additionally complicated by political dynamics outside the control of PG&E ESRPP.

In the following sections we provide more details on each of these outcomes.

INCREASED SALES AND PENETRATION OF PROGRAM-QUALIFIED MODELS (S1)

Results from the sales data modeling vary by product category and tier:

- We observe a statistically significant increase in sales for 5 of 11 tiers currently incented by the PG&E ESRPP program pilot.
- For an additional 3 of 11 tiers (basic air conditioners, advanced air conditioners, and advanced freezers) we were unable to estimate any statistically significant changes due to the ESRPP program, either due to a small number of data points or extreme seasonality in the sales stream.
- For an additional 3 of 11 tiers currently receiving incentives (basic air cleaners, advanced air cleaners, and advanced washers), we do not see any corresponding increase in sales.[31]

These results are summarized below in Table 5-2.

[31] One of these tiers (basic soundbars) was incented only in PY 2016. No increase in sales was observed for this tier.

Table 5-2. Summary of Sales Increases by Product Category and Tier

Product Category	Tier	Years Incented		Increase in Sales Above Baseline?	Notes
		PY 2016	PY 2017		
Air Cleaners	Basic	Yes	Yes	No	
	Advanced	Yes	Yes	No	
Air Conditioners	Basic	Yes	Yes	Indeterminate	Substantial uncertainty in modeling due to extreme seasonal sales fluctuations.
	Advanced	No	Yes	Too few sales	
Dryers	Basic	Yes	Yes	Yes	
	Advanced	Yes	Yes	Yes	
Freezers	Basic	Yes	Yes	Yes	
	Advanced	Yes	Yes	Too few sales	
Refrigerators	Basic	No	No	No	
	Advanced	No	Yes	Yes	
Soundbars	Basic	Yes	No	No	There is the possibility of "cannibalization" from the basic tier to the advanced tier.
	Advanced	Yes	Yes	Yes	
Washers	Basic	No	No	Yes	The difference between qualifying levels for basic and advanced is very small (5%). The overall product category shows a statistically significant increase.
	Advanced	No	Yes	No	

We summarize each of these trends below by product category, and where possible, provide additional context to help explain these findings:

- For air cleaners, we found decreases for both the basic and advanced tiers, but do not believe these decreases are due to the program. In particular there was a massive decrease in program-qualified sales share around the time that wildfires made air quality in the PG&E service territory very bad, and while unit sales of qualified units increased, the decrease in program-qualified share led to an overall decrease in predicted sales.
- For air conditioners, the differences were not statistically significant, likely due to the fact that the seasonality leads to such little pre-program data. The analysis of room air conditioners was also complicated by atypically hot temperatures in much of California in 2017 (compared to 2016).
- For dryers we observed an increase in program-qualified sales for both the basic and advanced tiers.
- For freezers we observed an increase in the basic tier as well as for all qualified products. We did not see an increase for advanced freezers, though because the sales were so small for advanced freezers in the pre-program period and essentially zero in the program period, this result is of limited practical importance.
- For refrigerators, we observed an increase in sales in the advanced tier. (PG&E does not incent basic tier models, and the change for basic tier models was not statistically significant.)

- Soundbars exhibited a shift from the basic tier to the advanced tier (i.e., there was a decrease in sales in the basic tier and an increase in sales in the advanced tier); we consider both changes to be due to the program to avoid over-counting impacts from the increases in the advanced tier, some of which are likely due to cannibalization between tiers in addition to overall increases in the advanced tier.
- For washers, we observed a statistically significant increase for basic tier models but not advanced tier models. Given that incentives were provided for the sales of advanced tier models but not basic tier models, this result is counterintuitive. However, we note that the difference in program-qualifying requirements between the basic and advanced tiers for washers is very small (ENERGY STAR vs. ENERGY STAR + 5%). It is possible that retailer efforts to increase the sales of advanced tier models (i.e., ENERGY STAR + 5%) may have also had an effect on basic tier models, even though these models did not themselves receive incentives.

Specific results by product category and tier are presented below in Table 5-3.

Table 5-3. Increased Sales (Above Baseline) of Program-Qualified Models

Product	Tier	Increase	SE	Lower Bound (95% CI)	Upper Bound (95% CI)	PQ Sales in the Post Period	% Change
Air Cleaners	Basic	-1,207	300	-1,716	-698	22,472	-5%
Air Cleaners	Advanced	-3,088	201	-3,429	-2,748	4,052	-76%
Air Cleaners	Qualified	-2,949	293	-3,446	-2,452	26,737	-11%
Room Air Conditioners	Basic	-6,983	6,973	-18,807	4,841	59,288	-12%
Room Air Conditioners	Qualified	-1,902	5,242	-10,790	6,987	59,813	-3%
Dryers	Basic	10,557	2,483	6,347	14,766	135,388	8%
Dryers	Advanced	159	20	125	193	279	57%
Dryers	Qualified	9,729	2,477	5,529	13,928	135,692	7%
Freezers	Basic	2,523	352	1,925	3,120	17,057	15%
Freezers [a]	Advanced	-5,357	761	-6,646	-4,067	1	-535669%
Freezers	Qualified	10,727	518	9,849	11,605	17,054	63%
Refrigerators	Basic	-3,142	3,215	-8,718	2,434	160,061	-2%
Refrigerators	Advanced	6,933	1,056	5,102	8,764	45,948	15%
Refrigerators	Qualified	3,075	2,780	-1,745	7,895	209,126	1%
Soundbars [b]	Basic	-986	61	-1,089	-883	421	-234%
Soundbars	Advanced	10,477	116	10,281	10,673	15,057	70%
Soundbars	Qualified	10,045	114	9,851	10,238	15,603	64%
Washers	Basic	92,754	1,624	89,938	95,569	108,917	85%
Washers	Advanced	-93,387	6,006	-103,802	-82,972	89,450	-104%
Washers	Qualified	7,106	2,138	3,399	10,813	202,395	4%

[a] A small number of sales in the program period for advanced freezers leads to large relative changes.
[b] PG&E stopped incenting basic tier soundbars in 2017.

Although PG&E does not currently plan to claim short-term savings associated with the program pilot, EMI Consulting did estimate energy and demand savings to understand what the magnitude of these savings might be. These results are shown in Table 5-4. As discussed in Section 2.4, energy savings are derived from average energy savings in the post-period for each tier, multiplied by the estimated sales increases for that product category and tier. We did not estimate savings for product categories/tiers without an increase in sales above baseline.

Table 5-4 Energy Savings for Program-Qualified Models for Program Years 1 and 2 (2016-2018)

Product [a]	Tier	Energy Savings (kWh)	Demand Reduction (kW)	Energy Savings (Therms)
Dryers	Basic	732,333 ± 292,022	123.561 ± 49.271	8,430 ± 3,362
	Advanced	23,262 ± 4,963	4.496 ± 0.959	-277 ± 59
Freezers	Basic	43,6241 ± 35,692	92.310 ± 7.552	-11,952 ± 978
Refrigerators	Advanced	480,971 ± 126,996	105.191 ± 27.775	-13,010 ± 3,435
Soundbars	Basic	-35,536 ± 3,718	-0.660 ± 0.069	822 ± 86
	Advanced	258,262 ± 4,831	4.020 ± 0.075	-5,902 ± 110

[a] Savings estimates with "+" values constitute a 90% confidence interval. Negative values represent negative savings due to interactive effects.
[b] PG&E stopped incenting basic tier soundbars in 2017.

INCREASED PROGRAM-QUALIFIED SALES FACTORED INTO RETAILER DECISION-MAKING (S2)

According to Cadmus' national-level year two interviews, internal stakeholders at participating RPP retailers believe that the key driver of product assortment process—which is also believed to be the key driver of increasing ESRPP product sales—is profitability. Since profitability is the most important factor to merchants, retailers disclosed they are largely distributing incentives to program-qualified product SKUs to make them appear more favorable and influence merchants' stocking decisions.

- These interviews showed that merchants and manufacturers have some influence on marketer's decisions regarding which products to promote, however, much of the retailer's marketing strategy is determined either at the national level or at the beginning of the year. Therefore, marketing staff make specific plans for ESRPP products but do not focus on it because their marketing focus is generally at a national level.

- According to Cadmus' national-level interviews with Nationwide in their first year of participation (PY 2017), senior management see ENERGY STAR as a point of differentiation for them, compared to other retailers, due to their level of commitment and the marketing support they put behind ENERGY STAR products. Nationwide was already a "strong performer" in selling ESRPP program-qualified models before joining ESRPP and claims to have seen a boost to sales since joining. Like the other participating retailers, Nationwide's primary decision factor is profitability. However, senior staff believe the biggest barrier to making profit from energy-efficient products is *lack of information*. These staff think ESRPP will help in training sales associates to sell program-qualified products to customers.

Despite this feedback from retailers, it remains difficult to directly gauge ESRPP's level of influence on retailer decision-making. In a highly-competitive industry with slim margins and quickly-changing customer preferences, retailers are hesitant to provide any information related to promotional or marketing strategies. Thus it becomes more critical to observe actual changes in retailer practices (for instance, by in-store data collection) rather than rely on prospective plans.

We note that there does appear to be a positive (albeit very qualitative) change in senior management views of ESRPP influence over time. One finding from the analysis of the 2016 interviews: "Senior management is starting to get interested, but because ESRPP is still small, the interest is limited." A finding from the 2018 interviews: "ESRPP is overall well received by retailers, including merchants, marketers, and VPs. Retail support for ESRPP has increased slightly since the first year."

SPECIFICATIONS/CODES/STANDARDS ORGANIZATIONS ABLE TO MAKE MORE TIMELY AND INFORMED DECISIONS (S3)

External collaborators believe that the process by which PG&E works with the ENERGY STAR program to advance ENERGY STAR-qualifying requirements works well. Interviewees noted that the specification development process is typically spread out over a long time period, and so the types of interactions between PG&E ESRPP staff and ENERGY STAR will depend on the schedule for draft specification revisions or new specifications.

PG&E ESRPP involvement with other codes and standards organizations, such as the CEC and DOE, take place primarily through PG&E's internal Codes and Standards group. Staff indicated that a key piece in codes and standards advocacy work is a "Code Change Theory Report" (CCTR), which details the "story behind the rule-making process." Interviewees noted that mandatory codes and standards (either state or federal) change much less frequently than do ENERGY STAR specifications, and so any ESRPP program impacts on such changes should be viewed through this lens. Interviewees also noted that the pace of progress for

federal standards in particular is dependent on national political dynamics and that, recently, there has been much less activity occurring than in previous years.

5.3 MID-TERM OUTCOMES

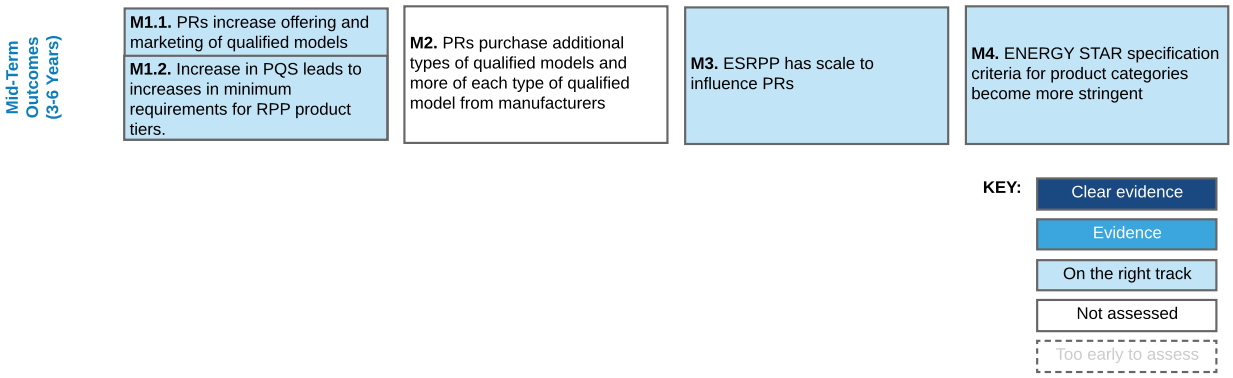
In the mid-term (3-6 years), the PG&E ESRPP Program Pilot is expected to result in five key outcomes:

- Participating retailers should increase their offering and marketing of program-qualified models, leading to an increase in the minimum qualifying requirements for ESRPP (logic model elements M1.1 and M1.2).
- To address the increase in demand, participating retailers should begin to purchase additional types of qualified models and more of each type from manufacturers (logic model element M2).
- As additional program administrators join the national collaborative, ESRPP should have achieved sufficient scale to increase retailer decision-making at the national level (logic model element M3).
- ENERGY STAR specification criteria for ESRPP product categories should become more stringent (largely due to the availability of the full category sales data obtained through ESRPP) (logic model element M4).

Evaluation results show the PG&E ESRPP Program Pilot is on track to achieve four of these mid-term outcomes in the program logic model (depicted graphically in Figure 5-3). We were unable to assess whether or not participating retailers are requesting additional qualified models/units from manufacturers (outcome M2) since the data required for this assessment have not yet been collected.[32]

[32] The data required for this will be based on interviews that Cadmus is slated to conduct with manufacturers in 2019.

Figure 5-3. Mid-Term Outcomes



In Table 5-5 and Table 5-6 below, we provide a summary of the specific evidence supporting this assessment.

Table 5-5. Summary of Assessment of Mid-Term Outcomes

Logic Model Element	Summary
M1.1. Participating Retailers increase offering and marketing of qualified models	**SUPPORTING EVIDENCE:** Analysis of in-store shelf assortment data collected during field visits shows an increasing trend in model assortment share for five product categories (dryers, refrigerators, room ACs, freezers, and washers). Analysis of this data also shows that retailers give preferential treatment to qualified models for all 9 of the 11 product tiers incented, though it is difficult to know what this would have looked like in the absence of ESRPP. **SHORTCOMINGS:** An additional two product categories are either flat (air cleaners and soundbars) or have a decreasing trend in model assortment share. The reasons for this are unclear.
M1.2 Increase in program-qualified share leads to increases in minimum requirements for ESRPP product tiers	**SUPPORTING EVIDENCE:** ESRPP eligibility requirements have "ratcheted up" for several products—including air cleaners and washers—in order to readjust for high market share. National requirements have also ratcheted up for the basic tier of refrigerators, though PG&E does not support currently this tier. Additionally, the program has made several additional adjustments to program requirements: (1) PG&E stopped incenting basic soundbars after PY 2016 due to high market share, and (2) PG&E decreased the incentive for basic tier dryers in PY2017. **SHORTCOMINGS:** "Ratcheting up" of program requirements in many cases requires setting an efficiency level based on ENERGY STAR, but which does not map directly to ENERGY STAR Most Efficient. This new level takes the form of "ENERGY START + XX%" and makes it difficult for retailers (and potentially customers) to easily understand which models are program-qualified.

Table 5-6. Summary of Assessment of Mid-Term Outcomes (continued)

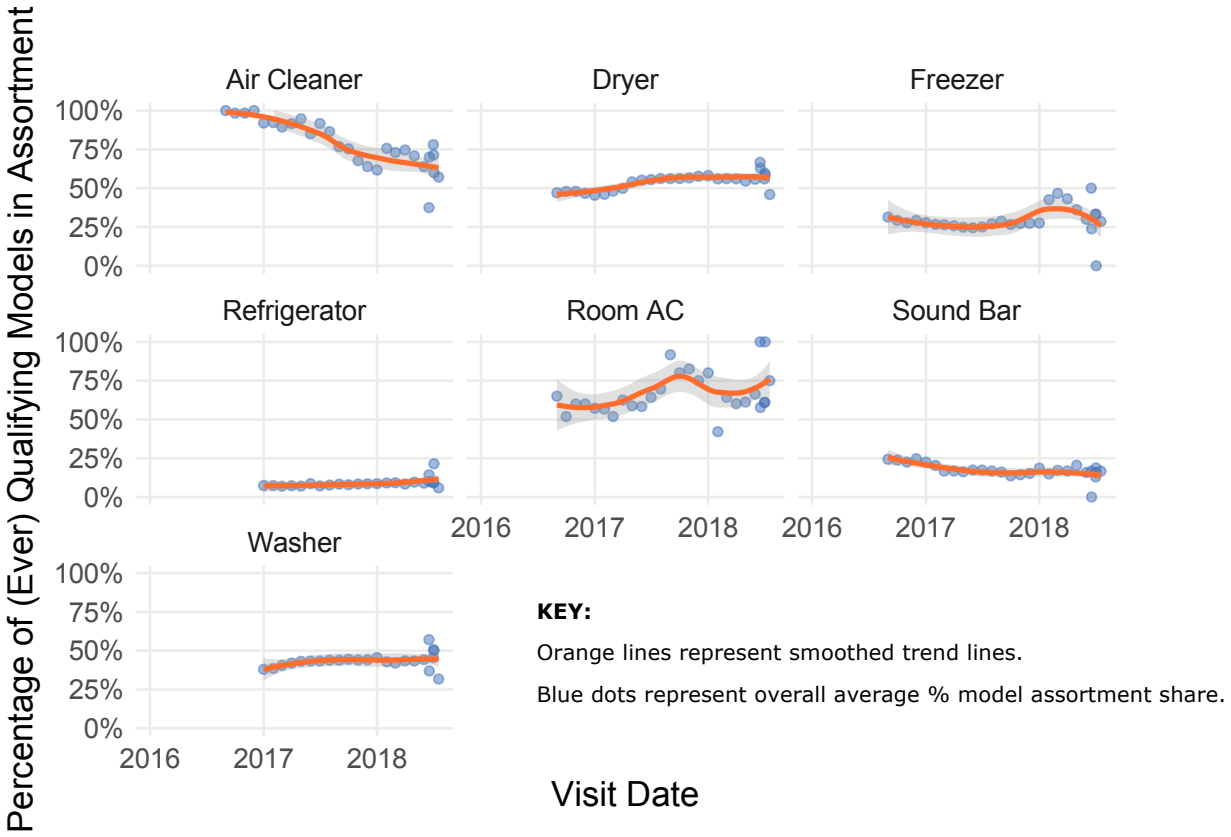
Logic Model Element	Summary
M3. ESRPP has scale to influence participating retailers	**SUPPORTING EVIDENCE:** Nationally, ESRPP has achieved coverage of an estimated 18% of the US population. This is lower than ESRPP's stated goal of 30% (based on retailer input), but high enough to keep retailers engaged with the program. Two suppliers interviewed as part of this research both provided confirmation that the ESRPP program has achieved sufficient scale such that market actors operating higher up in the supply chain (e.g., manufacturers and suppliers) are considering its impact on their business strategies, though the magnitude of the impact at this point is difficult to assess, and likely small. **SHORTCOMINGS:** Retailers indicate that the ESRPP program should attain a 30% market coverage nationally in order to be more effective. The national ESRPP program will require more Program Administrators to join before this is possible.
M4. ENERGY STAR specification criteria for product categories become more stringent	**SUPPORTING EVIDENCE:** Interviews conducted as part of this evaluation research suggest that ESRPP inputs have had a direct effect on the development of ENERGY STAR specification criteria, though not enough time has passed for these effects to be fully realized in the adoption of new specifications. Directional evidence for this assertion comes from interviews with external collaborators, who attest that the sales data and technical input from ESRPP has been a critical piece of the specification development process. Interview results suggest that PG&E ESRPP efforts have been particularly fruitful for air cleaners and soundbars.

In the following sections we provide more details on each of these outcomes.

PARTICIPATING RETAILERS INCREASE OFFERING AND MARKETING OF QUALIFIED MODELS (M1.1)

Program theory holds that as participating retailers are able to use incentive dollars to drive demand for energy efficient models, they must (in the mid-term) adjust their stock accordingly to address this. By looking at model assortment share on participating retailers' shelves over the course of the program period, we were able to assess whether this trend was observable. As shown below in Figure 5-4, we observed slight upward trends for five product categories (dryers, freezers, refrigerators, room ACs, and washers). We also observed two downward trends—for air cleaners and soundbars—though the data suggest these trends were driven largely by one or two retailers only.

Figure 5-4. Model Assortment Share Over Time[a]



a Trends shown here are for program period only, with the exception of refrigerators and washers, which began receiving incentives in April 2017.

In Table 5-7 we place these results in context with the results of the sales data modeling looking at increase in program-qualified sales share (a short-term outcome). This comparison shows that for most product categories, the results of the two analyses support a coherent storyline—that an increase in sales share of program-qualified models in the short-term may plausibly lead to an increase in program-qualified shelf assortment share in the mid-term. However, it is important to note that the two phenomena represent different measurements of program impacts, and do not necessarily align with each other.

Table 5-7. Comparison of Sales Data Analysis Results and Shelf Assortment Analysis Results

Product Category	Program-Qualified Sales Increase?	Program-Qualified Shelf Assortment Increase?
Air Cleaners	No	No
Dryers	Yes**	Slight increase**
Freezers	Yes (basic tier only)**	Slight increase**
Refrigerators	Yes (advanced tier only)**	Slight increase**
Room ACs	Indeterminate	Slight increase**
Soundbars	Yes (advanced tier only)**	No
Washers	No	Slight increase**

All increases were statistically-significant, p<.05.

In addition to stocking and assortment, program theory indicates that availability of incentives will lead retailers to provide qualified products with preferential treatment in their internal promotion decisions. As discussed in Section 3.1, the original evaluation plan envisioned using Retailer Implementation Plans to assess how the program was influencing these internal decisions, but in reality, the retailer implementation plans lack sufficient specificity to assess promotional decisions. In lieu of this data source, we have reviewed data collected by PG&E's field services subcontractors regarding the placement and pricing of products at participating retailers' stores.

We relied on model-level data collected from 403 individual store visits across 288 retail locations between January and August 2018. We calculated the percentage of models that were placed in a preferential location (anything other than simply in the aisle), the percentage of models that were currently discounted relative to the regular price, and the average discount amount among discounted products by product group and tier (non-qualified, basic, and advanced, as well as all qualified). The qualified designation is based on the categorization conducted by the field team; the basic and advanced tier designations are based on model matching we conducted for this analysis.

Results of this analysis are shown in Table 5-8. We found that all qualified tiers (basic, advanced, and all qualified) of all product groups received more preferential placement than non-qualified models, although not all differences are statistically significant. Results were more mixed for sale pricing and discount. Qualified air cleaners, freezers, and room air conditioners were all more likely to be on sale than non-qualified models, but dryers, refrigerators, sound bars, and washers were less likely. Given that a model was on sale, qualified air cleaners, dryers, freezers, room

air conditioners, and washers received larger discounts than non-qualified models, but refrigerators and sound bars received smaller discounts. These results for preferential placement and sale quantity are consistent with the program impact inducing changes in promotional decisions by the retailers, although without pre-program data we are unable to compare relative changes.

Table 5-8. Summary of Retailer Behavior Analysis Using Shelf Survey Data

Product	Tier/Group	Sales Analysis	Placement	On Sale	Size of Discount	Incented by PG&E?
Air Cleaners	Qualified	--	0	+	++	
	Basic	--	0	0	++	Yes
	Advanced	--	0	0	++	Yes
Dryers	Qualified	++	++	-	++	
	Basic	++	++	-	++	Yes
	Advanced	++	+	--	+	Yes
Freezers	Qualified	++	0	++	++	
	Basic	++	0	++	++	Yes
	Advanced	--	0	0	0	Yes
Refrigerators	Qualified	0	++	--	--	
	Basic	0	0	0	--	No
	Advanced	++	++	--	--	Yes
Room ACs	Qualified	0	++	+	++	
	Basic	0	0	+	++	Yes
	Advanced	0	++	0	0	PY 2017 forward
Sound Bars	Qualified	++	+	--	--	
	Basic	--	+	--	--	PY 2016 only
	Advanced	++	0	0	0	Yes
Washers	Qualified	++	++	--	++	
	Basic	++	++	--	++	No
	Advanced	--	0	-	++	Yes

Key: "++" and "+" signify large and small increases, respectively, relative to non-qualified models. "--" and "-" signify large and small decreases, respectively, relative to non-qualified models. "0" signifies no statistically significant difference was found.

These results also help corroborate the sales increases calculated in Section 5.2, especially with respect to product placement within the store. Although the correlation is not perfect, the tiers with short-term sales increases tended to be those with the strongest evidence of receiving more preferential treatment in terms of placement within the store. The qualitative correspondence between these results is shown in Table 5-9.

Table 5-9. Qualitative Comparison of Sales Modeling Results and Retailer Behavior Analysis Using Shelf Survey Data

Product Category	Tier	Years Incented		Increase in Sales Above Baseline?	Preferential Treatment by Retailers?
		PY 2016	PY 2017		
Air Cleaners	Basic	Yes	Yes	No	Yes
	Advanced	Yes	Yes	No	Yes
Air Conditioners	Basic	Yes	Yes	Indeterminate	Yes
	Advanced	No	Yes	Too few sales	Yes
Dryers	Basic	Yes	Yes	Yes	Yes
	Advanced	Yes	Yes	Yes	Yes
Freezers	Basic	Yes	Yes	Yes	Yes
	Advanced	Yes	Yes	Too few sales	No
Refrigerators	Basic	No	No	No	No
	Advanced	No	Yes	Yes	Yes
Soundbars	Basic	Yes	No	No	Yes
	Advanced	Yes	Yes	Yes	No
Washers	Basic	No	No	Yes	Yes
	Advanced	No	Yes	No	Yes

INCREASE IN PROGRAM-QUALIFIED SHARE LEADS TO INCREASES IN MINIMUM REQUIREMENTS FOR ESRPP PRODUCT TIERS (M1.2)

As a result of increasing sales share of program-qualified models, the national ESRPP collaborative has "ratcheted up" tier eligibility requirements for several products—including air cleaners, refrigerators, and washers—in order to readjust for high market share.

Interview results show that PG&E has been an important contributor to these tier eligibility decisions. PG&E's subcontractors perform market analysis on product categories to determine if and when adjustments should be made. Interviewees noted that while this can be a difficult task, it is critical to the long-term success of the program.

External collaborator interviewees expressed differing views on whether ESRPP should continue to set qualification levels that are higher than the requirements for ENERGY STAR. One interviewee believed that this complicated the process and that retailers had trouble understanding it. Another interviewee believed that some sort of tiers are necessary to help drive the market forward.

ESRPP HAS SCALE TO INFLUENCE PARTICIPATING RETAILERS (M3)

Nationally, ESRPP has achieved coverage of an estimated 18% of the US population.[33] This is lower than ESRPP's stated goal of 30% (based on retailer input), but high enough to keep retailers engaged with the program.

Several interviewees had expected early on that other California IOUs would have joined the ESRPP program, thereby giving it substantially greater scale, and were surprised when this did not happen. One interviewee noted that retailers believe having additional IOUs join the program would constitute an important milestone for the program.

Interview results show that some market actors in the traditional retail supply chain already know and care about ESRPP, which according to program theory was not expected to occur for another five years or so. For instance, one interviewee (a representative from an electronics manufacturing company) already had exposure to ESRPP, largely through connections in utilities, mainly PG&E. The interviewee stated that ENERGY STAR—and thus ESRPP—moves the market in a way that is surprising for a voluntary specification.

ENERGY STAR SPECIFICATION CRITERIA FOR PRODUCT CATEGORIES BECOME MORE STRINGENT (M4)

Interviews conducted as part of this evaluation research suggest that ESRPP inputs have had a direct effect on the development of ENERGY STAR specification criteria, though not enough time has passed for these effects to be fully realized in the adoption of new specifications. Directional evidence for this assertion comes from interviews with external collaborators, who attest that the sales data and technical input from ESRPP has been a critical piece of the specification development process. Several data points illustrate this:

- PG&E provided data (from ESRPP) and information for the CA IOU Comment Letter on the Version 4.0 Discussion Document for sound bars and for the second round of comments on Version 4.0.
- PG&E submitted comments on the ENERGY STAR Discussion Guide for Air Cleaners. The Guide includes acknowledgement of ESRPP's involvement in opening the spec revision. PG&E additionally provided insights from web scraped data to EPA, showing that the market share for ENERGY STAR

[33] This figure is based on PG&E estimates.

models was higher than reported by the EPA, and helping make the case for a revision to the existing specification.

- External collaborators interviewed as part of this evaluation believe that the process by which PG&E works with the ENERGY STAR program to advance ENERGY STAR-qualifying requirements works well. Interviewees noted that the specification development process is typically spread out over a long time period, and so the types of interactions between PG&E ESRPP staff and ENERGY STAR will depend on the schedule for draft specification revisions or new specifications.
- External collaborators indicated that the full category sales data provided by retailers as part of the ESRPP program requirements was a notable achievement. EPA staff reported that this data has been an important piece in specification-setting efforts and has allowed them to drive specifications higher than they otherwise would have been able to do.
- External collaborators also noted that PG&E has been able to leverage its own internal resources to address technical testing needs related to two ESRPP products (soundbars and air cleaners) and that the results of this testing have also aided specification-setting efforts.
- As one external collaborator noted: "[Specification-setting] runs the risk of not having a balanced pool if utilities are not accounted for. ESRPP helps EPA defend against pushback from manufacturers and others."

5.4 LONG-TERM OUTCOMES

In the long-term (7-10 years), the PG&E ESRPP Program Pilot is expected to result in three key outcomes:

- Manufacturers should increase the number and type of efficient models in ESRPP-targeted product categories in order to address increased demand (L1).
- This should correspond to an increase in the national market share of efficient models (L2).
- Lastly, federal standards should increase sooner than they otherwise would have for ESRPP product categories (L3).

As the PG&E ESRPP Program Pilot has only been operating for less than three years, the evaluation team did not assess any of the long-term outcomes for this report (Figure 5-5).

Figure 5-5. Long-Term Outcomes

6. CONCLUSIONS AND RECOMMENDATIONS

The 2016-2018 PG&E ESRPP Program Pilot Evaluation research resulted in the following key conclusions and recommendations:

Conclusion 1: The PG&E ESRPP Program Pilot has implemented key activities necessary for the program to operate effectively, but impacts vary by product category. This reinforces the need for the program to have product category-specific strategies and goals that can be tracked and periodically reevaluated. It also suggests that not all product categories may be suitable to include in the ESRPP program.

> **Recommendation 1.1: Continue to develop product category-specific strategies and targets that are tailored to each product.** Additionally, for product categories where an increase in market share is not the primary objective, make sure that another objective has been identified and is clearly documented. For instance, there may be products where the primary objective is to help advance ENERGY STAR specifications. In these cases, there should be a specific need that ESRPP can address (for instance, by providing full-category sales data). To ensure that credit is given to PG&E, it is critical to document the impacts that these data have on subsequent developments for specifications, codes, or standards.
>
> **Recommendation 1.2: Product categories for which we have not yet observed an increase in sales or assortment share should be closely monitored to ensure they are making reasonable progress toward the objective for that product category.** For some product categories, the value of obtaining full category sales data from retailers may provide substantial benefit to PG&E efforts to advance specifications, codes, and standards. In these cases, there is an argument for keeping these product categories in the program, assuming that the relevant sales data can be used to advance voluntary or mandatory requirements (see Recommendation #1.1 above). It may be prudent to make downward adjustments to the incentive amounts for these product categories to reflect this strategy.

Conclusion 2: Analysis of sales data shows short-term increases in the sales share of program-qualified models for 5/11 product tiers, or 4/7 product categories currently targeted by PG&E ESRPP. At the same time, we observed preferential retailer promotional efforts and assortment increases for many of these same product categories. Collectively, this provides evidence that the core ESRPP program mechanism is working for these product categories/tiers. Our analysis indicates that the ESRPP intervention is linked to a statistically-significant increase in sales for dryers (basic and advanced), freezers (advanced), and soundbars (advanced). Additionally, we see a small but statistically-significant upward trend in the shelf assortment of program-qualified models on store shelves—a mid-term outcome which is expected

to follow increases in program-qualified sales. Collectively these findings provide supporting evidence that, for some product categories, the core ESRPP intervention is having some effect.

Conclusion 3: National ESRPP program processes could be improved by adopting a simplified approach for defining tiers within a product category and, to the extent possible, aligning these tiers with ENERGY STAR requirements. An important feature of the ESRPP program design is the ability to "ratchet up" tier requirements as program-qualified share increases for these product categories. To date, the ESRPP collaborative has used a flexible method in which tier eligibility requirements are aligned annually with ENERGY STAR specifications except in cases where the market share for that product category is already high. In these cases, the tier requirements have been set to "ENERGY STAR + XX%" (where the precise percentage varies based on the current program-qualified market share). This is a necessary adjustment for the program to make. However, in some cases it has caused logistical difficulties for the program and for retailers because it becomes more difficult to determine which models actually qualify for each tier.

> **Recommendation 3.1: In the future, PG&E should work with other program sponsors to explore simplifying the qualifying requirements used for the national ESRPP program and, to the extent possible, keeping these qualifying requirements aligned with ENERGY STAR definitions.** For instance, ESRPP could choose to align qualifying requirements with ENERGY STAR Most Efficient (ESME) in categories where there is such designation. In categories that lack ESME, there may be value in working with the EPA to establish such a designation.

Conclusion 4: The full category sales data provided by participating retailers are a valuable tool, particularly for facilitating the development of specifications, codes, and standards. Interviews with external collaborators indicate that these data have already been used to facilitate the development of ENERGY STAR specifications. Further research has revealed that these data do not exist anywhere outside of the ESRPP efforts, making it an even more valuable resource.

> **Recommendation 4.1:** Given the long-term program goals of changing mandatory and voluntary specifications, PG&E should continue to work with regulatory bodies to provide data and analysis to accelerate the adoption of these rules.

Conclusion 5: PG&E's ESRPP program pilot is highly influential within the national ESRPP collaborative effort. Interviews with external collaborators provide evidence that PG&E is considered by other program sponsors and

collaborating agencies to be one of two primary drivers of the national ESRPP effort, the other driver being the Northwest Energy Efficiency Alliance (NEEA). In particular, it appears that PG&E and NEEA are driving much of the codes and standards advocacy work.

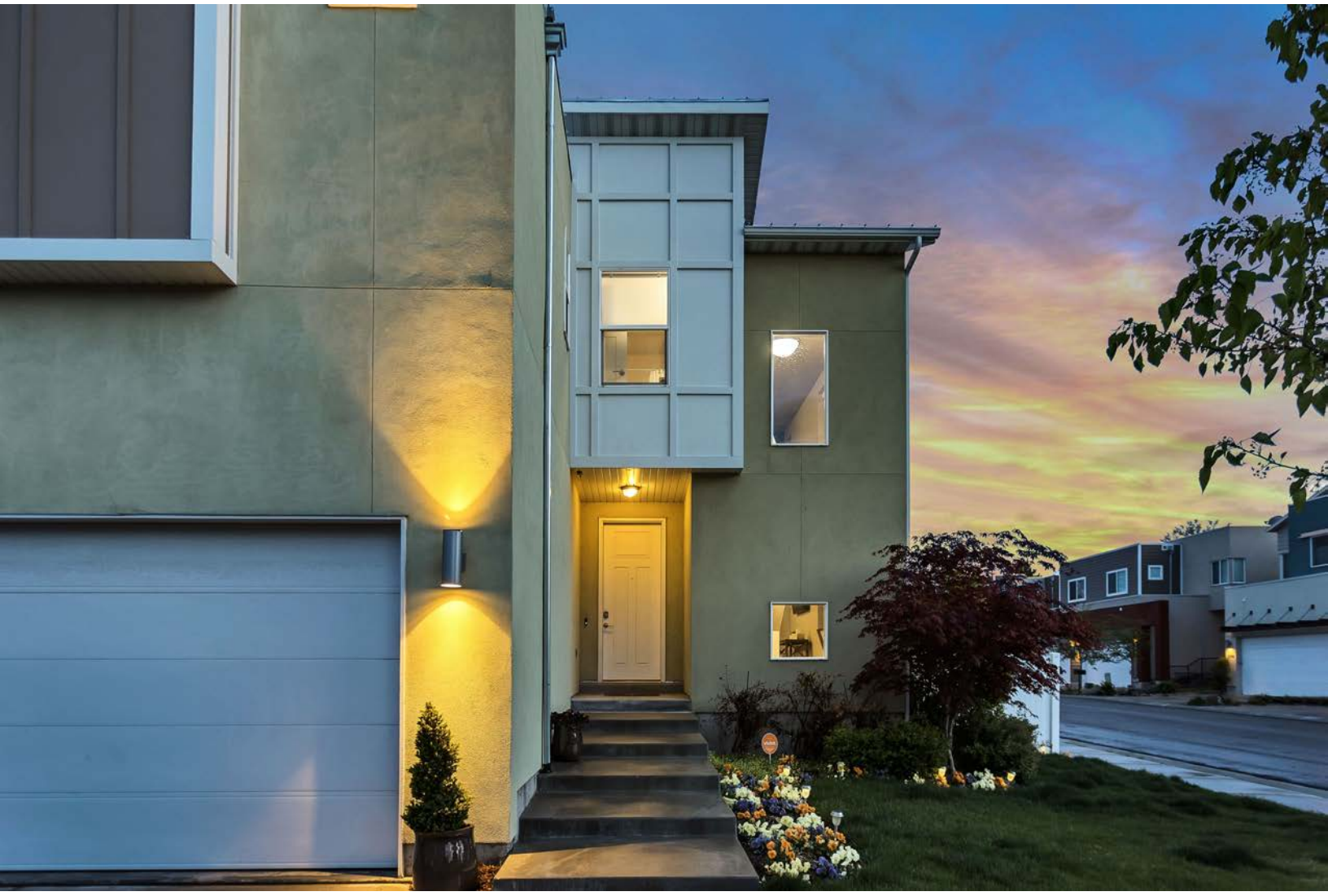
Conclusion 6: As the PG&E ESRPP Program Pilot continues to operate moving forward, the current baseline approach (i.e., a pre/post model averaging baseline) will become less useful as the pre-period sales data become outdated. Therefore, it will become increasingly important to use a baseline approach that is able to account for new developments and external changes in the market.

> **Recommendation 6.1: Moving forward, the PG&E ESRPP Program Pilot should adopt a baseline approach similar to that employed by NEEA to help understand and assess market transformation effects due to the ESRPP program**. There are several benefits of using a baseline approach similar to that utilized by NEEA: (1) the approach has already been in use for some time, (2) it is transparent and flexible, and (3) using such an approach would facilitate evaluation consistency across two of the most important ESRPP program sponsors.

PACIFIC GAS & ELECTRIC ENERGY STAR RETAIL PRODUCTS PLATFORM (ESRPP) PILOT EVALUATION

Appendices

January 18, 2019



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APPENDIX A: DETAILED REGRESSION MODELING METHODS

The primary approach taken by EMI Consulting to estimate increases in sales rates for qualified products is based on modeling sales rates in the pre-program period, using the model to predict sales into the program period, and the comparing the predictions to the observed sales rates. This process involved normalizing sales for seasonality, developing three models of sales in the pre-program baseline period, predicting program-period sales using the baseline model, and averaging results from the three models.

NORMALIZE SALES FOR SEASONALITY

Because sales vary significantly throughout the year, models of sales levels must account for seasonality. The approach taken by EMI Consulting was to normalize sales levels and develop models based on the normalized sales models. Because overall sales levels are potentially different in the pre-program period and the program period, we treated the calculated the normalized level separately for the pre-program period and the program period. We did this by summing up all qualified product sales by product group in each month and dividing each monthly sales value by the overall average annual share for that calendar month, and then taking the average across all instances of that calendar month to get a normalization factor. We then divide the sales by the normalization factor to calculate normalized sales. That is, the normalized sales value is the sales value relative to the average sales for that month. For example, for refrigerators in July 2017, the normalized sales value is calculated as:

$$Normalization\ factor_{Refrigerators,July2017} = \frac{Sales_{Refrigerators,July2017}}{1/2\left(\frac{Sales_{Refrigerators,July2016}}{AverageSales_{Refrigerators,Pre-program}} + \frac{Sales_{Refrigerators,July2017}}{AverageSales_{Refrigerators,Program}}\right)}$$

$$NormalizedSales_{Refrigerators,July201y} = \frac{Sales_{Refrigerators,July2017}}{Normalization\ factor_{Refrigerators,July2017}}$$

This uses the variation in sales over the full time series of data to normalize sales values so that months that had relatively high sales in both periods will have high seasonal sales, while months with low sales in both periods will have low seasonal value, and months that varied between the periods will have a moderate seasonal value. Normalized penetration rates are then calculated as the ratio of normalized program-qualified sales to normalized total sales. We normalize qualified and non-

qualified sales separately to allow for different patterns between the qualified and non-qualified products.

Fit Baseline Models

Based on the normalized sales numbers, EMI Consulting developed three statistical models of the baseline sales behavior. The first modeled the normalized monthly sales values, under the assumption that the effect of the program is to increase the sales of qualified products. For each product category, model one takes the form,

$$NormalizedSales_{month} = \beta_0 + \beta_1 Timetrend_{month} + \varepsilon_{month}$$

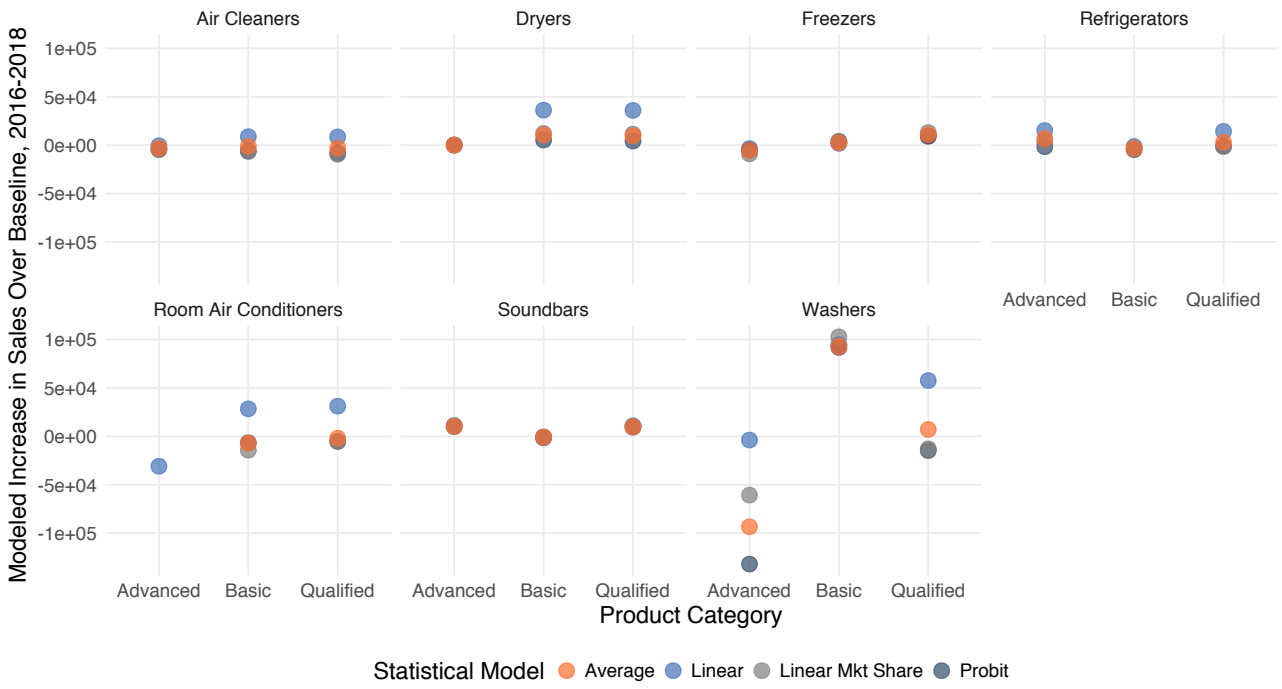
Where β_0 is an intercept, β_1 is the average increase over time, $Timetrend_{month}$ is the number of months since the beginning of the data, and ε_{month} is an error term. The second modeled the monthly penetration rate, under the assumption that the effect of the program is to increase the market share. The third modeled a transformation of the market share, based on the assumption that the effect of the program would have a smaller absolute impact on the market share when the market share is very small or very large, and a larger impact when it is modest. The second and third model take the same form, except that $NormalizedSales_{month}$is replaced by the normalized penetration rate for the second model and the normal cumulative distribution function of the penetration rate for the third model. For each product group and each model, we used leave-one-out prediction model fit to select between an intercept-only sub-model, where β_1 is fixed to zero, and a sub-model with an intercept and a trend. Leave-one-out prediction model fit is a measure of who well the form of the model is able to predict each observation in the model without using it. So for each observation, the sub-model parameters were estimated with all the other data but leaving the target observation out of the data. That observation was then compared to the predicted value for the sub-model that was estimated without it. Between the full sub-model and the intercept-only sub-model, the sub-model that gave better prediction fit was selected within each model grouping.

Predict Sales

For each product and each product group we used each of the three models to predict sales levels during the program period. For the first model, this involved taking the predicted normalized sales and de-normalizing the data to get predictions of actual sales, multiplying the predicted normalized sales by the normalization factor. For the second model, predicted qualified sales are equal to the predicted qualified market share (to get predicted normalized sales) multiplied by the normalization factor. For the third model, the predicted market share value calculated as the inverse cumulative distribution function of the predicted output. This is then used to calculate sales as in the second model.

The three models were averaged based on their prediction model fit during the pre-program period to develop a predicted sales value for each program group. EMI Consulting used a model averaging approach to combine the results from three different prediction models in order to adjust for uncertainty in what the true model is. The model averaging relied on the same leave-one-out prediction error process as described above. The relative weight for each model was determine by numerical optimizations to minimize the sum of the squared leave-one-out prediction errors across the three tier groupings (basic, advanced, all qualified). Estimated increases in qualified product sales were calculated as the difference between the observed sales and the predicted sales. If observed sales were larger than predicted sales, then that constituted an increase in the sales level during the program period. The results of these individual models are shown below in Figure A-1.

Figure A-1. Results for All Statistical Models



Calculate Confidence Bounds

To determine if the predicted increases are different from zero with at least 90% confidence, EMI Consulting calculated standard errors for the sum based on the monthly prediction standard errors and model averaging weights. For each model the standard error of the predicted increase was calculated as the square root of the sum of the prediction standard errors. The prediction standard errors incorporate both the uncertainty in the modeled average as well as the variation in each observation around that average, and thus are higher than the standard errors for the model fit alone.

As the overall estimate for the sales increase was a weighted average of the estimates from the three models, we calculated the standard error for the overall estimate as a linear combination where each item had a coefficient equal to its weight:

$$AverageIncreaseSE = \sqrt{\frac{\frac{Model1SE^2}{Model1SSPE} + \frac{Model2SE^2}{Model2SSPE} + \frac{Model3SE^2}{Model3SSPE}}{\frac{1}{Model1SSPE} + \frac{1}{Model2SSPE} + \frac{1}{Model3SSPE}}}$$

where $Model1SE$ is the standard error for the predicted increase from model one, $Model1SSPE$ is the sum of the squared prediction errors for model one, and other terms are the equivalent values for models two and three.

APPENDIX B: REGIONAL COMPARISON ANALYSIS

A fundamental challenge to understanding ESRPP program impacts is establishing a reliable baseline. This challenge exists for two reasons:

- ESRPP is national in scope, and retailer buying decisions and strategies frequently apply to entire regions (rather than individual stores). This means it is exceedingly difficult to identify a comparison group/area that is sufficiently similar to the treatment group (i.e., PG&E service territory) along key dimensions (i.e., has similar demographic and regulatory characteristics) but is *not* subject to any of the regional influence from ESRPP.
- Outside of full category sales data collected through the ESRPP program from participating retailers, market data required to understand program impacts is either scarce or nonexistent. In cases where such data do exist, for most product categories they do not contain the level of detail required to perform a comprehensive quantitative comparison.[1]

For this evaluation, we relied on a quasi-experimental "within participants" approach (i.e., the pre/post model averaging baseline) to mitigate any difficulties associated with finding a suitable comparison group. To supplement this approach, we performed two additional analyses: (1) a comparison of program-qualified share among participating retailers in PG&E service territory to program-qualified share for participating retailers in Southern California Edison (SCE) service territory, and (2) a comparison of volumetric shipment data for California and Massachusetts. These analyses are discussed in more detail below.

1.1 PG&E AND SCE PARTICIPATING RETAILER PROGRAM-QUALIFIED SHARE COMPARISON

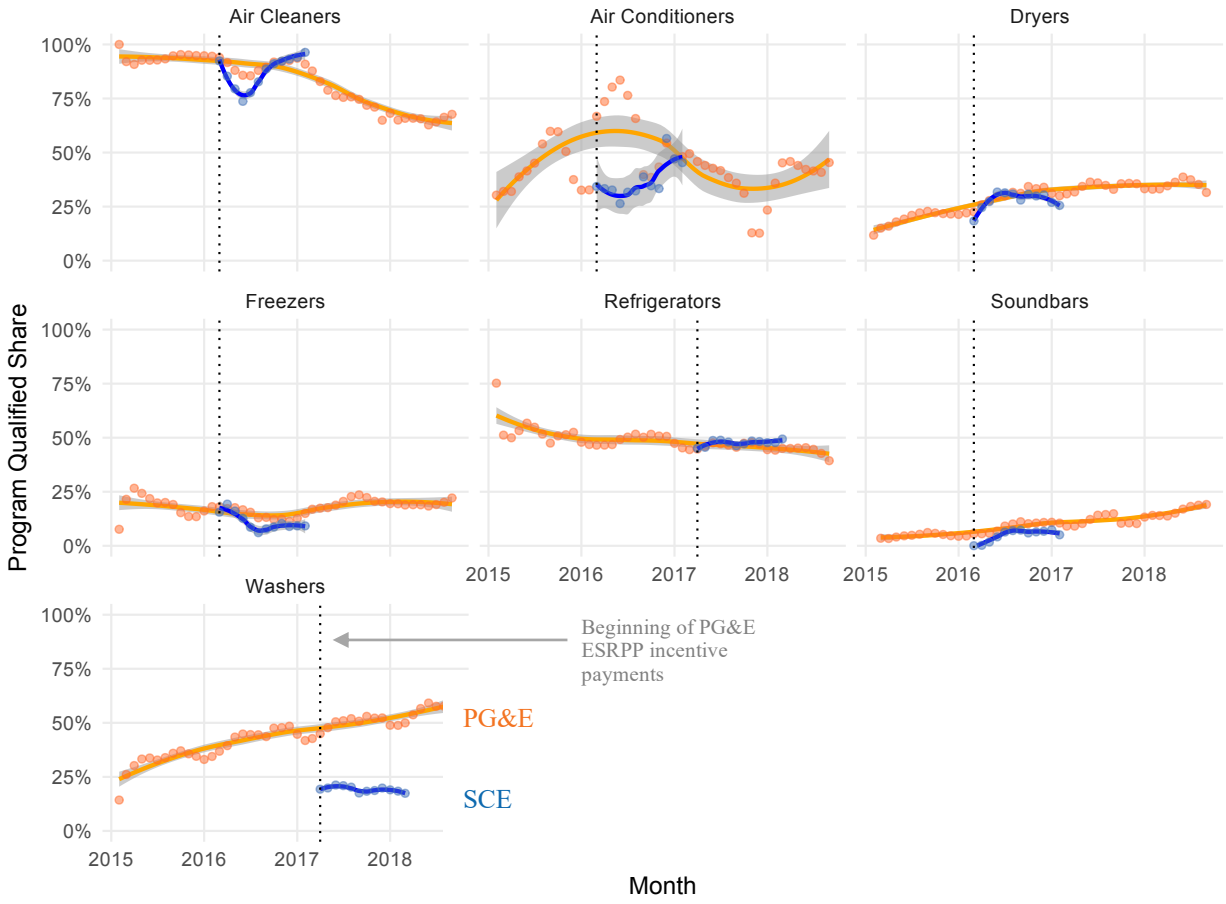
We first compared program-qualified share for participating retailers in PG&E service territory to program-qualified share for participating retailers in Southern California Edison (SCE) service territory. These data from SCE's service territory were collected from participating retailers as one requirement for program participation.

The results of this comparison are largely inconclusive, given that (1) SCE data were only available for a limited window of time, (2) it was not possible to compute retailer-specific values because of ESRPP contractual data masking requirements,

[1] For example, the AHAM data discussed in this appendix contain total unit shipment values by state, but do not contain any model-level information that would allow us to compute a program-qualified share.

and (3) it is impossible to precisely quantify any impacts from ESRPP that SCE service territory may have experienced due to the regional nature of retailer decision-making. The graphical results of this comparison are shown below in Figure B-1.

Figure B-1. Participating Retailer Program-Qualified Share Comparison by Product Category: PG&E and SCE

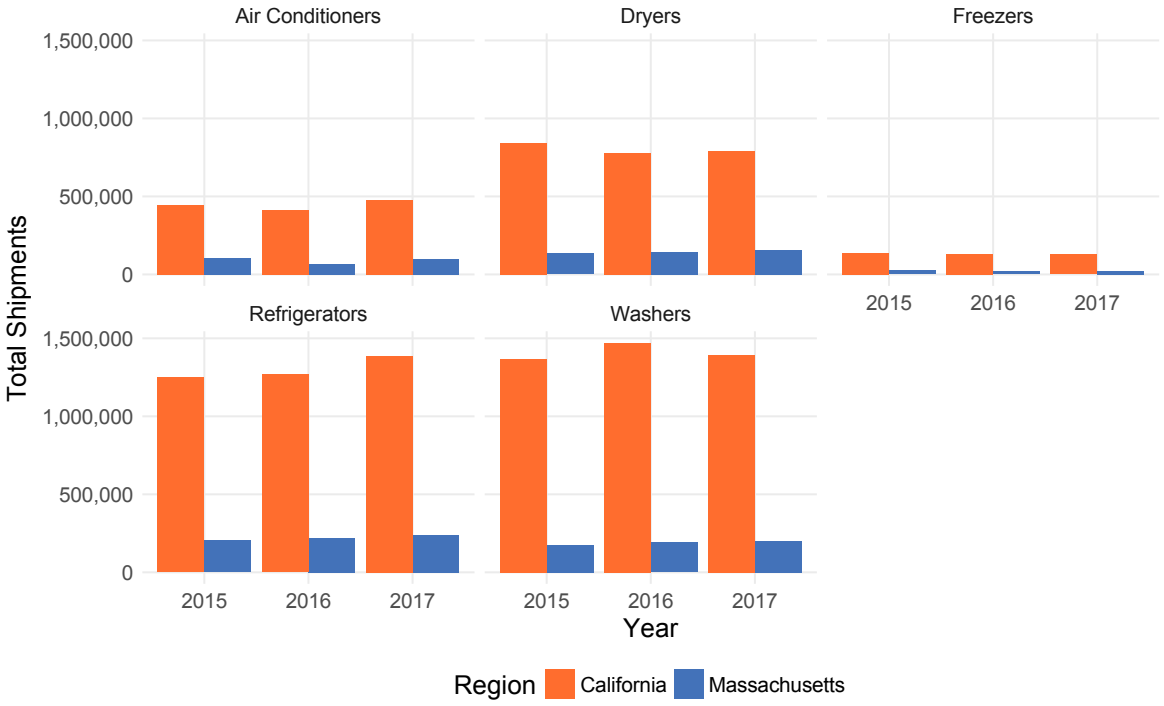


1.2 CALIFORNIA AND MASSACHUSETTS UNIT SHIPMENT DATA COMPARISON

For the period 2015-2017, the Association of Appliance and Home Manufacturers (AHAM) collected unit shipment data for several product categories included in ESRPP: air conditioners, dryers, freezers, refrigerators, and washers. These data provide total unit shipments to a given geographic area by month and year. The evaluation team examined these data for the period 2015-2017 for the states of California and Massachusetts to understand if trends in the overall volume of unit shipments differed *systematically* between the two states.

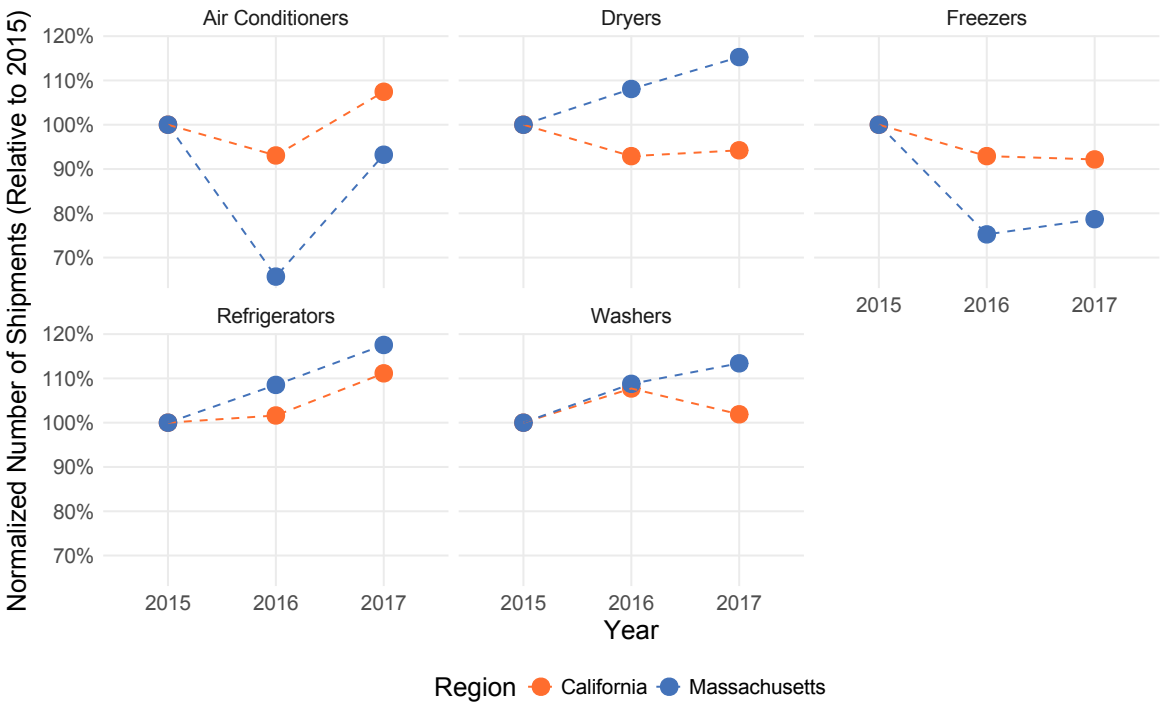
As shown in Figure B-2, the overall volume of shipments was much higher for California than for Massachusetts in every product category (as expected).

Figure B-2. Comparison of AHAM Unit Shipment Volumes: California and Massachusetts



To better understand what the relative trends were for the two state, the evaluation team normalized values for each state, using the 2015 value (for each product category) as a point of comparison. These results are shown below in Figure B-3. This analysis shows suggests that shipments for these products to California are not increasing uniformly over the ESRPP program period.

Figure B-3. Normalized Comparison of AHAM Unit Shipment Volumes: California and Massachusetts



This analysis also highlights limitations of unit shipment data: (1) It does not afford the ability to compute program-qualified share, and (2) because it is *shipment* data (and not sales data), it lacks the geographic precision of sales data—that is, we cannot know for certain that a unit *shipped* to California was ultimately sold to an end-use customer in California.

APPENDIX C: CUSTOMER BARRIERS ANALYSIS

In order to determine the effectiveness of its ESRPP program, PG&E identified the need to perform a market barriers analysis as part of its ESRPP Program Evaluation contract with EMI Consulting.

The overarching purpose of this analysis was to understand to what extent retailers may be implementing strategies that address any of five customer-facing market barriers which were previously identified as important in the consumer appliances and electronics market.[2] These market barriers include: Competing Priorities, Information and Search Costs, Product Availability, Inseparability of Product Features, and Performance Uncertainty.[2] This research was initially intended to rely solely on retailer implementation plans ("Plans") to document these strategies. However, an earlier review of these plans showed that in many places, the Plans lacked sufficient specificity to map retailer activities to market barriers. As such, this analysis was expanded to also include (1) program activities performed by PG&E and/or its field services subcontractor, and (2) the results of in-depth interviews with national-level retail staff (conducted by Cadmus, the multi-region RPP evaluator).

To complete this analysis, EMI Consulting reviewed the following resources provided by PG&E and/or its ESRPP partners to gather specific evidence showing that the five key market barriers mentioned above are in fact being addressed by retailer activities or program activities:

- Retail Products Platform Market Barriers Research Final Report (Research Into Action, February 2017)
- The 2017/2018 Retailer Implementation Plans
- ESRPP National Interviews, February (June 2018)
- PG&E ESRPP Overview by Retailer and Product Category (May 2018)
- PG&E ESRPP Shelf Survey Data (May-June 2018, provided by ICF International

In the table below, we provide a summary of findings showing the extent to which the PG&E ESRPP program may be addressing each of these barriers identified by the Research Into Action report.

[2] These barriers were identified in the report "Retail Products Platform Market Barriers Research Final Report." (Research Into Action, February 2017)

Table C-1. Customer Market Barrier Analysis

Market Barrier	Addressed in Logic Model?	Addressed in Retailer Plans?	Evidence from In-Store Visits[3]	Evidence from National Retailer Interviews
Competing Priorities *Customers are unable to obtain the features they value more highly than energy efficiency in an energy efficient model.* *(applies to all product categories)*	**Yes; Short-, Mid- & Long-term** Customers are able to obtain features in EE models when price is no longer a barrier. Additional work by RPP defining product tiers contribute by incorporating connectivity.	**Yes, though in most cases not product-specific** Plans include qualified products in holiday promotions and offer reward points for qualified products equal to the RPP incentive.	**Yes** Qualified models discounted for holiday promotions. Qualified models for multiple product categories showcased.	**Yes** National Retailer interviewees stated: Marketing of energy efficient products has increased since last year. ESRPP's main influence on marketing strategies is the price they advertise. *Price is the most important consideration for customers.* Some manufacturers indicated that they are aware of ESRPP and have made changes to their product lines as a result.

[3] The promotional period in the retailers' Plans covers April 2017 – March 2018.

Table C-1 (continued). Customer Market Barrier Analysis

Market Barrier	Addressed in Logic Model?	Addressed in Retailer Plans?	Evidence from In-Store Visits[4]	Evidence from National Retailer Interviews
Inseparability of Product Features *Unable to obtain an energy efficient model without also getting other premium features, causing the cost of the efficient model to exceed the perceived benefit.* *(applies to refrigerators)*	**Yes; Long-term** RPP incentives are designed to motivate retailers to assort and, in turn, motivate manufacturers to design efficient products across a wider range of feature sets. RPP to address inseparability of product features through the same mechanism that it uses to address competing priorities	**Partially** Plans include activities which indicate retailer interactions with manufacturers. (Ex: trade shows, conferences, merchant team collaborations)	**Some Evidence:** Observed increases in program-qualified models floored in certain product categories *may* include non-premium, energy efficient options. Retailers are expected to communicate with manufacturers regarding consumer preferences.	**Some Evidence:** National Retailer Interviews found: There is significant interaction between retailers and manufacturers in the new product design process. Some manufacturers indicated that they are aware of ESRPP and have made changes to their product lines as a result.
Information and Search Costs *Perceives the effort involved in learning about and identifying energy efficient products increases the cost of the efficient model to the point it exceeds the perceived benefit.* *(applies to clothes dryers, clothes washers, room ACs, soundbars)*	**Yes; Short-term** Promotions and marketing, as well as training of store employees, will help drive customers toward more EE options.	**Yes** Plans include employee training initiatives, adding Energy Star resources to the retailer website, advertisements, and product placement in-stores.	**Yes** Promotional signage for qualified models created by store associates. Retailer staff trained on RPP program, customer benefits program, and ROI.	**Yes** National retailer interviewees stated Internal stakeholders value information provided through ESRPP as it helps the retailers drive category sales.

[4] The promotional period in the retailers' Plans covers April 2017 – March 2018.

Table C-1 (continued). Customer Market Barrier Analysis

Market Barrier	Addressed in Logic Model?	Addressed in Retailer Plans?	Evidence from In-Store Visits[5]	Evidence from National Retailer Interviews
Product Unavailability *Unable to purchase an efficient model because it is impractical or impossible to find efficient models available for purchase.* *(applies to heat pump clothes dryers, standalone freezers)*	**Yes; Mid-term** Incentives are designed to lead to increased assortment share of EE models. This is one of the primary mechanisms underlying RPP.	**Partially** Plans include activities which indicate retailer interactions with manufacturers. (Ex: trade shows, conferences, merchant team collaborations).	**Yes** Observed increases in proportion of program-qualified models stocked in certain product categories.[6]	**Yes** National retailer interviews found: Merchants have stocked more energy efficient products, with incentives factoring heavily on their decisions. Retailers' sustainability staff share important info with merchants, such as ESRPP incentive details, program requirements, and profitability.

[5] The promotional period in the retailers' Plans covers April 2017 – March 2018.

[6] The shelf assortment data analysis determines "model assortment share," which is the proportion of unique program-qualified models divided by the total number of models for a given product category.

Table C-1 (continued). Customer Market Barrier Analysis

Market Barrier	Addressed in Logic Model?	Addressed in Retailer Plans?	Evidence from In-Store Visits[7]	Evidence from National Retailer Interviews
Performance Uncertainty *Customers are unsure whether an efficient model will deliver the promised energy savings while functioning as well as an inefficient option.* *(applies to heat pump clothes dryers only)*	**Yes; Mid-term and Long-term[8]** The ENERGY STAR label is likely to instill confidence in purchasing. ESRPP efforts are also designed to lead to the development of test procedures as part of the ENERGY STAR certification process.	**Partially** Plans include mentions of signage for qualified models and training, but do not include specifics (in most cases) regarding *which* models, and do not specifically mention addressing performance uncertainty.	**Some Evidence** Promotional signage for qualified models created by store associates. *(However, no specifics on performance uncertainty of heat pump clothes dryers, which is the only product subcategory for which this barrier applies).*	**Some Evidence** National retailer interviewees stated that ESRPP helps the sales associate to better sell products to customers and adds another level of credibility. (However, no specifics on performance uncertainty of heat pump clothes dryers).

[7] The promotional period in the retailers' Plans covers April 2017 – March 2018.

[8] The Research Into Action report that identified these market barriers indicated that this market barrier is not addressed by ESRPP program theory. However, we believe there is justifiable reason to believe that the current program theory does in fact address this issue, albeit not in the short term.

APPENDIX D: PROGRAM PERFORMANCE INDICATORS (PPIs) AND MARKET TRANSFORMATION INDICATORS (MTIs)

Tracking of Program Performance Indicators (PPIs) and Market Transformation Indicators (MTIs) is based on the PG&E ESRPP logic model. In the tables below, we first present PPIs, and then present MTIs. Lastly, a special set of MTIs—Customer Barrier Indicators—are described, though these indicators have not yet been operationalized.

Table D1. Program Performance Indicators: Part 1

LOGIC MODEL COMPONENT	ID	Metric	Data Collection Activity/ Source	Category	Mar-16	2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1
O1.1. Incentives for qualified units sold	O1.1	Dollar amount of incentives paid to each retailer by product category	Sales data portal	**All**	**$53,880**	**$431,010**	**$497,050**	**$481,480**	**$430,000**	**$963,510**	**$903,220**	**$903,640**	**$706,610**
				Air Cleaners	$ 7,820	$ 36,130	$ 33,860	$ 34,120	$ 41,870	$ 16,840	$ 23,170	$ 33,560	$ 9,290
				Air Conditioners	$ 360	$ 94,380	$ 73,360	$ 3,460	$ 2,720	$228,040	$ 83,840	$ 1,000	$ 2,140
				Clothes Dryers	$43,300	$278,200	$361,350	$395,550	$359,900	$349,650	$374,990	$434,580	$350,580
				Freezers	$ 2,170	$ 13,690	$ 11,980	$ 16,790	$ 11,580	$ 21,660	$ 33,360	$ 31,040	$ 16,820
				Refrigerators	N/A	N/A	N/A	N/A	N/A	$ 87,740	$117,020	$122,480	$ 81,620
				Sound Bars	$ 230	$ 8,610	$ 16,500	$ 31,560	$ 13,930	$ 15,700	$ 35,400	$ 54,820	$ 36,480
				Washers	N/A	N/A	N/A	N/A	N/A	$243,880	$235,440	$226,160	$209,680

Table D2. Program Performance Indicators: Part 2

LOGIC MODEL COMPONENT	ID	Metric	Data Collection Activity/ Source	Category	Mar-16	2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1
O1.2. Sales data platform with monthly retailer data	O1.2	Ability of data portal (Low, Medium or High) to enable program operations / program data analysis	Sales data portal	All	High / Med	High / Med	High / Med	High / Med	High / Med	High / Med	High / Med	High / Med	High / Med
O2.1 POP materials in PR stores	O2.1	Percentage of months to date where POP materials have been placed in stores	In-store field data	All	N/A	100%	73%	83%	88%	91%	92%	93%	94%
O2.2 Promotional activity data and shelf assortment data gathered	O2.2	Percentage of months to date where promotional/shelf survey data have been gathered	In-store field data	All	100%	100%	100%	100%	100%	100%	100%	100%	100%
O2.3 Store associates trained	O2.3	Cumulative number of store associates trained	In-store field data	All	-	415	1,020	1,380	1,973	2,739	3,456	4,210	4,935

Table D3. Program Performance Indicators: Part 3

LOGIC MODEL COMPONENT	ID	Metric	Data Collection Activity	Category	PY 1				PY 2			
					2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1
O3.1 Coverage of PAs	O3.1	Percentage of US population served by ESRPP	Program data review	All	18%				18%			
O3.2 Optimal set of PRs	O3.2	Initially, count of major retailers or major retail buying groups. In the longer term, may consider calculating total market share of participating retailers.	Program data review	All	4 major retailers				5 major retailers			6 major retailers
O3.3 Product categories selected and tiers defined	O3.3	Binary: Are product categories selected and tiers defined on an annual basis?	Program data review	All	Yes; however, tier definition is area for improvement				Yes; however, tier definition is area for improvement			

Table D4. Program Performance Indicators: Part 4

LOGIC MODEL COMPONENT	ID	Metric	Data Collection Activity	Category	PY 1				PY 2			
					2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1
O4. Input on specifications and standards, product selections and tier definitions using retailer sales data and other sources	O4a	Cumulative number of product categories for which ESRPP has contributed input on specification and standard development	Program data review	All	0				0			2
	O4b	Percentage of active product categories for which PG&E has participated in product selection and tier definition activities	Program data review	All	100%				100%			

Note: For general documentation of PG&E ESRPP outreach and advocacy efforts, please see Appendix E.

Table D5. Market Transformation Indicators: Short-Term, Part 1

LOGIC MODEL COMPONENT	ID	Metric	Data Collection Activity	Category	PY 1				PY 2			
					2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1
S1. Increased penetration of qualified models as a result of reduced barriers and increased PR sales of qualified models	S1	Program-qualified share for participating retailers by product category (and if possible, compare to national market share for all retailers)	Sales data portal	All	See main report.				See main report.			See main report.
S2. PRs factor ESRPP incentives and increased demand for PQ models into assortment and marketing/promotions decisions	S2	Percentage of retailers for which we have qualitative evidence on product level considerations, weighted by total sales volume*	Interviews with retailers	All	0%				N/A - No Interviews completed in 2017			100% (4 of 4 Retailers Interviewed) of Retailers; Medium-level of influence

Table D6. Market Transformation Indicators: Short-Term, Part 2

LOGIC MODEL COMPONENT	ID	Metric	Data Collection Activity	Category	PY 1				PY 2			
					2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1
S3. Specifications/codes/standards organizations are able to make more timely and informed decisions based on input and data from PG&E/ESRPP.	S3	Qualitative assessment using self-report feedback from EPA staff	Interviews with external collaborators	-	N/A No external collaborator interviews this year				Yes External collaborator interviewees indicate that PG&E ESRPP's data provides more visibility into where specs need to land. "If EPA is successful in getting new/more stringent specs, it will be because of NEEA and PG&E efforts." EPA is about to put out a discussion guide that was prompted by ESRPP's market data. ESRPP has been incentivizing products at 30%/50% above current ES levels and helped EPA advocate for more aggressive specification levels. External collaborator: "Specification setting runs the risk of not having a balanced pool if utilities are not accounted for. ESRPP helps EPA defend against pushback from manufacturers and others."			

Table D7. Market Transformation Indicators: Mid-Term Indicators, Part 1

LOGIC MODEL COMPONENT	ID	Metric	Data Collection Activity	Category	PY 1				PY 2			
					2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1
M1.1. PRs increase offering and marketing of qualified models	M1.1	Proportion of models on sales floor, within each product category, that are program qualified	In-store field data	All Retailers	See main report.				See main report.			See main report.
M1.2. Increase in PQS leads to increases in minimum requirements for RPP product tiers.	M1.2	Cumulative # of active product categories for which minimum tier requirements are increased	Program data review	All Retailers	0				3 Air cleaner basic tier and advanced tier both changed by ESRPP (2). Addition of advanced tier for room ACs.			4 ES spec change for washers
M2. PRs purchase additional types of qualified models and more of each type of qualified model from manufacturers	M2	Percentage of manufacturers for which we have qualitative evidence on increased requests for qualified models from manufacturers	Interviews with manufacturers		Not yet tracked. Manufacturer interviews must occur first.				Not yet tracked. Manufacturer interviews must occur first.			
M3. ESRPP has scale to influence PRs	M3	Self-report feedback from retailers on influence of ESRPP	Interviews with retailers	All Retailers	No; Limited program scale				N/A - No Interviews completed in 2017			Some, but larger scale is desired/needed for larger impact

Table D8. Market Transformation Indicators: Mid-Term Indicators, Part 2[a]

LOGIC MODEL COMPONENT	ID	Metric	Data Collection Activity	Category	Mar-16	2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1
M4. ENERGY STAR specification criteria for product categories become more stringent	M4	Percent progress towards ES spec revision metric.	Program data review	All	0%				0%				See individual product categories below
				Air Cleaners	0%				0%				50%
				Air Conditioners	0%				0%				1%
				Clothes Dryers	0%				0%				1%
				Freezers	0%				0%				1%
				Refrigerators	0%				0%				1%
				Sound Bars	0%				0%				50%
				Washers	0%				0%				1%

[a] *See Appendix G for more detailed information on specification advancement for air cleaners and soundbars.*

Table D8. Customer Barrier Indicators

CUSTOMER BARRIERS	ID	Metric	Data Collection Activity	Availability
Customer Awareness	CB1	Customer awareness of ENERGY STAR or plug load energy efficiency	Surveys with customers. May leverage reports from ENERGY STAR.	Tracking beginning in Q1 2019
Competing Priorities	CB2	Availability of key features in EE models (addresses barrier of Competing Priorities)	Retailer sales data / web-scraping	Tracking beginning in Q1 2019
Inseparability of Features	CB3	Availability of key features in EE models (addresses barrier of Inseparability of Features)	Retailer sales data / web-scraping	Tracking beginning in Q1 2019

APPENDIX E: DETAILED INFORMATION ON PG&E ESRPP OUTREACH AND ADVOCACY EFFORTS

Quarter	Date	Stakeholders	Event/Recognition	Description	Source
2012 Q1		PG&E, Retailers, U.S. EPA	BCE meetings	PG&E met with BCE retailers including Best Buy and Sears and U.S. EPA/ENERGY STAR to discuss the future of the BCE program. PG&E outlined plug-load concept with national platform (Whole Store/RPP), which elicited positive response from retailers and EPA.	Meeting agenda
2012 Q2	4-11-12	U.S. EPA, Retailers, Manufacturers, EEPS	ENERGY STAR Partner of the Year - Award	PG&E received ENERGY STAR Partner of the Year—Sustained Excellence recognition for its campaigns to promote ENERGY STAR certified products, collaborations to help build stakeholder support for ENERGY STAR programs and product specifications, and programs designed to bring ENERGY STAR certified products directly into customer homes and businesses. Key 2012 accomplishments included continuing to offer innovative streamlined ENERGY STAR-focused retail channel programs that cross utility service territory and state lines, simplifying program administration, reducing participation costs for retail and manufacturer partners, and driving a consistent message to customers about the benefits of energy efficiency.	https://www.cee1.org/content/sustained-excellence-award-winners
2012 Q2	4-11-12	U.S. EPA, PG&E	ENERGY STAR Partner of the Year Meeting	PG&E presented to U.S. EPA/ENERGY STAR (Peter Banwell, Hewan Tomlinson) the Future of BCE (Whole Store/RPP) concept. U.S. EPA committed to help support RPP concept development. Discussed strategies for new retail-based programs including an agenda item in 2012 ENERGY STAR Partners meeting.	Future of BCE presentation
2012 Q2	8-2-12	U.S. EPA, PG&E	Meeting	Strategic discussion with U.S. EPA regarding development and implementation of RPP concept and ENERGY STAR's role.	Meeting agenda
2012 Q3	8-17-12	CPUC ED, CA IOUs	Statewide PLA Meeting	IOUs discussed future plans to address PLA energy savings opportunities. IOUs presented 2013-2014 pilot plans. PG&E presented RPP pilot plans and progress in Phase 1 pilot with Kmart. Discussed needs related to market transformation, baselines, and EM&V.	Meeting agenda, presentations
2012 Q4		PG&E, IOUs, EEPS	Meetings	Meetings with SCE and west coast EEPS (West Coast Regional Utility Network) to recruit participation in BCE program. Presented Future of BCE and strategy for progressing from BCE to RPP.	Meeting agenda
2012 Q4	10-24-12	U.S. EPA, Retailers, Manufacturers, EEPS	ENERGY STAR Products Partner Meeting	BCE concept was basis for panel of retailers presenting the topic "Streamlining ENERGY STAR Partner Collaborations on Retail-Based Energy Efficiency Programs." ENERGY STAR Retail Action Council formed during this meeting. Reviewed RPP concept in meetings with Best Buy, Home Depot and Sears.	Presentation

Quarter	Date	Stakeholders	Event/Recognition	Description	Source
2013 Q1	1-9-13	Appliance and Consumer electronics manufacturers. NRDC	CES 2013	initial thoughts regarding future direction of utility PLA programs were discussed with manufacturers, suppliers and retailers, including an outline of RPP concept. Reviewed RPP concept with Noah Horowitz of NRDC.	
2013 Q3	3-27-13	CPUC ED, CA IOUs	PLA Workshop	PLA Program Development Workshop was the first of a series to determine the barriers and possible solutions to developing effective PLA programs. Participants discussed possible program pilots and identified success factors and risks. PG&E presented Whole Store concept (RPP), SCE presented STB energy efficiency, and SDG&E presented Home Energy Management Solution.	PLA-ED Two-day Workshop Agenda, PG&E RPP Pilot presentation
2013 Q4 - 2014 Q4		PG&E, Kmart	RPP Pilot Phase I	PG&E's Retail Plug-load Portfolio (RPP) Phase I Pilot ran from late 2013 through 2014. The RPP was a small-scale (<$50K in incentives) market transformation initiative that offered incentives to a participating retailer (Kmart) for the sale of specific qualified and efficient consumer electronics and appliances. Although results were mixed due to the limited duration of the pilot, the pilot allowed PG&E to establish a framework with which a larger programmatic effort could proceed.	http://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/About_Us/Organization/Divisions/Office_of_Governmental_Affairs/Legislation/2018/13-15%20Energy%20Efficiency%20Report_Final.pdf
2014 Q1	1-7-14	U.S EPA, NEEA, PG&E		Meeting to discuss upcoming Product Specification Revisions. For the RPP program, it is important to participate in specification revisions for products other than TVs. RPP design streamlines data processes, reduce per unit transaction costs and accesses total category sales data. Collaboration with EPA and other stakeholders improves estimates of unit energy consumption (UEC) for non-qualified units. Some product categories have very little energy data on non-qualifying units, which makes it difficult to verify actual energy savings and therefore justify EE programs. Proposal for PG&E to work with EPA and other stakeholders to conduct additional research.	Meeting agenda
2014 Q1	2-5-14	CPUC ED, CA IOUs, Sears, Lowe's, Best Buy, Home Depot	Retail Industry Workshop	Presentation and discussion of retail industry to enhance energy efficiency program collaborations among regulators, utilities, retailers and manufacturers to benefit customers and advance energy policy objectives.	Workshop presentation, Notes
2014 Q2	4-15-14	EEPS, retail buyers, retail suppliers	Sears Green Leadership Summit	Introduce RPP concept, including review of Kmart pilot, with Sears' utility partners, Sears suppliers, and Sears staff.	Presentation
2014 Q2	June 2014	CPUC, CA IOUs, EE advocates	CPUC En Banc	PG&E made brief presentation on innovative plug load program concept at statewide CPUC meeting to discuss future strategies for EE programs.	Presentation slide

Quarter	Date	Stakeholders	Event/Recognition	Description	Source
2014 Q3	8-17-14	PG&E, EEPS,EE professionals, Evaluators, Regulators	2014 ACEEE Summer Study on Energy Efficiency in Buildings	Informal session entitled "Next-Generation, Retail-Focused Residential Energy Efficiency Programs – What to do about EM&V?" Interactive session with 20 participants to introduce RPP concept and identify issues and solutions related to EM&V.	Session agenda and notes
2014 Q3	9-9-14	U.S. EPA, PG&E, SCE, NEEA, NEEP, EVT, DCSEU, NRDC	EPA Workshop: Designing Next Generation Retail Based Efficiency Programs	U.S. EPA led discussion to frame the opportunity for new energy efficiency program and to brainstorm what is needed to make the next generation of retail based programs (RPP) work.	Workshop agenda, Flipcharts, Notes
2014 Q3	Late Septemb er 2014	ENERGY STAR Retail Action Council	RAC Meeting	Meeting with Best Buy, Sears, Home Depot and Lowe's to review RPP concept and discuss recommendations.	
2014 Q4	10-28-14	U.S. EPA, ENERGY STAR Retail Action Council, Manufacturers, EEPS	ENERGY STAR Products Partner Meeting	EE 2.0 – Next Generation Retail Programs - presentation by ENERGY STAR RAC at plenary session outlining retailers' perspectives on utility energy efficiency programs and their endorsement of the RPP concept.	Meeting agenda, ENERGY STAR RAC presentation
2015 Q1	1-22-15	U.S. EPA, EEPS	U.S. EPA Webinar	On-line presentation to introduce potential participants to RPP and update them on progress in developing the RPP pilot. Target date for pilot initiation was 2Q2015.	Webinar presentation - Creating a More Energy Efficient Future for Residential Customers: The ENERGY STAR® Retail Products Platform
2015 Q1	2-15-15	Regulators	NARUC 2015 Winter Committee Meetings	Panel presentation to regulatory commissioners and staff discussing RPP concept and regulatory requirements. PG&E provided utility perspective.	Session presentation.
2015 Q2	4-20-15	U.S. EPA, ENERGY STAR Retail Action Council, PG&E, NEEA	ENERGY STAR Partner of the Year Meeting	Meetings during annual ENERGY STAR meeting to recruit potential participants.	
2015 Q3	Septemb er 2015	ACEEE	Innovative EE Programs	PG&E's RPP program recognized as innovative residential EE program in ACEEE report entitled, "New Horizons for Energy Efficiency: Major Opportunities to Reach Higher Electricity Savings by 2030."	ACEEE Report #U1507, page 34
2015 Q3	10-13-15	U.S. EPA, ENERGY STAR Retail Action Council,	ENERGY STAR Products Partner Meeting	RPP featured at 2015 ENERGY STAR Products partner meeting including U.S. EPA presentation during plenary session, RPP panel session with ENERGY STAR RAC and PG&E presentations.	Meeting agenda, ENERGY STAR RAC presentation, EEPS presentation, plenary presentation

Quarter	Date	Stakeholders	Event/Recognition	Description	Source
		Manufacturers, EEPS			
2015 Q3	10-21-15	U.S. EPA	Meeting regarding Advanced Tier Setting	Conference call with PG&E, U.S. EPA and other stakeholder to discuss PG&E's perspective and analysis on technical specification for the ESRPP advanced tiers. PG&E presentation entitled, "ENERGY STAR RPP Program: Defining Optional Advanced Tiers Discussion"	Meeting agenda, presentation
2016 Q2	2-4-16	EEPS, EE implementers, manufacturers, retailers	AESP Annual Meeting	Members of ESRPP team participated in closing session at AESP to review RPP. Meetings with potential program participants.	Abstract
2016 Q2	4-1-16	U.S. EPA, ENERGY STAR Retail Action Council, EEPS	RPP Pilot Launch	Inaugural participants - EEPS: PG&E, NEEA, SMUD, XCEL, ConEd, Efficiency Vermont, Focus on Energy, NJ Clean Energy Program; retailers: Best Buy, Home Depot, Sears; products: dryers, freezers, air cleaners, room air conditioners, soundbars.	Participation agreements, RPP Pitch Deck
2016 Q2	4-13-16	U.S. EPA, ENERGY STAR Retail Action Council, EEPS, Appliance and Consumer electronics manufacturers	ENERGY STAR Partner of the Year Meeting	Meetings during annual ENERGY STAR Partner of the Year event to recruit potential participants, discuss RPP concept with manufacturers, and conduct RAC review meeting of RPP.	
2016 Q2	4-13-16	EPA, NEEA, PG&E	Meeting	Introducing the concept of establishing Energy Star Most Efficient as the specification for basic Energy Star	Meeting agenda
2016 Q3	8-21-16	PG&E, EEPS,EE professionals, Evaluators, Regulators	2016 ACEEE Summer Study on Energy Efficiency in Buildings	Presentations to national audience. 3 RPP related papers: RPP design, RPP pilot and RPP evaluation.	Papers
2017 Q1	1-5-17	Appliance and Consumer electronics manufacturers	CES 2017	Interacted with manufacturers and informed them about plug-load energy efficiency programs and RPP's efforts to influence retailers. 3M, a TV component supplier, relayed this information to their business partners during CES because cost savings (or incentives) less than one dollar can influence the design of an energy efficient product and can impact its qualification as an ENERGY STAR product. LG, Samsung and Bosch recognized the potential benefits of participating in a national energy efficiency effort and extended offers to continue the conversation.	CES 2017 Trip Report

Quarter	Date	Stakeholders	Event/Recognition	Description	Source
2017 Q3	8-16-17	PG&E (Codes & Standards), U.S. EPA, U.S. DOE	Meetings	Separate meetings with EPA and DOE to discuss applications of RPP total category data as well as energy use data collected by PG&E in home tests and research, which can assist DOE and EPA in setting specifications and modifying test methods.	Meeting agendas
2017 Q3	9-13-17	Manufacturers, Retailers, Consumers, Governments, international organizations and agencies, Academia and Energy Efficiency Experts	EEDAL 2017	Presentation at California-hosted, international conference on energy efficient appliances entitled "Addressing Growing Plug-Load Energy Consumption with an Innovative Program Design – Results of the ENERGY STAR Retail Products Platform Pilot"	Conference paper
2017 Q3	10-23-17	U.S. EPA, ENERGY STAR Retail Action Council, Manufacturers, EEPS	ENERGY STAR Products Partner Meeting	RPP networking session, ENERGY STAR RAC marketing presentations to RPP sponsors, RPP marketing panel, PG&E/NEEA television planning session	Meeting agenda, presentations
2018 Q1	2-14-18	CPUC ED, Sears, Nationwide, Best Buy, Home Depot	RPP Retailer Q&A Session	PG&E hosted meeting with CPUC/ED and RPP retailers to overview current retail industry and to present marketing activities that support RPP.	Workshop presentations
2018 Q1	3-13-18	PG&E, U.S. DOE	Meeting with Director DOE Building Technology Office	Presented concept for integrated market transformation strategy that encompasses RPP and Codes & Standards. Integrated strategy is consistent with DOE BTO's mission for appliance standards and emerging technology.	Concept slide
2018 Q2	July 2018	AESP	Innovative EE Programs	PG&E RPP program recognized by AESP in their 2018 magazine as innovative option to address cost effectiveness issues.	"Strategies to Improve Cost Effectiveness in a Tight Environment", AESP Magazine, 2018 Issue.
2018 Q3	8-12-18	EEPS, EE professionals, Evaluators, Regulators	2018 ACEEE Summer Study on Energy Efficiency in Buildings	Presentations to national audience. RPP paper on market transformation.	Papers
2018 Q3	9-4-18	U.S. EPA, ENERGY STAR Retail Action	ENERGY STAR Products Partner Meeting	ENERGY STAR RAC marketing presentations to RPP sponsors, RPP marketing panel	Meeting agenda, presentations

Quarter	Date	Stakeholders	Event/Recognition	Description	Source
		Council, Manufacturers, EEPS			
2018 Q4	10-29-18	ASAP, ACEEE, PG&E, NEEA, appliance standards advocates, manufacturers	ASAP Steering Committee Meeting	Appliance Standards Assistance Project (ASAP) annual advisory group meeting formulates recommendations for revisions to appliance standards and test methods. Meeting included breakout session for next generation of home appliance standards including discussion of RPP total category data and potential application to standard setting.	Meeting agenda

APPENDIX F: PROGRAM LOGIC MODEL DEVELOPMENT

Several changes to PG&E ESRPP Program Pilot operations have occurred since the program began operating in 2016. These lessons have necessitated changes to the evaluation approach, and have led to several revisions to the original program logic model. We provide some additional details regarding these revisions below, and show the evolution of the original logic model to the proposed logic model moving forward.

Key changes that informed the development of a new logic model include the following:

- Overall program operations have been more fluid than initially envisioned, with a number of interactions occurring between elements in the program logic model. In the revised logic model (shown below in Figure F3) used for this evaluation research, these interactions are depicted by placing elements within dotted lines, rather than creating arrows from each element to the other. This depiction represents that within a dotted box, each element may potentially impact all other elements, resulting in a non-linear set of effects.
- During the early phases of program design, participating retailers were expected to commit to creating and implementing Retailer Implementation Plans ("Plans") for increasing the sales of energy-efficient models in the targeted product categories. These Plans would then serve as a tool to understand how retailers were using incentive dollars to drive sales of program-qualified units. In the course of this evaluation, it became clear that the Plans provided by retailers did not contain the level of detail initially expected by evaluators, and that there is no mechanism to obtain more-specific Plans. To address this, the evaluation approach has shifted slightly to place more weight on data collected from retailer store locations during in-store field visits by the PG&E ESRPP field services team.
- While the importance of the full category sales data collected from participating retailers has always been recognized, this pathway of influence within the program theory has become even more critical as our research has shown that such data simply does not exist elsewhere for the majority of the product categories included in ESRPP. As a result, the revised logic model more clearly emphasizes the importance of this data to the program's ability to facilitate the development of specifications, codes, and standards (this is represented by the right-most column in the revised model).

In the three figures below, we provide a graphical representation showing the original logic model, a mapping between the original logic model and the revised logic model, and the revised logic model itself.

Figure F1. Original Program Logic Model

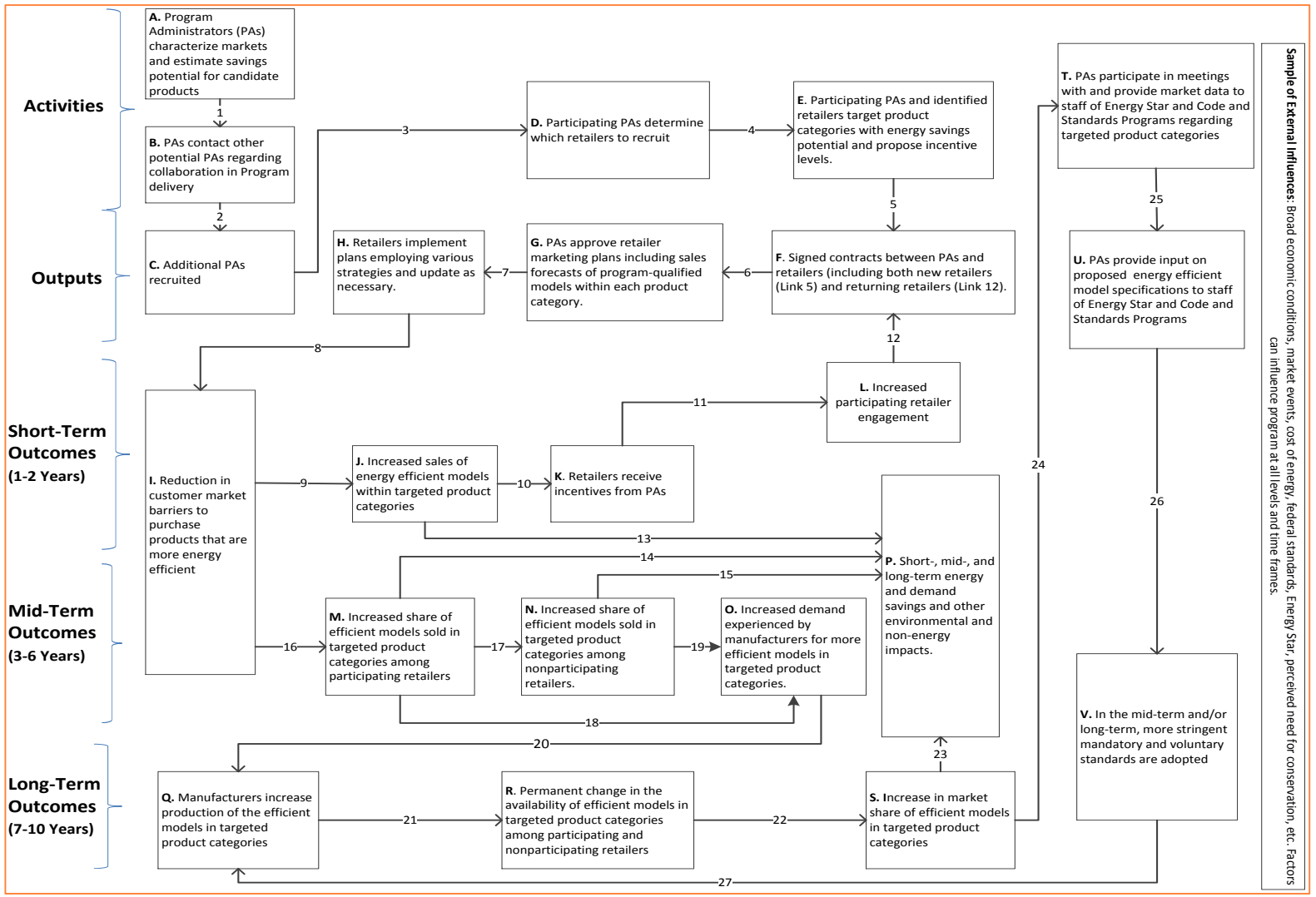
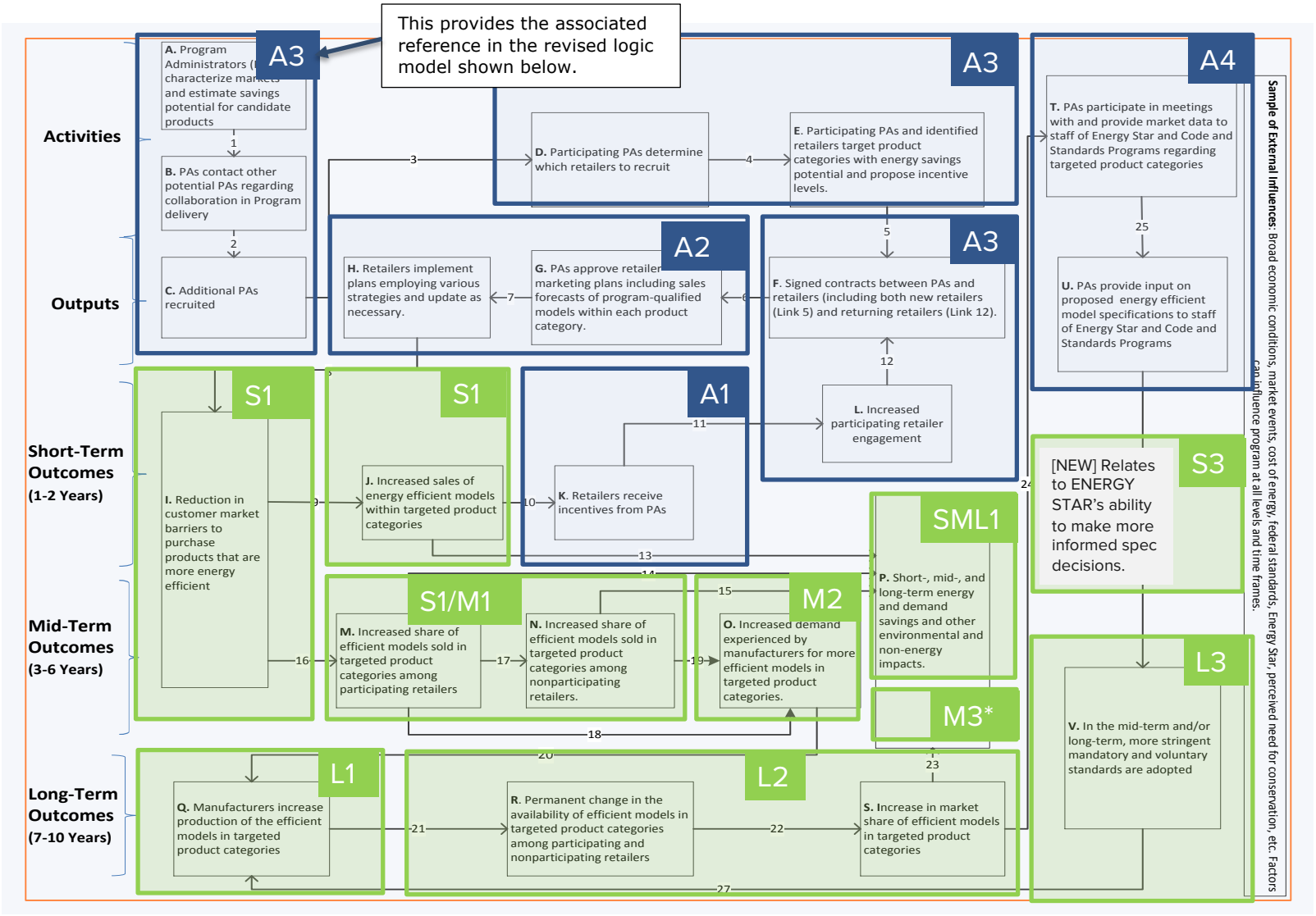
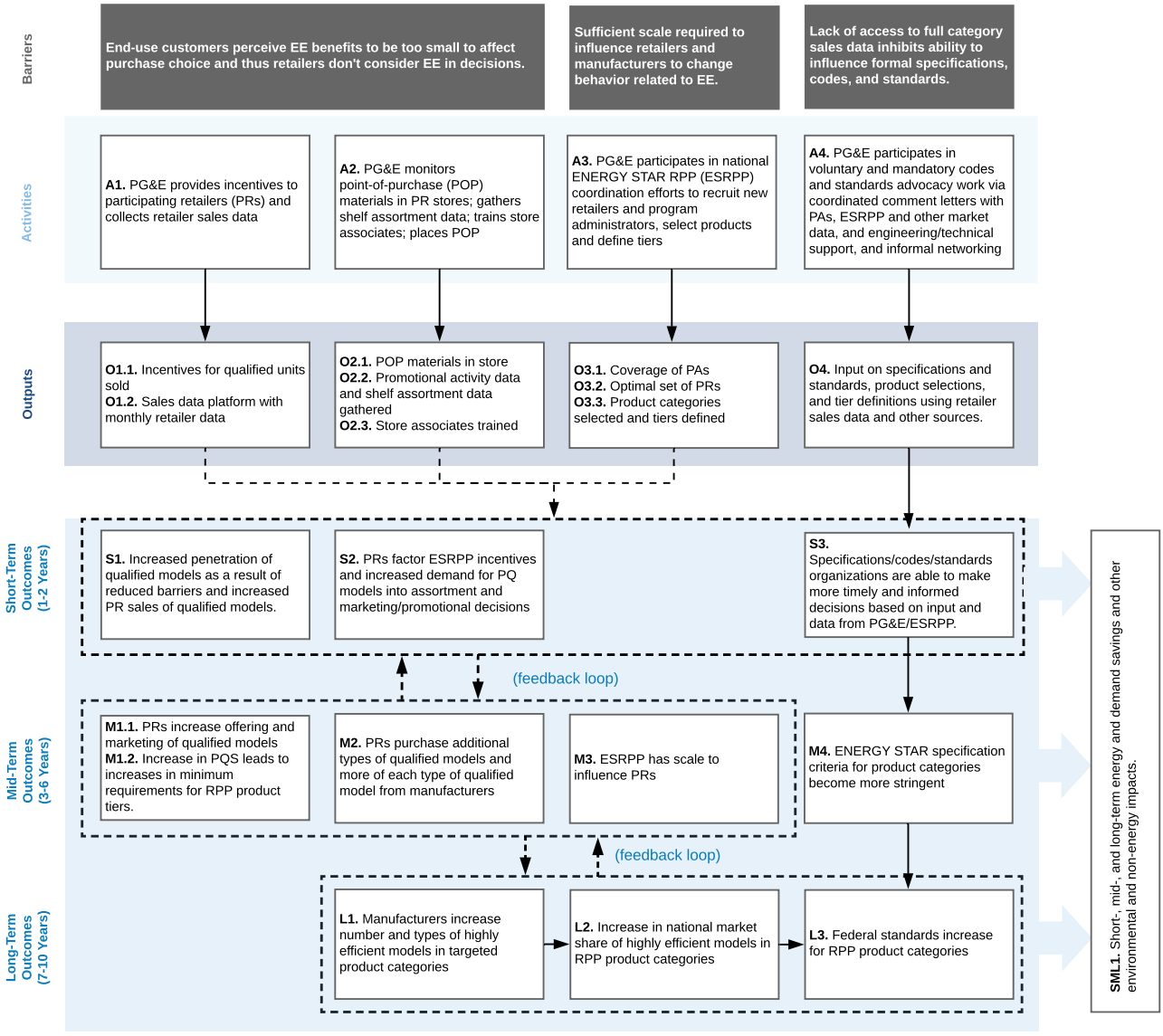


Figure F2. Mapping Between Original Logic Model and Revised Logic Model



** Note: M3 is a new node added to the revised logic model (with no analog in the original model), relating to the ability of ESRPP to achieve national scale necessary to influence retailer decisions. S2 in the new logic model has no direct analog in the original logic model.*

Figure F3. Revised Logic Model



Key: - - - - - - - - **Dashed lines denote multiple interactions between elements inside (i.e., arrows connecting all elements).**

External Influences:
Broad economic conditions, market events, cost of energy, federal standards, ENERGY STAR, perceived need for conservation, and possible others.

Note: Factors can influence the program at all levels and time frames.

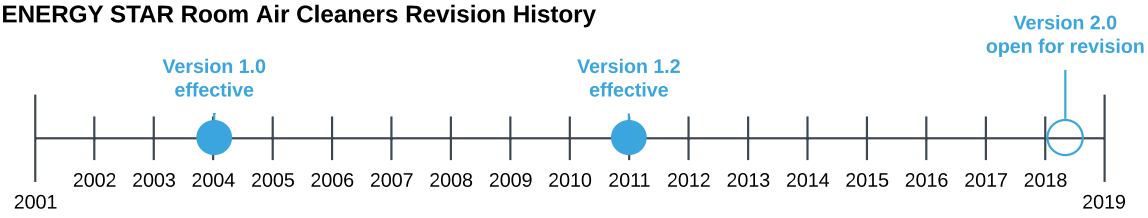
APPENDIX G: DETAILED INFORMATION ON ENERGY STAR SPECIFICATION ADVANCEMENT TRACKING

In this appendix, we provide detailed information on the tracking of logic model element M4: "ENERGY STAR specification criteria for product categories becomes more stringent." To assess progress toward this goal, we recommend using the market transformation indicator "percent progress toward ENERGY STAR specification revision" using the graphics shown below for air cleaners and soundbars. The percent progress metrics shown here (actual as of mid-2018 and projected for PY3) represent PG&E estimates of progress toward the next specification revision.

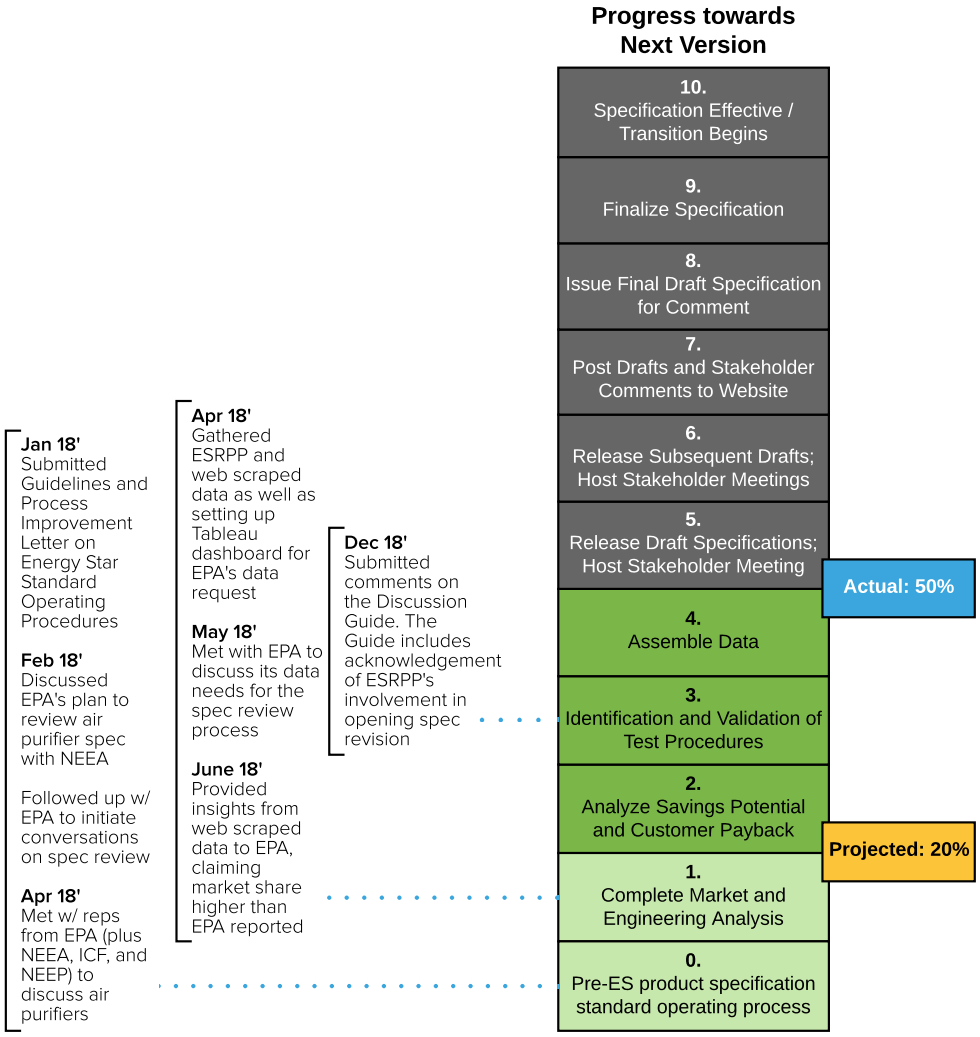
Product Category: Room Air Cleaners

The Energy Star Air Purifier Version 2.0 specification is open for revision as of October 2018 due in part to ESRPP's actvities, including meeting with ESRPP market actors (epecially the EPA), submitting comments on guides, and providing insights from ESRPP program market data. Version 2.0 Draft 1 Specification is scheduled to be released for comments December 2018. PG&E and NEEA ESRPP analysis also identified a need to investigate why the smaller air cleaners are less efficient.

ENERGY STAR Room Air Cleaners Revision History



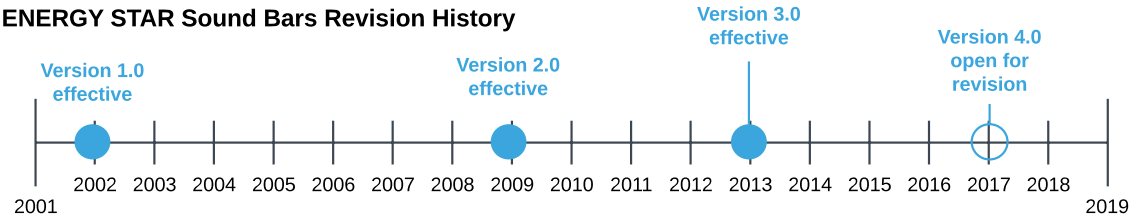
PG&E ESRPP Activities Related to ENERGY STAR Room Air Cleaners Revisions



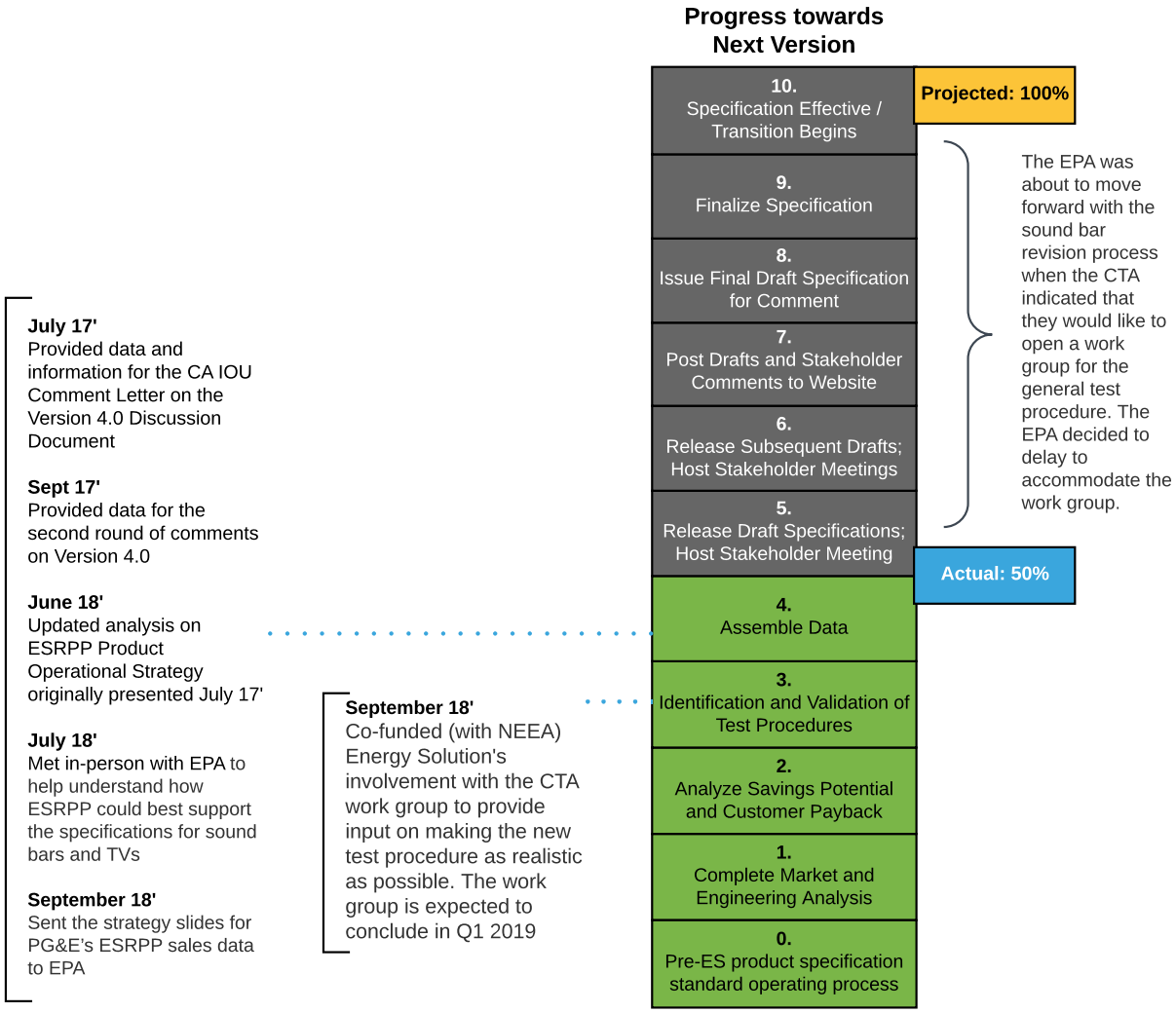
Product Category: Sound Bars

There are no federal or state standards for soundbars. PG&E ESRPP is advocating for a specfiication revision that makes efficiency more transparent by improving categorizations of soundbars to better reflect actual sales and by improving measurement and reporting of energy consumption, particularly for active-mode.

ENERGY STAR Sound Bars Revision History



PG&E ESRPP Activities Related to ENERGY STAR Sound Bars Revisions



Advice 4071-G/5487-E
March 5, 2019

Attachment B

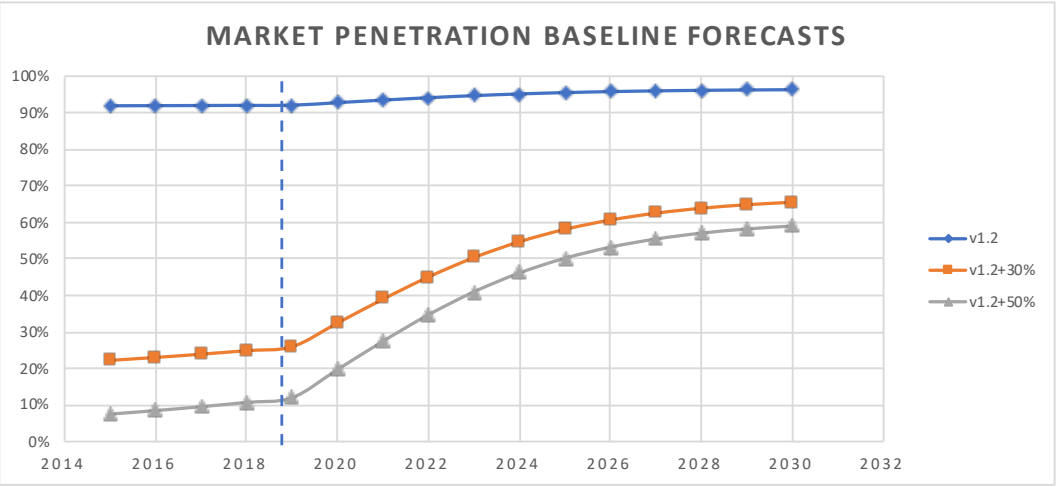
Program Baseline Projections

Air Cleaner Baseline Summary

Last Updated: January 30, 2019

Updated By: Ari Mytelka, Energy Solutions

Year	Baseline Market Share		
	ENERGY STAR v1.2	ENERGY STAR v1.2 + 30%	ENERGY STAR v1.2 + 50%
2015	92%	22%	8%
2016	92%	23%	8%
2017	92%	24%	10%
2018	92%	25%	11%
2019	92%	26%	12%
2020	93%	32%	20%
2021	93%	39%	27%
2022	94%	45%	35%
2023	95%	50%	41%
2024	95%	55%	46%
2025	96%	58%	50%
2026	96%	61%	53%
2027	96%	63%	55%
2028	96%	64%	57%
2029	96%	65%	58%
2030	96%	65%	59%



How to interpret the charts in this document:

These charts represent the 15-year statewide forecast of market penetration values of the program-qualifying ENERGY STAR v1.2, ENERGY STAR v1.2+30%, and ENERGY STAR v1.2+50% levels absent program intervention. The charts only show forecasts for the given measure levels and do not forecast market penetration for future revisions of ENERGY STAR. Caveat: the air cleaner statewide baselines may be less reliable than baselines for other ESRPP products given the significant online sales for this product, which might have sales trends distinct from the trends seen in ESRPP retailers.

Derivation:

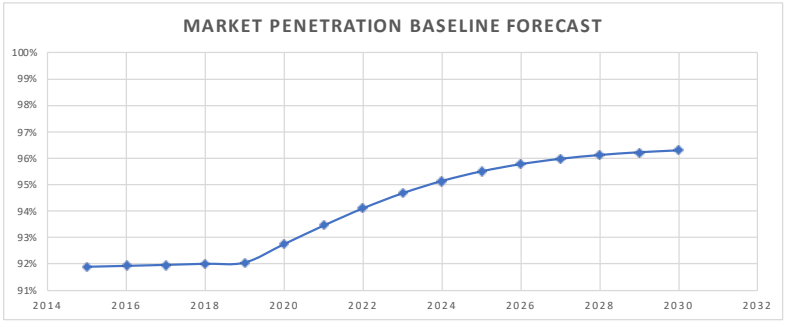
The baselines are calculated in segments, which are divided by significant non-program-related events such as changes to federal standards. For each segment, four key parameters describe the curve: the initial market share, the maximum potential market share, the qualitative growth rate, and the segment start and end years. The parameters are informed by the best available ESRPP program and market sales data alongside subject matter expert opinion. Since market conditions change over time, it is recommended that these charts are reviewed each year and updated as necessary to reflect changes in market conditions.

Contents:

ENERGY STAR v1.2 Air Cleaner Baseline

Last Updated: January 12, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2015	92%
2016	92%
2017	92%
2018	92%
2019	92%
2020	93%
2021	93%
2022	94%
2023	95%
2024	95%
2025	96%
2026	96%
2027	96%
2028	96%
2029	96%
2030	96%



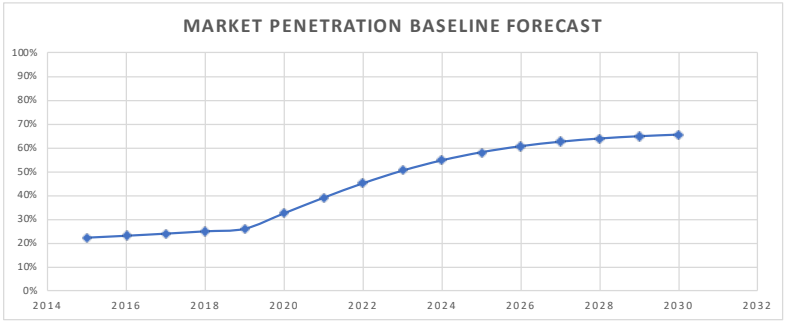
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2015	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	92%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	95%	NEEA SMEs indicate that compliance issues might limit the maximum market penetration potential to 95%.	If an incremental cost study during this time segment shows a significant incremental cost to the ENERGY STAR v1.2 level, this value might be decreased. If compliance issues are resolved, this value might be increased to 100%.
Segment 1	Growth Rate*	slow	ENERGY STAR v1 was released in 2004, and air cleaners are not federally regulated. SMEs indicate that rapid change typically only occurs with regulatory enhancement, and SMEs are not aware of recent technology innovations likely to significantly affect EE.	We do not expect to update this value in future years.
Segment 1	End Year	2019	SME input suggests that the EPA will likely revise the ENERGY STAR specification to v2 soon, given that the revision process is already ongoing. The effective date of the ENERGY STAR v2 specification will end segment 1.	If the effective date of a new ENERGY STAR specification does not occur in 2019, this value should be amended to reflect the actual effective date.
Segment 2	Maximum Market Penetration Potential	100%	After the specification revision, there is no obvious limit to the maximum market potential.	If an incremental cost study during this time segment shows a significant incremental cost to the ENERGY STAR v1.2 level, this value might be decreased.
Segment 2	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might decrease the growth rate if the ENERGY STAR v2 requirements are less stringent than ENERGY STAR v1.2 + 30%.
Segment 2	End Year	2030	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR v1.2 + 30% Air Cleaner Baseline

Last Updated: January 12, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2015	22%
2016	23%
2017	24%
2018	25%
2019	26%
2020	32%
2021	39%
2022	45%
2023	50%
2024	55%
2025	58%
2026	61%
2027	63%
2028	64%
2029	65%
2030	65%



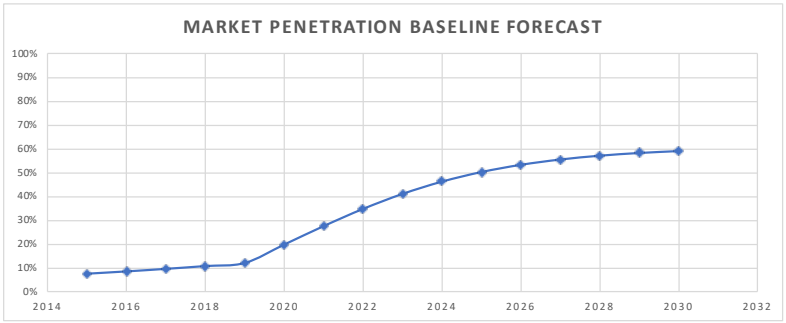
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2015	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	22%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	95%	NEEA SMEs indicate that compliance issues might limit the maximum market penetration potential to 95%.	If an incremental cost study shows a significant incremental cost to the measure level relative to the basic ENERGY STAR measure level, this value might be decreased. If compliance issues are resolved, this value might be increased to 100%.
Segment 1	Growth Rate*	slow	ENERGY STAR v1 was released in 2004, and air cleaners are not federally regulated. SMEs indicate that rapid change typically only occurs with regulatory enhancement, and SMEs are not aware of recent technology innovations likely to significantly affect EE.	We do not expect to update this value in future years.
Segment 1	End Year	2019	SME input suggests that the EPA will likely revise the ENERGY STAR specification to v2 soon, given that the revision process is already ongoing. The effective date of the ENERGY STAR v2 specification will end segment 1.	If the effective date of a new ENERGY STAR specification does not occur in 2019, this value should be amended to reflect the actual effective date.
Segment 2	Maximum Market Penetration Potential	100%	After the specification revision, there is no obvious limit to the maximum market potential.	If an incremental cost study shows a significant incremental cost to the measure level relative to the basic ENERGY STAR measure level, this value might be decreased.
Segment 2	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might decrease the growth rate if the ENERGY STAR v2 requirements are less stringent than ENERGY STAR v1.2 + 30%.
Segment 2	End Year	2030	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR v1.2 + 50% Air Cleaner Baseline

Last Updated: January 12, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2015	8%
2016	8%
2017	10%
2018	11%
2019	12%
2020	20%
2021	27%
2022	35%
2023	41%
2024	46%
2025	50%
2026	53%
2027	55%
2028	57%
2029	58%
2030	59%



		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2015	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	8%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	95%	NEEA SMEs indicate that compliance issues might limit the maximum market penetration potential to 95%.	If an incremental cost study shows a significant incremental cost to the measure level relative to the basic ENERGY STAR measure level, this value might be decreased. If compliance issues are resolved, this value might be increased to 100%.
Segment 1	Growth Rate*	slow	ENERGY STAR v1 was released in 2004, and air cleaners are not federally regulated. SMEs indicate that rapid change typically only occurs with regulatory enhancement, and SMEs are not aware of recent technology innovations likely to significantly affect EE.	We do not expect to update this value in future years.
Segment 1	End Year	2019	SME input suggests that the EPA will likely revise the ENERGY STAR specification to v2 soon, given that the revision process is already ongoing. The effective date of the ENERGY STAR v2 specification will end segment 1.	If the effective date of a new ENERGY STAR specification does not occur in 2019, this value should be amended to reflect the actual effective date.
Segment 2	Maximum Market Penetration Potential	100%	After the specification revision, there is no obvious limit to the maximum market potential.	If an incremental cost study shows a significant incremental cost to the measure level relative to the basic ENERGY STAR measure level, this value might be decreased.
Segment 2	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might decrease the growth rate if the ENERGY STAR v2 requirements are less stringent than ENERGY STAR v1.2 + 30%.
Segment 2	End Year	2030	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ESRPP Data

2015 ESRPP Market Penetration from ESRPP Data in PG&E Territory

These inputs to the baselines come directly from the ESRPP sales data:

2015 Market Penetration of ENERGY STAR v1.2	2015 Market Penetration of ENERGY STAR v1.2 + 30%	2015 Market Penetration of ENERGY STAR v1.2 + 50%
91.9%	22.2%	7.51%

Growth Parameter Assumptions

	slow	medium	fast
p	0.006	0.012	0.031
q	0.130	0.255	0.335
p+q	0.136	0.267	0.366
start year	5	5	5

The growth parameters are quartiles of the naturally occurring market adoption (NOMAD) Bass curve parameters for evaluated federal and Title 20 standards (see "Evaluated NOMAD" section for complete list of standards and parameters). The p and q values express the rates of technology innovation and technology imitation, with higher values indicating greater innovation and higher levels of competition. The start year parameter describes the number of years (prior to the forecast start year) a technology has been commercially available to consumers.

For the p and q values, the "slow" values are the first quartile p and q across all evaluated standards, the "medium" values are the median across all evaluated standards, and the "fast" values are the third quartile. This is representative of evaluated NOMAD for appliance energy efficiency measures and enables a quantification of Bass curve parameters from qualitative assessments of the product rates of competition and innovation.

The start year for all three scenarios is the first quartile for all evaluated Title 20 standards. The first quartile was used because all ESRPP measure levels are based on the voluntary ENERGY STAR specifications, which are more stringent and forward-looking than the

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2005 T-20	Std 1	Commercial Refrigeration Equipment, Solid Door	1995	0.009	0.433
2005 T-20	Std 2	Commercial Refrigeration Equipment, Transparent Door	1995	0.002	0.507
2005 T-20	std 3	Commercial Ice Maker Equipment	1995	0.005	0.535
2005 T-20	std 4	Walk-In Refrigerators / Freezers	1995	0.011	0.248
2005 T-20	std 5	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2005 T-20	std 6	Large Packaged Commercial Air-Conditioners, Tier 1	1990	0.000	0.500
2005 T-20	std 7	Large Packaged Commercial Air-Conditioners, Tier 2	1990	0.000	0.353
2005 T-20	std 8	Residential Pool Pumps, High Eff Motor, Tier 1	1965	0.001	0.045
2006 T-20	std 9	Residential Pool Pumps, 2-speed Motors, Tier 2	1975	0.000	0.202
2005 T-20	std 10	Portable Electric Spas			
2005 T-20	std 11a	General Service Incandescent Lamps, Tier 1	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2010)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2011)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2012)	1970	0.000	0.213
2005 T-20	std 12a	Pulse Start Metal Halide HID Luminaires, Tier 1	1992	0.001	0.348
2005 T-20	std 12b	Pulse Start Metal Halide HID Luminaires, Tier 2	1992	0.001	0.348
2005 T-20	std 13	Modular Furniture Task Lighting Fixtures	2000	0.132	0.198
2005 T-20	std 14	Hot Food Holding Cabinets	2000	0.008	0.480
2005 T-20	std 15	External Power Supplies, Tier 1	2000	0.025	0.356
2005 T-20	std 16	External Power Supplies, Tier 2	2000	0.012	0.386
2005 T-20	std 17	Consumer Electronics - Audio Players	2000	0.040	0.431
2005 T-20	std 18a	Consumer Electronics - TVs	2000	0.054	0.503
2005 T-20	std 18b	Consumer Electronics - DVDs	2000	0.126	0.099
2005 T-20	std 19	Water Dispensers	2000	0.037	0.343
2005 T-20	std 20	Unit Heaters and Duct Furnaces	1965	0.007	0.097
2005 T-20	std 21	Commercial Dishwasher Pre-Rinse Spray Valves	2003	0.039	0.389
2006 T-20	std 22a	BR, ER and R20 Incandescent Reflector Lamps: Residential	2000	0.023	0.145
2006 T-20	std 22b	BR, ER and R20 Incandescent Reflector Lamps: Commercial	2000	0.023	0.145
2008 T-20	std 23	Metal Halide Fixtures	2000	0.003	0.366
2008 T-20	std 24	Portable Lighting Fixtures	2000	0.002	0.498
2008 T-20	std 25	General Purpose Lighting -- 100 watt	2000	0.004	0.346

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2008 T-20	std 26	General Purpose Lighting -- 75 watt	2000	0.007	0.294
2008 T-20	std 27	General Purpose Lighting -- 60 and 40 watt	2000	0.011	0.255
2008 T-20		General Service Lamps (EISA Phase 2)	2000	0.003	0.220
2009 T-20	std 28a	Televisions - Tier 1	2000	0.004	0.534
2009 T-20	std 28b	Televisions - Tier 2	2000	0.008	0.380
2011 T-20	Std 29	Small Battery Chargers - Tier 1 (consumer with no USB charger or USB charger <20 watt-ho	2000	0.007	0.321
	Std 30	Small Battery Chargers - Tier 2 (consumer with USB charger >=20 watt-hours)	2000	0.012	0.241
2011 T-20	Std 31	Small Battery Chargers - Tier 3 (non-consumer)	2000	0.004	0.263
2011 T-20	Std 32	Large Battery Chargers (>=2kW rated input)	2000	0.003	0.275
2010-12 Fed App	Fed 1	Electric Motors 1-200HP	2000	0.030	0.030
2010-12 Fed App	Fed 2	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2010-12 Fed App	Fed 3	Commercial Refrigeration	1995	0.008	0.360
	Fed 4	ASHRAE Products (Commercial boilers)	1965	0.007	0.097
2010-12 Fed App	Fed 5	Residential Electric & Gas Ranges	1965	0.007	0.097
2010-12 Fed App	Fed 6	Incandescent Reflector Lamps	2008	0.008	0.292
2010-12 Fed App	Fed 7	General Service Fluorescent Lamps	2000	0.010	0.330
2013-15 Fed App	Fed 8	Commercial Clothes Washers	1970	0.017	0.167
2013-15 Fed App	Fed 9	Residential Pool Heaters	1895	0.010	0.001
2013-15 Fed App	Fed 10	Residential Direct Heating Equipment	1950	0.065	0.168
2013-15 Fed App	Fed 11	Residential Refrigerators & Freezers	2005	0.011	0.247
2013-15 Fed App	Fed 12	Residential Room AC	2005	0.018	0.214
2013-15 Fed App	Fed 13	Fluorescent Ballasts	2000	0.014	0.173
2013-15 Fed App	Fed 14	Small Commercial Package Air-Conditioners >=65 and <135 kBtu/h	1980	0.100	0.001
2013-15 Fed App	Fed 15	Large and Very Large Commercial Package Air-Conditioners >=135 kBtu/h	1986	0.100	0.001
2013-15 Fed App	Fed 16	Computer Room Acs >=65,000 Btu/h and < 760,000 Btu/h	2005	0.700	0.020
2013-15 Fed App	Fed 17	Residential Dishwashers	1960	0.019	0.238
2013-15 Fed App	Fed 18	Residential Clothes Dryers	1970	0.047	0.107
2013-15 Fed App	Fed 19	Residential Gas-fired water heater	1915	0.005	0.020
2013-15 Fed App	Fed 20	Residential Electric storage water heater	1988	0.003	0.338
2013-15 Fed App	Fed 21	Residential Gas-fired instantaneous water heater	2015	1.000	1.000
2013-15 Fed App	Fed 22	Residential Oil-fired storage water heater	1988	0.050	0.002

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2013-15 Fed App	Fed 23	Small Electric Motors	2009	0.054	0.263
2013-15 Fed App	Fed 24	Residential Clothes Washers (Front Loading)	2015	0.031	0.152
2013-15 Fed App	Fed 25	Residential Clothes Washers (Top Loading) Tier I	2015	0.031	0.152
2013-15 Fed App	Fed 26	Residential Central AC, Heat Pumps and Furnaces	2003	0.011	0.222

Subject Matter Expert Input

QUESTION	SME Responses
1. Please describe your background, including the main organizations that you are and have been affiliated with, your role(s), and how many years you worked with each organization.	3 years experience with Home Depot, 9 years experience with Ecova 3 years experience in HVAC product development, 4 years experience with AHAM, 3 years experience consulting for EPA ENERGY STAR 25 years experience with Nationwide's marketing, 20 years experience outside of Nationwide as a buyer or sales manager 12 years experience in market analysis; 15 years experience in energy efficiency; 18 years experience in product development and energy efficiency
2. Can you give your best estimate of the current [energy efficiency measure level, e.g., ESME 2016] market share for California? What sources inform your estimate?	Cited EPA Unit Shipment Data, noted that the California ESRPP sales are mostly representative of overall California sales (though they are not necessarily nationally representative). See the ESRPP sales, understanding the fraction of the market that ESRPP makes up using external data.
3. Are you aware of any differences between brick-and-mortar vs. online sales for [product]? Do you think that sales from the participating big-box ESRPP retailers are likely to be representative of the [product] market in California?	We assume the ESRPP sales are representative, but for air cleaners they might account for 40% of all sales. Nationwide and big-box retailers cover most products, but there are significant online sales. Not sure. PG&E ESRPP sales are likely generally representative and are a significant portion of the California sales.
4. Are you aware of any upcoming technology innovations that would impact energy efficiency? Do you see major market barriers to their adoption?	There's constant change, but I'm not aware of anything specific. I do not track the technology components at all. Nothing major in the market.
5. Are there any major manufacturers that do not seem to be invested in incorporating energy efficiency into their products?	Did not list manufacturers that limit EE No one's going out of their way to not make ENERGY STAR products. Did not list manufacturers that limit EE Manufacturers aim to hit minimum standards for ENERGY STAR, and the federal administration's deregulation approach enables manufacturers to take an approach separate from engagement.
a. If yes: Would you predict changes in the current manufacturer market share distribution?	-

Subject Matter Expert Input

QUESTION	SME Responses
6. Are you aware of residential product subclasses (e.g., for washers, agitator top-loaders), applications, or size bins where you would expect very low (< 5%) market penetration at the measure level by 2030?	Products with Sensors: Only about half of the ENERGY STAR dishwashers use soil sensors to determine cycle operations. A smaller percentage of room air cleaners and dehumidifiers use sensors to drive their operation. There will always be some products that aim to fill the lowest-cost niche without EE as a concern, and compliance might limit the total ENERGY STAR market share to 95%. Other SMEs did not list subclasses that limit EE.
a. If yes: Would you predict changes in the current balance of market share for product subcategories?	-
b. If no: Would it be feasible without ESRPP or EPA intervention for market penetration at the measure level to reach ~100% by 2030?	No Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR. It's especially difficult when measure levels are ENERGY STAR +30% or +50% because consumers can't differentiate those products from basic ENERGY STAR. It could be possible without ESRPP intervention, but DOE and EPA intervention would be needed, and currently the product is not federally regulated.
7. Do you think that [energy efficiency measure level] products could eventually reach 100% saturation in the market? Why?	Across all products, 100% won't happen within the timeline forecast unless DOE or States set the current ENERGY STAR level (or ESRPP basic tier level) as a mandatory minimum. Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR. It's especially difficult when measure levels are ENERGY STAR +30% or +50% because consumers can't differentiate those products from basic ENERGY STAR. It could be possible without ESRPP intervention, but DOE and EPA intervention would be needed, and currently the product is not federally regulated.
a. If no: Do you have an estimate for the maximum saturation level?	No estimates
8. When would you expect to see 25% [energy efficiency measure level] market penetration? 50%? 75%?	No estimates
9. Do you think the rate of innovation in the [product] market is roughly the same as it was 5 – 10 years ago, or has it increased/decreased?	There is more innovation now than there was ~10 years ago because of increased demand in China and to a smaller extent in the US. Similar Innovation seems to be driven mostly by economic growth and health, and has definitely increased over the past 5 years.

Subject Matter Expert Input

QUESTION	SME Responses
10. Compared to 5 – 10 years ago, how likely do you think manufacturers are to imitate/proliferate EE innovations?	Similar There appears to be a lot of imitation – EE technologies don't have to be from one of the market leaders. The technology side of things (connectivity, better features) is quicker than fundamental technology change.
11. How do the current market barriers compare to the historical market barriers for meeting what is now the federal standard level?	The increasing changes in the retailer landscape may cause some EE promoting retailers to shift their priorities, which could limit an ally for overcoming barriers in the past. For air cleaners, price is less important than for some other products. Demand is need-driven based on air quality and whether a household has at-risk individuals (e.g., a person with asthma).
12. What are the typical adoption trends (in terms of growth rates for efficient products) you observe when no DOE rulemaking is in effect, between adoption and the effective date, and shortly after the effective date? Do you forecast similar trends when the EPA specifications are revised?	What helps drive efficiency is either if it has other features for consumers or if there were product redesigns happening for other reasons. There are also some other drivers, e.g., EPA's SNAP rule will require a refrigerant update across all lines. If products are federally regulated, there's always a tendency to go more efficient during a redesign if possible. For products that aren't federally regulated, increasing efficiency would not be a primary driver during a product redesign. Manufacturers will develop products with features to help sell a product and any increase in efficiency as part of a redesign is likely an ancillary benefit. In general, if building managers are buying appliances in bulk, efficiency will likely be a consumer preference. If efficiency is a way to differentiate their products from competitors, that's something that companies will use to sell it and maybe leading to moderate market share growth. Another driver in the market is consolidation (in manufacturers, product lines, suppliers, or other), which could drive efficiency one way or another. There is manufacturer resistance to quicker-than-planned change due to sunk costs on capital investments. There's a little bit of growth even when there's no regulation. We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs. I need to be thinking a year in advance. Knowledge and awareness of upcoming change is important. Organizations should clearly understand what the levels are and what the change is going to be. Manufacturer understanding of their target market influences how quickly they come up to speed. For high end appliances, they may have already integrated it into their products because they could afford to or it provides features. They can offer that in higher margin products.
13. For experts with insight into regulations: When do you expect major regulatory events (DOE rulemakings and/or EPA specification revisions) to occur for this product? Do you expect regulations to proceed according to the posted schedules?	NEEA assumes an ENERGY STAR revision will occur in 2019, as the revision process is already ongoing and a discussion guide was released in October 2018.

Subject Matter Expert Input

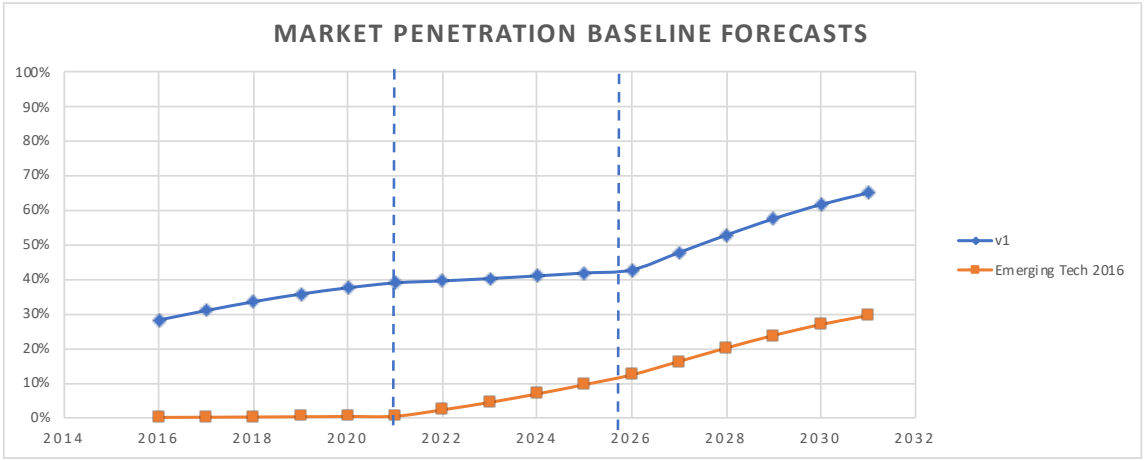
QUESTION	SME Responses
14. For experts with insight into retail: When a code change or ENERGY STAR revision occurs, do retailers begin altering their stock and marketing when the change is announced, when the change becomes effective, or (for voluntary specifications) after the change becomes effective?	We try to be ready around the time of the effective date, maybe a little earlier for DOE, maybe a little after the effective date for ENERGY STAR. We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs
Interview Citations	Christianson, A. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Leritz, N. December 20, 2018 Phone interview with T. Kisch. Leybourn, S. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Steinhoff, C. and Moran, D. June 5, 2018. Phone interview with A. Mytelka and T. Kisch. Weinberg, R. December 10, 2018. Phone interview with A. Mytelka and T. Kisch.

Dryers Baseline Summary

Last Updated: January 30, 2019

Updated By: Ari Mytelka, Energy Solutions

	Baseline Market Share	
Year	ENERGY STAR v1	Emerging Tech 2016
2016	28%	0%
2017	31%	0%
2018	34%	0%
2019	36%	0%
2020	38%	0%
2021	39%	0%
2022	40%	2%
2023	40%	4%
2024	41%	7%
2025	42%	10%
2026	43%	12%
2027	48%	16%
2028	53%	20%
2029	57%	24%
2030	62%	27%
2031	65%	30%



How to interpret the charts in this document:

These charts represent the 15-year forecast of market penetration values of the program-qualifying ENERGY STAR v1 and ENERGY STAR Emerging Tech 2016 levels absent program intervention. The charts only show forecast for the initial measure levels and do not forecast market penetration for future revisions of ENERGY STAR.

Derivation:

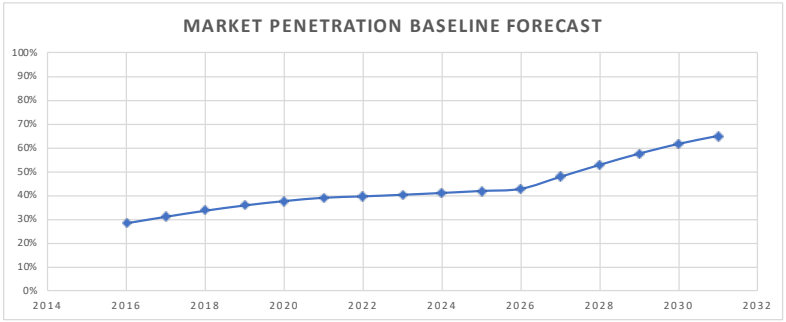
The baselines are calculated in segments, which are divided by significant non-program-related events such as changes to federal standards. For each segment, four key parameters describe the curve: the initial market share, the maximum potential market share, the qualitative growth rate, and the segment start and end years. The parameters are informed by the best available ESRPP program and market sales data alongside subject matter expert opinion. Since market conditions change over time, it is recommended that these charts are reviewed each year and updated as necessary to reflect changes in market conditions.

Contents:

ENERGY STAR v1 Dryers Baseline

Last Updated: January 10, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	28%
2017	31%
2018	34%
2019	36%
2020	38%
2021	39%
2022	40%
2023	40%
2024	41%
2025	42%
2026	43%
2027	48%
2028	53%
2029	57%
2030	62%
2031	65%



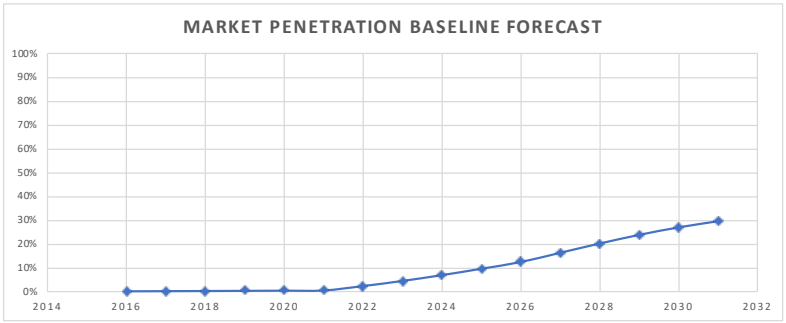
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	28%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	57%	Navigant SME input indicates that in the near term, market penetration is likely to increase quickly until it matches the ENERGY STAR washer market penetration. Due to manufacturer and retailer interest in pairing efficient dryers with efficient washers, SMEs do not expect the dryer penetration to exceed the washer ENERGY STAR level.	This value might be updated to reflect updated information on the ENERGY STAR share for washers.
Segment 1	Growth Rate*	fast	Historical ENERGY STAR Unit Shipment Data has shown the market share to increase quickly. SME input suggests that this is due to the recent introduction of the first ENERGY STAR specification.	We do not expect to update this value in future years.
Segment 1	End Year	2021	SME input suggests that the EPA will likely revise the ENERGY STAR specification to v2.0 within a few years. The effective date of the ENERGY STAR v2.0 specification will end segment 1.	If the effective date of a new ENERGY STAR specification does not occur in 2021, this value should be amended to reflect the actual effective date.
Segment 2	Maximum Market Penetration Potential	57%	After the new specification is effective, manufacturers will have increased incentive to innovate and compete, but SMEs have indicated that there is still a significant market for the lowest-cost models, and manufacturers do not have incentive to release models that are more efficient than the baseline but not efficient enough to qualify for the new ENERGY STAR specification.	If new technology allows dryers to meet ENERGY STAR without an incremental cost, we would increase this value to 100%. If the anticipated DOE standard is set to the current ENERGY STAR level, we would increase the value to 100%.
Segment 2	Growth Rate*	medium	SMEs have indicated that the current growth rate is high due to the recent introduction of the first ENERGY STAR specification, but they expect growth to level out as the market share of ENERGY STAR dryers approaches the market share of ENERGY STAR washers.	We might increase the growth rate if the anticipated new DOE standard is set at the ENERGY STAR v1 level.
Segment 2	End Year	2026	We expect a new standard to go into effect in 2026. The effective date of the DOE regulatory cycle will end segment 2.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed effective date.
Segment 3	Maximum Market Penetration Potential	100%	After the new standard is effective, there is no obvious limitation on the maximum market potential.	If there remains a significant incremental cost between the lowest-cost DOE-compliant models and the ENERGY STAR v1 level, this value might be decreased.
Segment 3	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might decrease the growth rate if the ENERGY STAR specification does not update at the time the new DOE standard goes into effect or the new DOE standard level is lower than anticipated.
Segment 3	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR 2016 Emerging Tech Dryers Baseline

Last Updated: January 10, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	0%
2017	0%
2018	0%
2019	0%
2020	0%
2021	0%
2022	2%
2023	4%
2024	7%
2025	10%
2026	12%
2027	16%
2028	20%
2029	24%
2030	27%
2031	30%



		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	0%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	5%	Referencing the ENERGY STAR Qualified Products List, models that meet the Most Efficient criteria make up 5% of the total count of ENERGY STAR models. We assume the penetration in the market as a whole will not exceed the representation among ENERGY STAR models.	This value might be updated to reflect updated information on the ESME model count in the ENERGY STAR QPL.
Segment 1	Growth Rate*	slow	SMEs indicate that there is a consumer education barrier, and most consumers are not interested in efficiency gains beyond the minimum needed for basic ENERGY STAR qualification.	We do not expect to update this value in future years.
Segment 1	End Year	2021	SME input suggests that the EPA will likely revise the ENERGY STAR specification to v2.0 within a few years. The effective date of the ENERGY STAR v2.0 specification will end segment 1.	If the effective date of a new ENERGY STAR specification does not occur in 2021, this value should be amended to reflect the actual effective date.
Segment 2	Maximum Market Penetration Potential	57%	After the new specification is effective, manufacturers will have increased incentive to innovate and compete, but SMEs have indicated that for laundry products there is still a significant market for the lowest-cost models. We estimate this market as the percentage of non-ENERGY STAR washers, which are a more mature product.	If new technology allows dryers to meet ENERGY STAR without an incremental cost, we would increase this value to 100%. If the anticipated DOE standard is set to the current ENERGY STAR level, we would increase the value to 100%.
Segment 2	Growth Rate*	medium	If the measure level matches the updated ENERGY STAR v2 level, the consumer education market barrier will be reduced as the ENERGY STAR label facilitates identification of the highly efficient products meeting the 2016 Emerging Tech level.	We might decrease the growth rate if the measure level is still higher than the new ENERGY STAR level.
Segment 2	End Year	2026	We expect a new standard to go into effect in 2026. The effective date of the DOE regulatory cycle will end segment 2.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed effective date.
Segment 3	Maximum Market Penetration Potential	57%	After the new specification is effective, manufacturers will have increased incentive to innovate and compete, but SMEs have indicated that for laundry products there is still a significant market for the lowest-cost models. We estimate this market as the percentage of non-ENERGY STAR washers, which are a more mature product.	If there remains a significant incremental cost between the lowest-cost DOE-compliant models and the ENERGY STAR v1 level, this value might be decreased.
Segment 3	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might decrease the growth rate if the ENERGY STAR specification does not update at the time the new DOE standard goes into effect or the new DOE standard level is lower than the current ENERGY STAR v1 level.
Segment 3	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ESRPP Data

2016 - 2018 ESRPP Market Penetration from ESRPP Data in PG&E Territory

These inputs to the baselines come directly from the ESRPP sales data:

2016 Market Penetration of ENERGY STAR v1	2016 Market Penetration of ENERGY STAR Emerging Tech	2018 Market Penetration of ENERGY STAR v7 Washers
28.3%	0.12%	56.52%

The ESRPP program collaborates with the ENERGY STAR program, and one input to the dryer baselines derives from the model count of ENERGY STAR Most Efficient dryers listed on the Qualified Product List (QPL), as a percentage of the total model count of ENERGY STAR qualified models on the QPL:

QPL ESME % by Model Count	5.2%

Growth Parameter Assumptions

	slow	medium	fast
p	0.006	0.012	0.031
q	0.130	0.255	0.335
p+q	0.136	0.267	0.366
start year	5	5	5

The growth parameters are quartiles of the naturally occurring market adoption (NOMAD) Bass curve parameters for evaluated federal and Title 20 standards (see "Evaluated NOMAD" section for complete list of standards and parameters). The p and q values express the rates of technology innovation and technology imitation, with higher values indicating greater innovation and higher levels of competition. The start year parameter describes the number of years (prior to the forecast start year) a technology has been commercially available to consumers.

For the p and q values, the "slow" values are the first quartile p and q across all evaluated standards, the "medium" values are the median across all evaluated standards, and the "fast" values are the third quartile. This is representative of evaluated NOMAD for appliance energy efficiency measures and enables a quantification of Bass curve parameters from qualitative assessments of the product rates of competition and innovation.

The start year for all three scenarios is the first quartile for all evaluated Title 20 standards. The first quartile was used because all ESRPP measure levels are based on the voluntary ENERGY STAR specifications, which are more stringent and forward-looking than the

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2005 T-20	Std 1	Commercial Refrigeration Equipment, Solid Door	1995	0.009	0.433
2005 T-20	Std 2	Commercial Refrigeration Equipment, Transparent Door	1995	0.002	0.507
2005 T-20	std 3	Commercial Ice Maker Equipment	1995	0.005	0.535
2005 T-20	std 4	Walk-In Refrigerators / Freezers	1995	0.011	0.248
2005 T-20	std 5	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2005 T-20	std 6	Large Packaged Commercial Air-Conditioners, Tier 1	1990	0.000	0.500
2005 T-20	std 7	Large Packaged Commercial Air-Conditioners, Tier 2	1990	0.000	0.353
2005 T-20	std 8	Residential Pool Pumps, High Eff Motor, Tier 1	1965	0.001	0.045
2006 T-20	std 9	Residential Pool Pumps, 2-speed Motors, Tier 2	1975	0.000	0.202
2005 T-20	std 10	Portable Electric Spas			
2005 T-20	std 11a	General Service Incandescent Lamps, Tier 1	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2010)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2011)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2012)	1970	0.000	0.213
2005 T-20	std 12a	Pulse Start Metal Halide HID Luminaires, Tier 1	1992	0.001	0.348
2005 T-20	std 12b	Pulse Start Metal Halide HID Luminaires, Tier 2	1992	0.001	0.348
2005 T-20	std 13	Modular Furniture Task Lighting Fixtures	2000	0.132	0.198
2005 T-20	std 14	Hot Food Holding Cabinets	2000	0.008	0.480
2005 T-20	std 15	External Power Supplies, Tier 1	2000	0.025	0.356
2005 T-20	std 16	External Power Supplies, Tier 2	2000	0.012	0.386
2005 T-20	std 17	Consumer Electronics - Audio Players	2000	0.040	0.431
2005 T-20	std 18a	Consumer Electronics - TVs	2000	0.054	0.503
2005 T-20	std 18b	Consumer Electronics - DVDs	2000	0.126	0.099
2005 T-20	std 19	Water Dispensers	2000	0.037	0.343
2005 T-20	std 20	Unit Heaters and Duct Furnaces	1965	0.007	0.097
2005 T-20	std 21	Commercial Dishwasher Pre-Rinse Spray Valves	2003	0.039	0.389
2006 T-20	std 22a	BR, ER and R20 Incandescent Reflector Lamps: Residential	2000	0.023	0.145
2006 T-20	std 22b	BR, ER and R20 Incandescent Reflector Lamps: Commercial	2000	0.023	0.145
2008 T-20	std 23	Metal Halide Fixtures	2000	0.003	0.366
2008 T-20	std 24	Portable Lighting Fixtures	2000	0.002	0.498
2008 T-20	std 25	General Purpose Lighting -- 100 watt	2000	0.004	0.346

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2008 T-20	std 26	General Purpose Lighting -- 75 watt	2000	0.007	0.294
2008 T-20	std 27	General Purpose Lighting -- 60 and 40 watt	2000	0.011	0.255
2008 T-20		General Service Lamps (EISA Phase 2)	2000	0.003	0.220
2009 T-20	std 28a	Televisions - Tier 1	2000	0.004	0.534
2009 T-20	std 28b	Televisions - Tier 2	2000	0.008	0.380
2011 T-20	Std 29	Small Battery Chargers - Tier 1 (consumer with no USB charger or USB charger <20 watt-ho	2000	0.007	0.321
	Std 30	Small Battery Chargers - Tier 2 (consumer with USB charger >=20 watt-hours)	2000	0.012	0.241
2011 T-20	Std 31	Small Battery Chargers - Tier 3 (non-consumer)	2000	0.004	0.263
2011 T-20	Std 32	Large Battery Chargers (>=2kW rated input)	2000	0.003	0.275
2010-12 Fed App	Fed 1	Electric Motors 1-200HP	2000	0.030	0.030
2010-12 Fed App	Fed 2	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2010-12 Fed App	Fed 3	Commercial Refrigeration	1995	0.008	0.360
	Fed 4	ASHRAE Products (Commercial boilers)	1965	0.007	0.097
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2010-12 Fed App	Fed 6	Incandescent Reflector Lamps	2008	0.008	0.292
2010-12 Fed App	Fed 7	General Service Fluorescent Lamps	2000	0.010	0.330
2013-15 Fed App	Fed 8	Commercial Clothes Washers	1970	0.017	0.167
2013-15 Fed App	Fed 9	Residential Pool Heaters	1895	0.010	0.001
2013-15 Fed App	Fed 10	Residential Direct Heating Equipment	1950	0.065	0.168
2013-15 Fed App	Fed 11	Residential Refrigerators & Freezers	2005	0.011	0.247
2013-15 Fed App	Fed 12	Residential Room AC	2005	0.018	0.214
2013-15 Fed App	Fed 13	Fluorescent Ballasts	2000	0.014	0.173
2013-15 Fed App	Fed 14	Small Commercial Package Air-Conditioners >=65 and <135 kBtu/h	1980	0.100	0.001
2013-15 Fed App	Fed 15	Large and Very Large Commercial Package Air-Conditioners >=135 kBtu/h	1986	0.100	0.001
2013-15 Fed App	Fed 16	Computer Room Acs >=65,000 Btu/h and < 760,000 Btu/h	2005	0.700	0.020
2013-15 Fed App	Fed 17	Residential Dishwashers	1960	0.019	0.238
2013-15 Fed App	Fed 18	Residential Clothes Dryers	1970	0.047	0.107
2013-15 Fed App	Fed 19	Residential Gas-fired water heater	1915	0.005	0.020
2013-15 Fed App	Fed 20	Residential Electric storage water heater	1988	0.003	0.338
2013-15 Fed App	Fed 21	Residential Gas-fired instantaneous water heater	2015	1.000	1.000
2013-15 Fed App	Fed 22	Residential Oil-fired storage water heater	1988	0.050	0.002

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2013-15 Fed App	Fed 23	Small Electric Motors	2009	0.054	0.263
2013-15 Fed App	Fed 24	Residential Clothes Washers (Front Loading)	2015	0.031	0.152
2013-15 Fed App	Fed 25	Residential Clothes Washers (Top Loading) Tier I	2015	0.031	0.152
2013-15 Fed App	Fed 26	Residential Central AC, Heat Pumps and Furnaces	2003	0.011	0.222

Subject Matter Expert Input

QUESTION	SME Responses
1. Please describe your background, including the main organizations that you are and have been affiliated with, your role(s), and how many years you worked with each organization.	3 years experience in HVAC product development, 4 years experience with AHAM, 3 years experience consulting for EPA ENERGY STAR 25 years experience with Nationwide's marketing, 20 years experience outside of Nationwide as a buyer or sales manager 3 years experience with Home Depot, 9 years experience with Ecova 12 years experience in market analysis; 15 years experience in energy efficiency; 18 years experience in product development and energy efficiency 10 years experience consulting to support DOE rulemakings
2. Can you give your best estimate of the current [energy efficiency measure level, e.g., ESME 2016] market share for California? What sources inform your estimate?	Cited EPA Unit Shipment Data, noted that the California ESRPP sales are mostly representative of overall California sales (though they are not necessarily nationally representative). DOE certification database shows ~40% for electric (based on model counts). This is a bit higher than observed during the previous DOE standards rulemaking, which was around 25%. Somewhere in the middle likely. See the ESRPP sales. Other SMEs did not make an estimate.
3. Are you aware of any differences between brick-and-mortar vs. online sales for [product]? Do you think that sales from the participating big-box RPP retailers are likely to be representative of the [product] market in California?	Not sure PG&E ESRPP sales are likely generally representative and are a significant portion of the California sales. Nationwide and big-box retailers cover more than 80%, and there aren't significant online sales of dryers. National sales data is likely representative of California, unless skewed by strong EE programs specific to California. Some of the advanced HP models are easier to find online than in stores, but online sales are likely in the high single digits or teens as a percent of the total market. Regional appliance stores have ~20% of the market, and because of their format might be more willing/able to showcase advanced technologies than national big-box retailers. We assume the ESRPP sales are representative.

Subject Matter Expert Input

QUESTION	SME Responses
4. Are you aware of any upcoming technology innovations that would impact energy efficiency? Do you see major market barriers to their adoption?	Near-term, 2nd-generation HP dryers are even more efficient than 1st generation, with CEF values above 5. These U.S. models still look like a traditional dryer from a consumer standpoint, and don't have a slower cycle time than 1st gen. ESTAR program has helped with this a lot, especially with their 80-minute maximum cycle time requirement. In the longer-term, one example of innovative technology is ultra-sonic drying, being developed as a partnership between a major manufacturer and a U.S. national lab. The technology looks promising and feasible, but still in the prototype stage, and likely many years out before it could become a consumer-ready product. On the gas side, one example of innovative technology would be something similar to a HP but for gas. But this is still conceptual or possibly very earliest stages of development, and therefore would be at least 5 years out or more. Heat pump dryers are already being sold, and the slower dry cycle involved in heat pump drying is better for clothes. A manufacturer is working with ORNL on a Thermoelectric Heat Pump Clothes Dryer project (https://www.energy.gov/eere/buildings/downloads/thermoelectric-clothes-dryer) that uses thermoelectric heating with goals of reducing conventional dryer energy consumption by 50% and having installed cost premium <$565. These products could likely have an efficiency between the ENERGY STAR level and a pure heat pump level in terms of energy efficiency at a price similar to conventional technology. ORNL is targeting a similar cycle time to current dryers. Additionally, ORNL has worked on an Ultrasonic Dryer (https://www.ornl.gov/partnerships/ultrasonic-drying) with another manufacturer. An ultrasonic dryer would have the efficiency of a heat pump dryer without the use of harmful heat and have a similar cycle time to conventional dryers. Researchers are currently looking for commercialization partners. There's constant change, but currently it's hard to sell heat pump dryers due to the higher price point and longer cycle time. I do not track the technology components at all. Ultrasonic dryers are of interest long-term
5. Are there any major manufacturers that do not seem to be invested in incorporating energy efficiency into their products?	No one's going out of their way to not make ENERGY STAR products. All of the major manufacturers seem to be investing to some degree in energy efficient products. Some of them, however, also compete heavily at the low end of the price range, where it is much more difficult to offer high efficiency due to intense price competition. Other SMEs did not list manufacturers that limit EE.
a. If yes: Would you predict changes in the current manufacturer market share distribution?	-
6. Are you aware of residential product subclasses (e.g., for washers, agitator top-loaders), applications, or size bins where you would expect very low (< 5%) market penetration at the measure level by 2030?	Due to the small market share, there's less incentive to innovate on gas dryers, though that doesn't necessarily mean the market penetration will be < 5%. Other SMEs did not list subclasses that limit EE, and one explicitly noted that there is still EE potential for gas dryers.
a. If yes: Would you predict changes in the current balance of market share for product subcategories?	Market share of gas dryers has slowly but steadily declined over the past 10-20 years, and seems likely for that trend to continue.

Subject Matter Expert Input

QUESTION	SME Responses
b. If no: Would it be feasible without RPP or EPA intervention for market penetration at the measure level to reach ~100% by 2030?	No Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. There has been significant growth over the past few years, it's hard to say where that would end. Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR. EE is something customers expect, but only some customers are willing to pay a premium, the majority are not.
7. Do you think that [energy efficiency measure level] products could eventually reach 100% saturation in the market? Why?	Across all products, 100% won't happen within the timeline forecast unless DOE or States set the current ENERGY STAR level (or ESRPP basic tier level) as a mandatory minimum. There is still intense price competition (on the low-price range) for laundry appliances, so there will always be a lot of the lowest-price models that just meet the DOE standard. Getting those units up to ESTAR efficiency would likely require the DOE standard to be set at that level, due to the intense pricing pressures for that segment of the market (since a more efficient design usually costs more to produce). Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR. EE is something customers expect, but only some customers are willing to pay a premium, the majority are not. Consumers have not typically been choosing heat pump dryers.
a. If no: Do you have an estimate for the maximum saturation level?	45-50%, matching the penetration for washers Other SMEs did not make an estimate.
8. When would you expect to see 25% [energy efficiency measure level] market penetration? 50%? 75%?	50% soon, 75% not at all without regulation. Other SMEs did not make an estimate.
9. Do you think the rate of innovation in the [product] market is roughly the same as it was 5 – 10 years ago, or has it increased/decreased?	There is more innovation now than there was ~10 years ago. Similar There has been a noticeable increase in innovation in the past 5-10 years. This was the last major home appliance that manufacturers have focused on (from an EE standpoint), and there has been significant innovation following the release of the first ENERGY STAR emerging tech award and specification. Other SMEs did not make an estimate.

Subject Matter Expert Input

QUESTION	SME Responses
10. Compared to 5 – 10 years ago, how likely do you think manufacturers are to imitate/proliferate EE innovations?	There is more competition now than there was ~10 years ago. There has been a noticeable increase in competition in the past 5-10 years. This was the last major appliance manufacturers looked at. Similar Other SMEs did not make an estimate.
11. How do the current market barriers compare to the historical market barriers for meeting what is now the federal standard level?	There are issues with the lack of selection of EE dryers to match EE washers. Biggest market barrier is price-sensitivity, which was a factor previously also. Potentially, there may be technical barriers to installing HP technologies. Sufficient airflow is required for a HP because you're exchanging heat, so that wouldn't work well in a tightly closed closet, for example. There's also a consumer education barrier – consumers are likely not as familiar with what a heat pump is, and may not fully understand the benefits the technology. Dryers do not have an Energy Guide label on them. The increasing changes in the retailer landscape may cause some EE promoting retailers to shift their priorities, which could limit an ally for overcoming barriers in the past. We want to make sure we put together efficient washer/dryer pairs.
12. What are the typical adoption trends (in terms of growth rates for efficient products) you observe when no DOE rulemaking is in effect, between adoption and the effective date, and shortly after the effective date? Do you forecast similar trends when the EPA specifications are revised?	We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs. I need to be thinking a year in advance. What helps drive efficiency is either if it has other features for consumers or if there were product redesigns happening for other reasons. There are also some other drivers, e.g., EPA's SNAP rule will require a refrigerant update across all lines. If products are federally regulated, there's always a tendency to go more efficient during a redesign if possible. For products that aren't federally regulated, increasing efficiency would not be a primary driver during a product redesign. Manufacturers will develop products with features to help sell a product and any increase in efficiency as part of a redesign is likely an ancillary benefit. In general, if building managers are buying appliances in bulk, efficiency will likely be a consumer preference. If efficiency is a way to differentiate their products from competitors, that's something that companies will use to sell it and maybe leading to moderate market share growth. Another driver in the market is consolidation (in manufacturers, product lines, suppliers, or other), which could drive efficiency one way or another. There is manufacturer resistance to quicker-than-planned change due to sunk costs on capital investments. There's a little bit of growth even when there's no regulation. Market historical data show that adoption has been moving. The baseline starts increasing slowly with anticipation of a new standard and natural growth in market adoption.

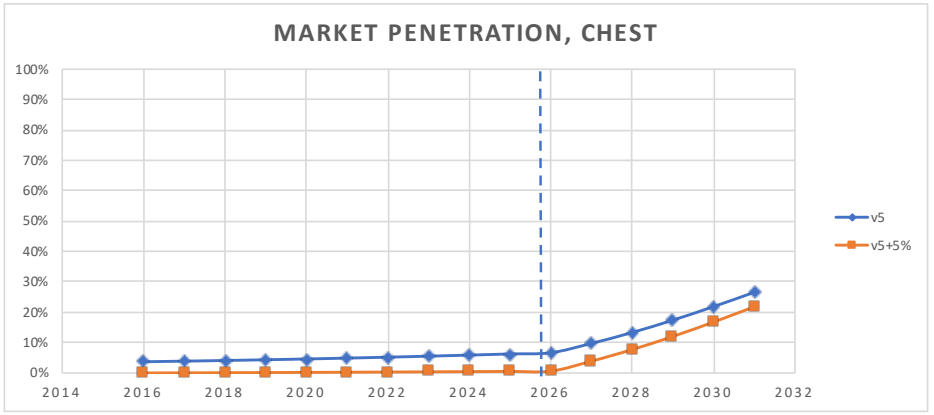
Subject Matter Expert Input

QUESTION	SME Responses
13. For experts with insight into regulations: When do you expect major regulatory events (DOE rulemakings and/or EPA specification revisions) to occur for this product? Do you expect regulations to proceed according to the posted schedules?	Cited the Fall 2018 Unified Agenda of Regulatory and Deregulatory Actions for DOE (https://www.reginfo.gov/public/do/eAgendaMain?operation=OPERATION_GET_AGENCY_RULE_LIST&currentPub=true&agencyCode=&showStage=active&agencyCd=1900&Image58.x=68&Image58.y=7). It has been several years since ESTAR released v1.0 of the spec. If it follows the trend of other home appliances, and based on observed availability of HE products in the market, it's reasonable to expect that a v2.0 spec could come out within the next few years. CEE is working on or just recently finalized tier definitions. Look at the DOE's schedule: https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201810&RIN=1904-AD99.
14. For experts with insight into retail: When a code change or ENERGY STAR revision occurs, do retailers begin altering their stock and marketing when the change is announced, when the change becomes effective, or (for voluntary specifications) after the change becomes effective?	We try to be ready around the time of the effective date, maybe a little earlier for DOE, maybe a little after the effective date for ENERGY STAR. We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs.
Interview Citations	Christianson, A. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Leritz, N. December 20, 2018 Phone interview with T. Kisch. Leybourn, S. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Steinhoff, C. and Moran, D. June 5, 2018. Phone interview with A. Mytelka and T. Kisch. Sutherland, T. January 4, 2019. Phone interview with A. Mytelka. Weinberg, R. December 10, 2018. Phone interview with A. Mytelka and T. Kisch.

Freezers Summary

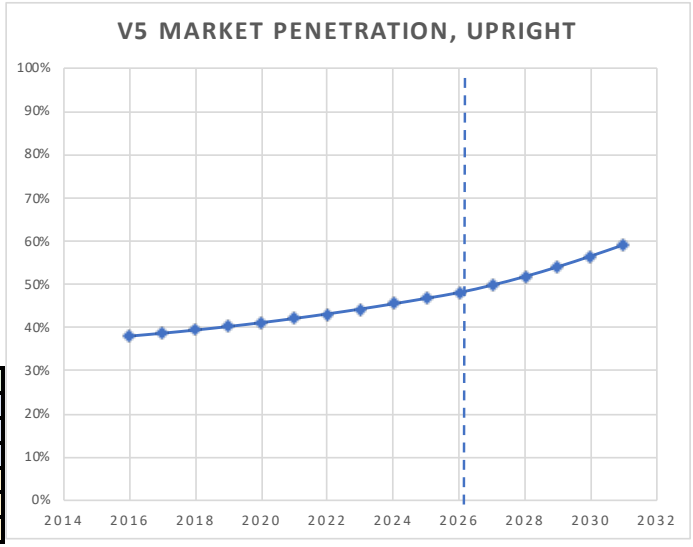
Last Updated: January 30, 2019
Updated By: Ari Mytelka, Energy Solutions

	Market Penetration		
Year	Chest v5	Chest v5+5%	Upright
2016	4%	0%	38%
2017	4%	0%	39%
2018	4%	0%	39%
2019	4%	0%	40%
2020	5%	0%	41%
2021	5%	0%	42%
2022	5%	0%	43%
2023	6%	0%	44%
2024	6%	0%	45%
2025	6%	1%	47%
2026	7%	1%	48%
2027	10%	4%	50%
2028	13%	8%	52%
2029	17%	12%	54%
2030	22%	17%	57%
2031	27%	22%	59%



How to interpret these charts:

These charts represent the 15-year forecast of market penetration values of the program-qualifying ENERGY STAR v5 and ENERGY STAR v5+5% levels absent program intervention. Upright and chest freezers are forecast separately, but the curves can be combined into a forecast for all freezers by taking the weighted average of the two curves, using the chest/upright distribution from the "ESRPP Data" tab. As there have been no PG&E ESRPP sales (or incentives paid) for ENERGY STAR v5+5% upright freezers, that measure level is not forecast for the product subclass. The charts only show forecast for the initial measure levels and do not forecast market penetration for future revisions of ENERGY STAR.



Derivation:

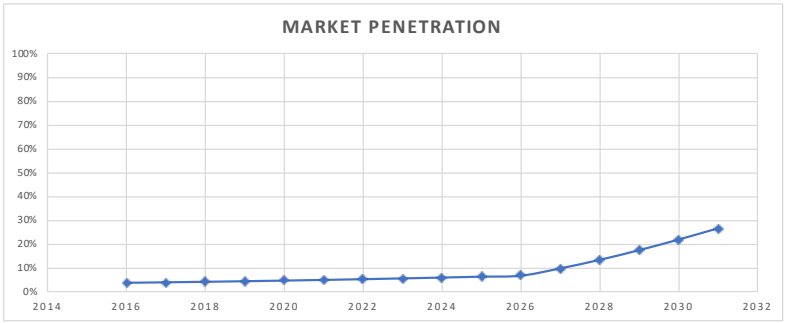
The baselines are calculated in segments, which are divided by significant non-program-related events such as changes to federal standards. For each segment, four key parameters describe the curve: the initial market share, the maximum potential market share, the qualitative growth rate, and the segment start and end years. The parameters are informed by the best available ESRPP program and market sales data alongside subject matter expert opinion. Since market conditions change over time, it is recommended that these charts are reviewed each year and updated as necessary to reflect changes in market conditions.

Contents:

ENERGY STAR v5 Freezers, Chest

Last Updated: January 3, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	4%
2017	4%
2018	4%
2019	4%
2020	5%
2021	5%
2022	5%
2023	6%
2024	6%
2025	6%
2026	7%
2027	10%
2028	13%
2029	17%
2030	22%
2031	27%



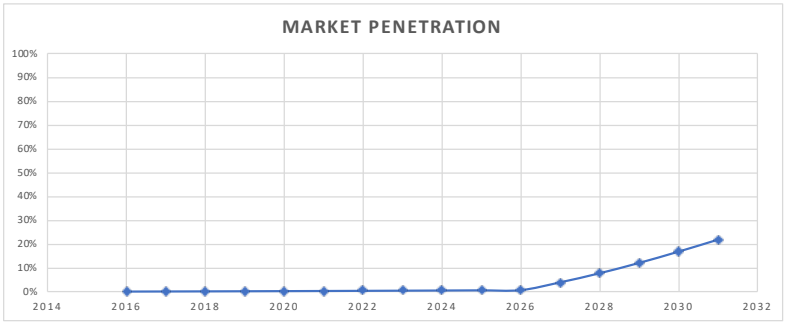
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	4%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	22%	Compact models (product class 18) comprise 79% of the market but 0% of the ENERGY STAR sales in the RPP data. There are qualifying models, but the fact that they have no sales suggests that there is an additional market barrier for these low-end products. This is consistent with SME input that cost is the main market barrier.	If we see evidence of a decreasing incremental cost for compact units, we might increase this value.
Segment 1	Growth Rate*	slow	Product subject matter experts note that there is little competition for improving energy efficiency in the freezer market, less than is seen in the refrigerator market. Retail expert input suggests that retailers plan modifications to their stocking practices to coincide with the effective date of a new standard or specification, so we do not expect significant change prior to the effective date.	We might increase the growth rate if the ENERGY STAR specification opens prior to the beginning of the next DOE regulatory cycle, and this accelerated schedule is not attributable to RPP advocacy.
Segment 1	End Year	2026	We expect a new standard to go into effect in 2026. The effective date of the DOE regulatory cycle will end segment 1.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed opening of the DOE standard.
Segment 2	Maximum Market Penetration Potential	100%	After the new DOE standard is effective, the lowest-cost freezers will be more efficient, so the incremental cost of ENERGY STAR v5 efficiency is expected to decrease. With a decreased economic market barrier, there is no obvious limitation on the maximum market penetration potential. Consulting the ENERGY STAR QPL, ENERGY STAR products are available in both compact and standard chest freezer configurations.	If there is still a significant incremental cost between the minimal DOE-compliant models and ENERGY STAR v5 models, we might decrease this value.
Segment 2	Growth Rate*	medium	With an updated DOE standard and an updated ENERGY STAR specification, we expect market share of the current ENERGY STAR level to increase more rapidly. SMEs confirm that the typical market adoption pattern is a step function with more rapid growth in market share in conjunction with codes & standards enhancement. However, retail SMEs indicated that there is not significant competition on energy efficiency for freezers, so the growth rate would likely be limited even after the effective date of a new code.	We would increase the growth rate if the updated DOE standard is set at the ENERGY STAR v5 level.
Segment 2	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR v5 +5% Freezers, Chest

Last Updated: January 3, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	0%
2017	0%
2018	0%
2019	0%
2020	0%
2021	0%
2022	0%
2023	0%
2024	0%
2025	1%
2026	1%
2027	4%
2028	8%
2029	12%
2030	17%
2031	22%



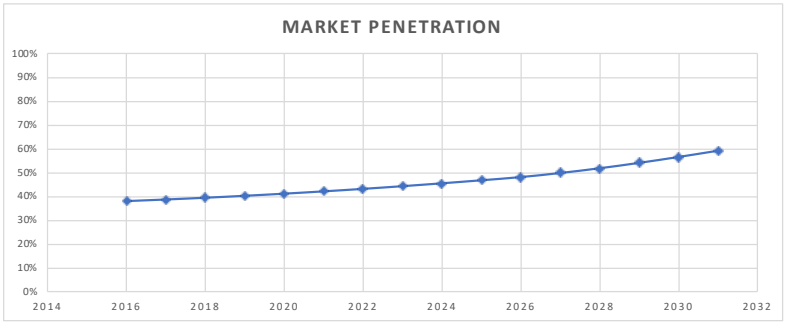
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	0%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	4%	Compact models (product class 18) comprise 79% of the market but 0% of the ENERGY STAR sales in the RPP data. There are qualifying models, but the fact that they have no sales suggests that there is an additional market barrier for these low-end products. This is consistent with SME input that cost is the main market barrier. Additionally, there are relatively few models on the ENERGY STAR QPL that meet v5+5%; they represent 1/6 of all the chest freezers listed on the QPL.	If we see evidence of a decreasing incremental cost for compact units, we might increase this value. If v5+5% models gain greater representation in the QPL, we would increase this value.
Segment 1	Growth Rate*	slow	Product subject matter experts note that there is little competition for improving energy efficiency in the freezer market, less than is seen in the refrigerator market. Retail expert input suggests that retailers plan modifications to their stocking practices to coincide with the effective date of a new standard or specification, so we do not expect significant change prior to the effective date.	We might increase the growth rate if the ENERGY STAR specification opens prior to the beginning of the next DOE regulatory cycle, and this accelerated schedule is not attributable to RPP advocacy.
Segment 1	End Year	2026	We expect a new standard to go into effect in 2026. The effective date of the DOE regulatory cycle will end segment 1.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed opening of the DOE standard.
Segment 2	Maximum Market Penetration Potential	100%	After the new DOE standard is effective, the lowest-cost freezers will be more efficient, so the incremental cost of ENERGY STAR v5+5% efficiency is expected to decrease. With a decreased economic market barrier, there is no obvious limitation on the maximum market penetration potential. Consulting the ENERGY STAR QPL, v5+5% products are available in both compact and standard chest freezer configurations.	If there is still a significant incremental cost between the minimal DOE-compliant models and ENERGY STAR v5+5% models, we might decrease this value.
Segment 2	Growth Rate*	medium	With an updated DOE standard and an updated ENERGY STAR specification, we expect market share of the current ENERGY STAR +5% level to increase more rapidly. SMEs confirm that the typical market adoption pattern is a step function with more rapid growth in market share in conjunction with codes & standards enhancement. However, retail SMEs indicated that there is not significant competition on energy efficiency for freezers, so the growth rate would likely be limited even after the effective date of a new code.	We would increase the growth rate if the updated DOE standard is set at the ENERGY STAR v5+5% level.
Segment 2	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR v5 Freezers, Upright

Last Updated: January 3, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	38%
2017	39%
2018	39%
2019	40%
2020	41%
2021	42%
2022	43%
2023	44%
2024	45%
2025	47%
2026	48%
2027	50%
2028	52%
2029	54%
2030	57%
2031	59%



		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	38%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	99%	NEEA SMEs identified product class 9I as lacking ENERGY STAR representation. This product class is 1% of upright freezers according to the sales data.	If we identify 9I ENERGY STAR freezers in the sales data, we would increase this value to include class 9I. If we identify another subclass lacking ENERGY STAR representation, we might decrease this value.
Segment 1	Growth Rate*	slow	Product subject matter experts note that there is little competition for improving energy efficiency in the freezer market, less than is seen in the refrigerator market. Retail expert input suggests that retailers plan modifications to their stocking practices to coincide with the effective date of a new standard or specification, so we do not expect significant change prior to the effective date.	We might increase the growth rate if the ENERGY STAR specification opens prior to the beginning of the next DOE regulatory cycle, and this accelerated schedule is not attributable to RPP advocacy.
Segment 1	End Year	2026	We expect a new standard to go into effect in 2026. The effective date of the DOE regulatory cycle will end segment 1.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed opening of the DOE standard.
Segment 2	Maximum Market Penetration Potential	100%	After the new DOE standard is effective, the lowest-cost freezers will be more efficient, so the incremental cost of ENERGY STAR v5 efficiency is expected to decrease. With a decreased economic market barrier, there is no obvious limitation on the maximum market penetration potential. Consulting the ENERGY STAR QPL, ENERGY STAR products are available across all upright freezer configurations except class 9-BI, which is 0% of sales.	If there is still a significant incremental cost between the minimal DOE-compliant models and ENERGY STAR v5 models, we might decrease this value.
Segment 2	Growth Rate*	medium	With an updated DOE standard and an updated ENERGY STAR specification, we expect market share of the current ENERGY STAR level to increase more rapidly. SMEs confirm that the typical market adoption pattern is a step function with more rapid growth in market share in conjunction with codes & standards enhancement. However, retail SMEs indicated that there is not significant competition on energy efficiency for freezers, so the growth rate would likely be limited even after the effective date of a new code.	We would increase the growth rate if the updated DOE standard is set at the ENERGY STAR v5 level.
Segment 2	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ESRPP Data

Configuration	Distribution: % of Freezer Market	2016 Market Penetration of ENERGY STAR v5	2016 Market Penetration of ENERGY STAR v5 + 5%	Product Class 9I	Product Class 18
Chest:	66%	3.7%	0.01%	0.00%	78.5%
Upright:	34%	38.0%	0.00%	1.38%	0.00%

Reference for the DOE's Residential Freezer Product Classes:

8. Upright freezers with manual defrost
9. Upright freezers with automatic defrost without an automatic icemaker
9I. Upright freezers with automatic defrost with an automatic icemaker
9-BI. Built-In Upright freezers with automatic defrost without an automatic icemaker
9I-BI. Built-in upright freezers with automatic defrost with an automatic icemaker
10. Chest freezers and all other freezers except compact freezers
10A. Chest freezers with automatic defrost
16. Compact upright freezers with manual defrost
17. Compact upright freezers with automatic defrost
18. Compact chest freezers

Product classes 1 - 7 and 11 - 15 are refrigerator products.

Growth Parameters

	slow	medium	fast
p	0.006	0.012	0.031
q	0.13	0.26	0.33
p+q	0.14	0.27	0.37
start year	5	5	5

The growth parameters are quartiles of the naturally occurring market adoption (NOMAD) Bass curve parameters for evaluated federal and Title 20 standards (see "Evaluated NOMAD" section for complete list of standards and parameters). The p and q values express the rates of technology innovation and technology imitation, with higher values indicating greater innovation and higher levels of competition. The start year parameter describes the number of years (prior to the forecast start year) a technology has been commercially available to consumers.

For the p and q values, the "slow" values are the first quartile p and q across all evaluated standards, the "medium" values are the median across all evaluated standards, and the "fast" values are the third quartile. This is representative of evaluated NOMAD for appliance energy efficiency measures and enables a quantification of Bass curve parameters from qualitative assessments of the product rates of competition and innovation.

The start year for all three scenarios is the first quartile for all evaluated Title 20 standards. The first quartile was used because all ESRPP measure levels are based on the voluntary ENERGY STAR specifications, which are more stringent and forward-looking than the

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2005 T-20	Std 1	Commercial Refrigeration Equipment, Solid Door	1995	0.009	0.433
2005 T-20	Std 2	Commercial Refrigeration Equipment, Transparent Door	1995	0.002	0.507
2005 T-20	std 3	Commercial Ice Maker Equipment	1995	0.005	0.535
2005 T-20	std 4	Walk-In Refrigerators / Freezers	1995	0.011	0.248
2005 T-20	std 5	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2005 T-20	std 6	Large Packaged Commercial Air-Conditioners, Tier 1	1990	0.000	0.500
2005 T-20	std 7	Large Packaged Commercial Air-Conditioners, Tier 2	1990	0.000	0.353
2005 T-20	std 8	Residential Pool Pumps, High Eff Motor, Tier 1	1965	0.001	0.045
2006 T-20	std 9	Residential Pool Pumps, 2-speed Motors, Tier 2	1975	0.000	0.202
2005 T-20	std 10	Portable Electric Spas			
2005 T-20	std 11a	General Service Incandescent Lamps, Tier 1	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2010)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2011)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2012)	1970	0.000	0.213
2005 T-20	std 12a	Pulse Start Metal Halide HID Luminaires, Tier 1	1992	0.001	0.348
2005 T-20	std 12b	Pulse Start Metal Halide HID Luminaires, Tier 2	1992	0.001	0.348
2005 T-20	std 13	Modular Furniture Task Lighting Fixtures	2000	0.132	0.198
2005 T-20	std 14	Hot Food Holding Cabinets	2000	0.008	0.480
2005 T-20	std 15	External Power Supplies, Tier 1	2000	0.025	0.356
2005 T-20	std 16	External Power Supplies, Tier 2	2000	0.012	0.386
2005 T-20	std 17	Consumer Electronics - Audio Players	2000	0.040	0.431
2005 T-20	std 18a	Consumer Electronics - TVs	2000	0.054	0.503
2005 T-20	std 18b	Consumer Electronics - DVDs	2000	0.126	0.099
2005 T-20	std 19	Water Dispensers	2000	0.037	0.343
2005 T-20	std 20	Unit Heaters and Duct Furnaces	1965	0.007	0.097
2005 T-20	std 21	Commercial Dishwasher Pre-Rinse Spray Valves	2003	0.039	0.389
2006 T-20	std 22a	BR, ER and R20 Incandescent Reflector Lamps: Residential	2000	0.023	0.145
2006 T-20	std 22b	BR, ER and R20 Incandescent Reflector Lamps: Commercial	2000	0.023	0.145
2008 T-20	std 23	Metal Halide Fixtures	2000	0.003	0.366
2008 T-20	std 24	Portable Lighting Fixtures	2000	0.002	0.498
2008 T-20	std 25	General Purpose Lighting -- 100 watt	2000	0.004	0.346

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2008 T-20	std 26	General Purpose Lighting -- 75 watt	2000	0.007	0.294
2008 T-20	std 27	General Purpose Lighting -- 60 and 40 watt	2000	0.011	0.255
2008 T-20		General Service Lamps (EISA Phase 2)	2000	0.003	0.220
2009 T-20	std 28a	Televisions - Tier 1	2000	0.004	0.534
2009 T-20	std 28b	Televisions - Tier 2	2000	0.008	0.380
2011 T-20	Std 29	Small Battery Chargers - Tier 1 (consumer with no USB charger or USB charger <20 watt-ho	2000	0.007	0.321
	Std 30	Small Battery Chargers - Tier 2 (consumer with USB charger >=20 watt-hours)	2000	0.012	0.241
2011 T-20	Std 31	Small Battery Chargers - Tier 3 (non-consumer)	2000	0.004	0.263
2011 T-20	Std 32	Large Battery Chargers (>=2kW rated input)	2000	0.003	0.275
2010-12 Fed App	Fed 1	Electric Motors 1-200HP	2000	0.030	0.030
2010-12 Fed App	Fed 2	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2010-12 Fed App	Fed 3	Commercial Refrigeration	1995	0.008	0.360
	Fed 4	ASHRAE Products (Commercial boilers)	1965	0.007	0.097
2010-12 Fed App	Fed 5	Residential Electric & Gas Ranges	1965	0.007	0.097
2010-12 Fed App	Fed 6	Incandescent Reflector Lamps	2008	0.008	0.292
2010-12 Fed App	Fed 7	General Service Fluorescent Lamps	2000	0.010	0.330
2013-15 Fed App	Fed 8	Commercial Clothes Washers	1970	0.017	0.167
2013-15 Fed App	Fed 9	Residential Pool Heaters	1895	0.010	0.001
2013-15 Fed App	Fed 10	Residential Direct Heating Equipment	1950	0.065	0.168
2013-15 Fed App	Fed 11	Residential Refrigerators & Freezers	2005	0.011	0.247
2013-15 Fed App	Fed 12	Residential Room AC	2005	0.018	0.214
2013-15 Fed App	Fed 13	Fluorescent Ballasts	2000	0.014	0.173
2013-15 Fed App	Fed 14	Small Commercial Package Air-Conditioners >=65 and <135 kBtu/h	1980	0.100	0.001
2013-15 Fed App	Fed 15	Large and Very Large Commercial Package Air-Conditioners >=135 kBtu/h	1986	0.100	0.001
2013-15 Fed App	Fed 16	Computer Room Acs >=65,000 Btu/h and < 760,000 Btu/h	2005	0.700	0.020
2013-15 Fed App	Fed 17	Residential Dishwashers	1960	0.019	0.238
2013-15 Fed App	Fed 18	Residential Clothes Dryers	1970	0.047	0.107
2013-15 Fed App	Fed 19	Residential Gas-fired water heater	1915	0.005	0.020
2013-15 Fed App	Fed 20	Residential Electric storage water heater	1988	0.003	0.338
2013-15 Fed App	Fed 21	Residential Gas-fired instantaneous water heater	2015	1.000	1.000
2013-15 Fed App	Fed 22	Residential Oil-fired storage water heater	1988	0.050	0.002

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2013-15 Fed App	Fed 23	Small Electric Motors	2009	0.054	0.263
2013-15 Fed App	Fed 24	Residential Clothes Washers (Front Loading)	2015	0.031	0.152
2013-15 Fed App	Fed 25	Residential Clothes Washers (Top Loading) Tier I	2015	0.031	0.152
2013-15 Fed App	Fed 26	Residential Central AC, Heat Pumps and Furnaces	2003	0.011	0.222

Subject Matter Expert Input

QUESTION	SME Responses
1. Please describe your background, including the main organizations that you are and have been affiliated with, your role(s), and how many years you worked with each organization.	3 years experience in HVAC product development, 4 years experience with AHAM, 3 years experience consulting for EPA ENERGY STAR 3 years experience with Home Depot, 9 years experience with Ecova 25 years experience with Nationwide's marketing, 20 years experience outside of Nationwide as a buyer or sales manager 12 years experience in market analysis; 15 years experience in energy efficiency; 18 years experience in product development and energy efficiency 10 years experience consulting to support DOE rulemakings
2. Can you give your best estimate of the current [energy efficiency measure level, e.g., ESME 2016] market share for California? What sources inform your estimate?	Cited EPA Unit Shipment Data, noted that the California ESRPP sales are mostly representative of overall California sales (though they are not necessarily nationally representative). Upright and Chest have similar market shares. From the ENERGY STAR Unit Shipment Data, it looks like 42% overall. See the ESRPP sales. Other SMEs made no estimate.
3. Are you aware of any differences between brick-and-mortar vs. online sales for [product]? Do you think that sales from the participating big-box RPP retailers are likely to be representative of the [product] market in California?	PG&E ESRPP sales are likely generally representative and are a significant portion of the California sales. Nationwide and big-box retailers cover more than 80%, and there aren't significant online sales of freezers. Not sure No real difference for online sales. ESRPP might be missing models that are only sold through dealers or direct to building contractors, but neither of these is likely to be a major blind spot. We assume the ESRPP sales are representative.
4. Are you aware of any upcoming technology innovations that would impact energy efficiency? Do you see major market barriers to their adoption?	There's constant change, but there isn't anything significant in freezers currently. I do not track the technology components at all. There might be emerging technologies that add to the standby power usage and slow down adoption of EE freezers or even decrease the market share. Same as for refrigerators (variable-speed/capacity compressors, vacuum-insulated panels). Price might also be a bigger market barrier for freezers, but not necessarily for built-in units.
5. Are there any major manufacturers that do not seem to be invested in incorporating energy efficiency into their products?	No one's going out of their way to not make ENERGY STAR products. Manufacturers are interested, but there's less drive than for refrigerators. Other SMEs did not list manufacturers that limit EE.
a. If yes: Would you predict changes in the current manufacturer market share distribution?	-
6. Are you aware of residential product subclasses (e.g., for washers, agitator top-loaders), applications, or size bins where you would expect very low (< 5%) market penetration at the measure level by 2030?	Chest freezers have more basic construction than upright, so there may be fewer opportunities to increase efficiency. There are no ENERGY STAR products in the 9I upright freezer subclass. Other SMEs did not list subclasses that limit EE.

Subject Matter Expert Input

QUESTION	SME Responses
a. If yes: Would you predict changes in the current balance of market share for product subcategories?	No expected change from the current distribution No
b. If no: Would it be feasible without RPP or EPA intervention for market penetration at the measure level to reach ~100% by 2030?	No Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR.
7. Do you think that [energy efficiency measure level] products could eventually reach 100% saturation in the market? Why?	Across all products, 100% won't happen within the timeline forecast unless DOE or States set the current ENERGY STAR level (or ESRPP basic tier level) as a mandatory minimum. Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR. Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. For chest freezers, eventually, for upright freezers, there's no indication that class 9I would gain ENERGY STAR models. Not 100% because of the cost factor, unless there is regulatory pressure.
a. If no: Do you have an estimate for the maximum saturation level?	Upright freezers: everything except class 9I, which in the NEEA RPP sales represent 3% of upright freezers
8. When would you expect to see 25% [energy efficiency measure level] market penetration? 50%? 75%?	No estimate
9. Do you think the rate of innovation in the [product] market is roughly the same as it was 5 – 10 years ago, or has it increased/decreased?	All SMEs either indicated the rate is similar or did not make an estimate.
10. Compared to 5 – 10 years ago, how likely do you think manufacturers are to imitate/proliferate EE innovations?	Similar Similar. These are products that are well-known, it's the same types of component-level changes that contribute to better energy efficiency. Other SMEs made no estimate.
11. How do the current market barriers compare to the historical market barriers for meeting what is now the federal standard level?	People buy with a size that meets their needs as the first consideration, then the price is the next priority, and EE only comes after price. The increasing changes in the retailer landscape may cause some EE promoting retailers to shift their priorities, which could limit an ally for overcoming barriers in the past. I'm not getting feedback either way. Price is the biggest market barrier, that hasn't changed in impact from historical, and there aren't other key market barriers.

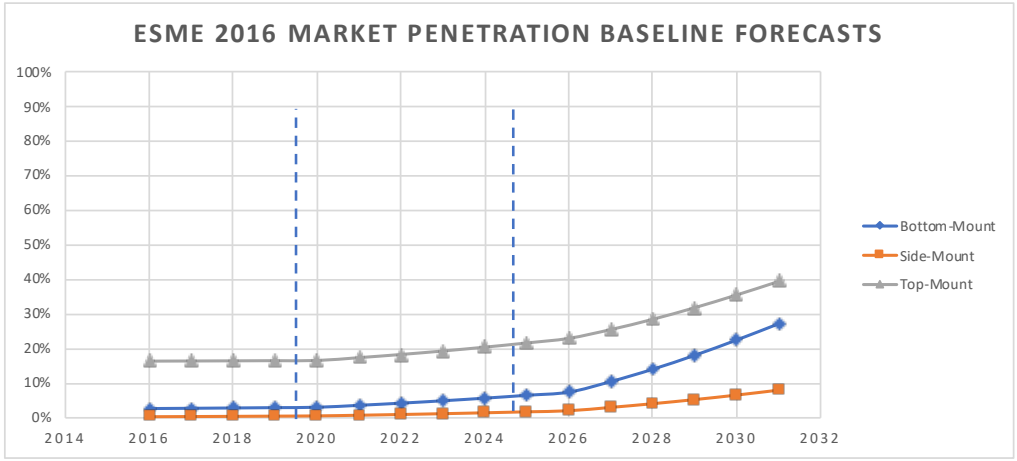
Subject Matter Expert Input

QUESTION	SME Responses
12. What are the typical adoption trends (in terms of growth rates for efficient products) you observe when no DOE rulemaking is in effect, between adoption and the effective date, and shortly after the effective date? Do you forecast similar trends when the EPA specifications are revised?	What helps drive efficiency is either if it has other features for consumers or if there were product redesigns happening for other reasons. There are also some other drivers, e.g., EPA's SNAP rule will require a refrigerant update across all lines. If products are federally regulated, there's always a tendency to go more efficient during a redesign if possible. For products that aren't federally regulated, increasing efficiency would not be a primary driver during a product redesign. Manufacturers will develop products with features to help sell a product and any increase in efficiency as part of a redesign is likely an ancillary benefit. In general, if building managers are buying appliances in bulk, efficiency will likely be a consumer preference. If efficiency is a way to differentiate their products from competitors, that's something that companies will use to sell it and maybe leading to moderate market share growth. Another driver in the market is consolidation (in manufacturers, product lines, suppliers, or other), which could drive efficiency one way or another. There is manufacturer resistance to quicker-than-planned change due to sunk costs on capital investments. We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs. I need to be thinking a year in advance. There's always a period when manufacturers know the regulations are coming, but it takes time to carry updates through their design process to show up when standards take effect. This is across products, not just freezers. It is less of an impact for ESTAR than DOE, since they don't have as long of a lead time. There's a little bit of growth even when there's no regulation. Market historical data show that adoption is not moving and will not move until some sort of intervention. The baseline starts increasing slowly with anticipation of a new standard and natural growth in market adoption.
13. For experts with insight into regulations: When do you expect major regulatory events (DOE rulemakings and/or EPA specification revisions) to occur for this product? Do you expect regulations to proceed according to the posted schedules?	Cited the Fall 2018 Unified Agenda of Regulatory and Deregulatory Actions for DOE (https://www.reginfo.gov/public/do/eAgendaMain?operation=OPERATION_GET_AGENCY_RULE_LIST&currentPub=true&agencyCode=&showStage=active&agencyCd=1900&Image58.x=68&Image58.y=7). Look at the DOE's schedule: https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201810&RIN=1904-AD84.
14. For experts with insight into retail: When a code change or ENERGY STAR revision occurs, do retailers begin altering their stock and marketing when the change is announced, when the change becomes effective, or (for voluntary specifications) after the change becomes effective?	We try to be ready around the time of the effective date, maybe a little earlier for DOE, maybe a little after the effective date for ENERGY STAR We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs
Interview Citations	Christianson, A. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Leritz, N. December 20, 2018 Phone interview with T. Kisch. Leybourn, S. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Steinhoff, C. and Moran, D. June 5, 2018. Phone interview with A. Mytelka and T. Kisch. Watson, T. December 19, 2018. Phone interview with A. Mytelka and T. Kisch. Weinberg, R. December 10, 2018. Phone interview with A. Mytelka and T. Kisch.

Refrigerator Baseline Summary

Last Updated: January 30, 2019
Updated By: Ari Mytelka, Energy Solutions

	Baseline Market Share		
Year	Bottom-Mount ESME 2016	Top-Mount ESME 2016	Side-Mount ESME 2016
2016	3%	16%	0%
2017	3%	16%	0%
2018	3%	16%	0%
2019	3%	17%	0%
2020	3%	17%	1%
2021	4%	17%	1%
2022	4%	18%	1%
2023	5%	19%	1%
2024	6%	20%	1%
2025	7%	22%	2%
2026	7%	23%	2%
2027	10%	26%	3%
2028	14%	28%	4%
2029	18%	32%	5%
2030	22%	35%	7%
2031	27%	39%	8%



How to interpret the charts in this document:

These charts represent the 15-year statewide forecast of market penetration values of the program-qualifying ENERGY STAR Most Efficient measure level absent program intervention. Bottom-mount, top-mount, and side-mount freezer refrigerator configurations are forecast separately, but the curves can be combined into a forecast for all refrigerators by taking the weighted average of the three curves using the distribution from the "ESRPP Data" tab. As compact refrigerators are ineligible for ENERGY STAR Most Efficient recognition, they are not forecast. The charts only show forecasts for the given measure levels and do not forecast market penetration for future revisions of ENERGY STAR.

Derivation:

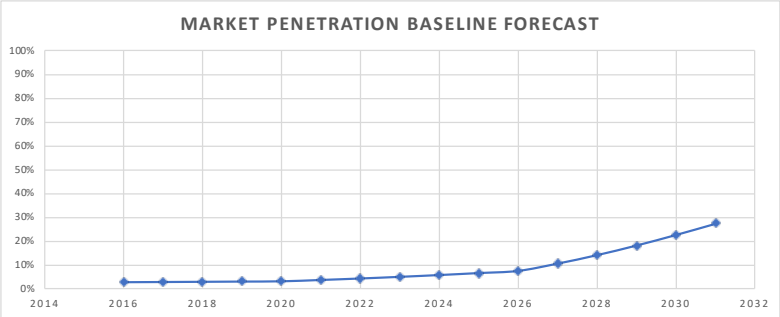
The baselines are calculated in segments, which are divided by significant non-program-related events such as changes to federal standards. For each segment, four key parameters describe the curve: the initial market share, the maximum potential market share, the qualitative growth rate, and the segment start and end years. The parameters are informed by the best available ESRPP program and market sales data alongside subject matter expert opinion. Since market conditions change over time, it is recommended that these charts are reviewed each year and updated as necessary to reflect changes in market conditions.

Contents:

ENERGY STAR Most Efficient 2016 Bottom-Mount Refrigerator Baseline

Last Updated: January 13, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	3%
2017	3%
2018	3%
2019	3%
2020	3%
2021	4%
2022	4%
2023	5%
2024	6%
2025	7%
2026	7%
2027	10%
2028	14%
2029	18%
2030	22%
2031	27%



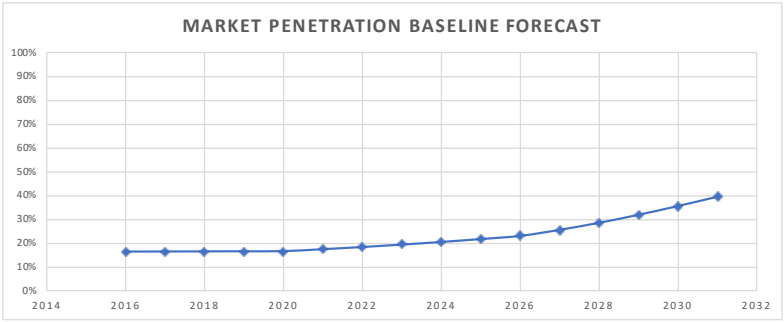
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	3%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	10%	Market historical data unit shipment data from ENERGY STAR (https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives) suggest that ENERGY STAR market share is not moving and likely will not without outside intervention. SME input confirms that efficiency has leveled off.	We do not expect to update this value in future years.
Segment 1	Growth Rate*	slow	Market historical data unit shipment data from ENERGY STAR (https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives) suggest that ENERGY STAR market share is not moving and likely will not without outside intervention. SME input confirms that efficiency has leveled off.	We might increase the growth rate if the ENERGY STAR specification opens prior to the beginning of the next DOE regulatory cycle, and this accelerated schedule is not attributable to RPP advocacy.
Segment 1	End Year	2020	The DOE federal standards process expected to open in 2020. The start of the DOE regulatory cycle will end segment 1.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed opening of the DOE standard.
Segment 2	Maximum Market Penetration Potential	60%	In anticipation of a new standard, the market share could grow to a higher level. However, RPP program data show that ESME bottom-mount freezer refrigerators are very rare outside the 5A DOE product class (products with through-the-door ice dispensers). That product class has consistently made up 55-60% of the PG&E RPP bottom-mount freezer refrigerator sales. A product subject matter expert confirms that bottom-mount freezer refrigerators with through-the-door ice dispensers dominate the ESME 2016 efficiency level, so we can expect that the 5A product category will continue dominating this efficiency level until the DOE standard is updated.	If a new feature or sub-category of bottom-mount freezer refrigerators arises that cannot meet ESME 2016, we might decrease this value. If we see significant ESME market share outside the 5A product class, we might increase this value.
Segment 2	Growth Rate*	slow	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might increase the growth rate if a new ENERGY STAR specification becomes effective prior to the finalization of a new DOE standard, and this accelerated schedule is not attributable to RPP advocacy.
Segment 2	End Year	2026	We expect a new standard to go into effect in 2026.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed DOE effective date.
Segment 3	Maximum Market Penetration Potential	100%	With an updated DOE standard, we do not see a market share limit for the 2016 ESME level. A product subject matter expert confirms that there are no product subcategories which would be unable to reach the ESME 2016 level.	If a new feature or sub-category of bottom-mount freezer refrigerators arises that cannot meet ESME 2016, we might decrease this value.
Segment 3	Growth Rate*	medium	With an updated DOE standard and an updated ENERGY STAR specification, we expect market share of the 2016 ESME level to increase more rapidly. Product subject matter experts confirm that the typical market adoption pattern is a step function with rapid adoption in conjunction with codes and standards.	We might decrease the growth rate if the ENERGY STAR specification does not update at the time the new DOE standard goes into effect or the new DOE standard level is lower than anticipated.
Segment 3	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR Most Efficient 2016 Top-Mount Refrigerator Baseline

Last Updated: January 13, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	16%
2017	16%
2018	16%
2019	17%
2020	17%
2021	17%
2022	18%
2023	19%
2024	20%
2025	22%
2026	23%
2027	26%
2028	28%
2029	32%
2030	35%
2031	39%



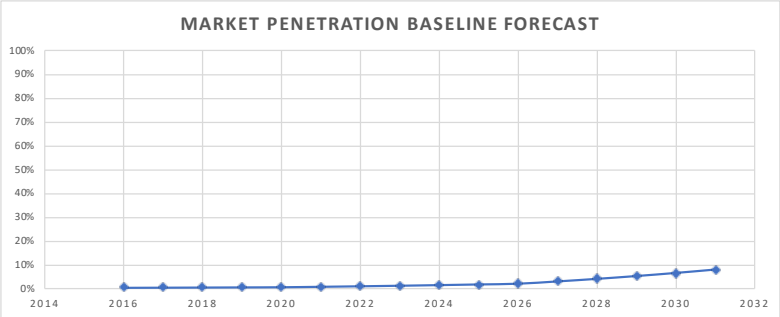
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	16%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	20%	Market historical data unit shipment data from ENERGY STAR (https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives) suggest that ENERGY STAR market share is not moving and likely will not without outside intervention. SME input confirms that efficiency has leveled off.	We do not expect to update this value in future years.
Segment 1	Growth Rate*	slow	Market historical data unit shipment data from ENERGY STAR (https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives) suggest that ENERGY STAR market share is not moving and likely will not without outside intervention. SME input confirms that efficiency has leveled off.	We might increase the growth rate if the ENERGY STAR specification opens prior to the beginning of the next DOE regulatory cycle, and this accelerated schedule is not attributable to RPP advocacy.
Segment 1	End Year	2020	The DOE federal standards process expected to open in 2020. The start of the DOE regulatory cycle will end segment 1.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed opening of the DOE standard.
Segment 2	Maximum Market Penetration Potential	100%	In anticipation of a new standard, the market share could grow to a higher level. A product subject matter expert confirms that there are no product subcategories which would be unable to reach the ESME 2016 level.	If a new feature or sub-category of top-mount freezer refrigerators arises that cannot meet ESME 2016, we might decrease this value.
Segment 2	Growth Rate*	slow	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might increase the growth rate if a new ENERGY STAR specification becomes effective prior to the finalization of a new DOE standard, and this accelerated schedule is not attributable to RPP advocacy.
Segment 2	End Year	2026	We expect a new standard to go into effect in 2026.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed DOE effective date.
Segment 3	Maximum Market Penetration Potential	100%	With an updated DOE standard, we do not see a market share limit for the 2016 ESME level. A product subject matter expert confirms that there are no product subcategories which would be unable to reach the ESME 2016 level.	If a new feature or sub-category of top-mount freezer refrigerators arises that cannot meet ESME 2016, we might decrease this value.
Segment 3	Growth Rate*	medium	With an updated DOE standard and an updated ENERGY STAR specification, we expect market share of the 2016 ESME level to increase more rapidly. A product subject matter expert confirms that the typical market adoption pattern is a step function with rapid adoption in conjunction with codes and standards.	We might decrease the growth rate if the ENERGY STAR specification does not update at the time the new DOE standard goes into effect or the new DOE standard level is lower than anticipated.
Segment 3	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR Most Efficient 2016 Side-Mount Refrigerator Baseline

Last Updated: January 13, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	0%
2017	0%
2018	0%
2019	0%
2020	1%
2021	1%
2022	1%
2023	1%
2024	1%
2025	2%
2026	2%
2027	3%
2028	4%
2029	5%
2030	7%
2031	8%



		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	0%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	5%	Market historical data unit shipment data from ENERGY STAR (https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives) suggest that ENERGY STAR market share is not moving and likely will not without outside intervention. SME input confirms that efficiency has leveled off.	We do not expect to update this value in future years.
Segment 1	Growth Rate*	slow	Market historical data unit shipment data from ENERGY STAR (https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives) suggest that ENERGY STAR market share is not moving and likely will not without outside intervention. SME input confirms that efficiency has leveled off.	We might increase the growth rate if the ENERGY STAR specification opens prior to the beginning of the next DOE regulatory cycle, and this accelerated schedule is not attributable to RPP advocacy.
Segment 1	End Year	2020	The DOE federal standards process expected to open in 2020. The start of the DOE regulatory cycle will end segment 1.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed opening of the DOE standard.
Segment 2	Maximum Market Penetration Potential	20%	In anticipation of a new standard, the market share could grow to a higher level. However, program data show that the unincentivized basic ENERGY STAR tier has less than 20% of the side-mounted freezer market share, so we expect the ESME market share to remain at or below this level.	If the non-incentivized basic ENERGY STAR tier gains significant market share, we might increase this value.
Segment 2	Growth Rate*	slow	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might increase the growth rate if a new ENERGY STAR specification becomes effective prior to the finalization of a new DOE standard, and this accelerated schedule is not attributable to RPP advocacy.
Segment 2	End Year	2026	We expect a new standard to go into effect in 2026.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed DOE effective date.
Segment 3	Maximum Market Penetration Potential	100%	With an updated DOE standard, we do not see a market share limit for the 2016 ESME level. A product subject matter expert confirms that there are no product subcategories which would be unable to reach the ESME 2016 level.	If a new feature or sub-category of side-mount freezer refrigerators arises that cannot meet ESME 2016, we might decrease this value.
Segment 3	Growth Rate*	slow	With an updated DOE standard and presumably an updated ENERGY STAR specification, we expect market share of the 2016 ESME level to increase. Because so few side-mount models currently meet the ESME level, we do not expect growth rates as high as the rates for bottom-mount or top-mount freezer units. A product subject matter expert confirms that the side-mount market is expected to improve more slowly than the top-mount and bottom-mount markets.	We might decrease the growth rate if the ENERGY STAR specification does not update at the time the new DOE standard goes into effect or the new DOE standard level is lower than anticipated.
Segment 3	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ESRPP Data

2015-2018 ESRPP Market Penetration from ESRPP Data in PG&E Territory

These inputs to the baselines come directly from the ESRPP sales data:

2016 Market Penetration of ENERGY STAR Most Efficient within the Bottom-Mount Configuration	2016 Market Penetration of ENERGY STAR Most Efficient within the Top-Mount Configuration	2016 Market Penetration of ENERGY STAR Most Efficient within the Side-Mount Configuration
2.7%	16.38%	0.32%

These distribution percentages come directly from the ESRPP sales data and can be used to determine the weighted average:

Market Share of the Bottom-Mount Configuration*	Market Share of the Top-Mount Configuration*	Market Share of the Side-Mount Configuration*
40.3%	38.97%	20.72%

* Market share is the market share among standard-size refrigerators.

Reference for the DOE's Refrigerator Product Classes:

1. Refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost

1A. All-refrigerators—manual defrost

2. Refrigerator-freezers—partial automatic defrost

3. Refrigerator-freezers—automatic defrost with top-mounted freezer without an automatic icemaker

3-BI. Built-in refrigerator-freezer—automatic defrost with top-mounted freezer without an automatic icemaker

3I. Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service

3I-BI. Built-in refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service

3A. All-refrigerators—automatic defrost

3A-BI. Built-in All-refrigerators—automatic defrost

4. Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker

4-BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker

4I. Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service

4I-BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service

5. Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker

5-BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker

5I. Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service

5I-BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service

5A. Refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service

5A-BI. Built-in refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service

6. Refrigerator-freezers—automatic defrost with top-mounted freezer with through-the-door ice service

7. Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service

7-BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service

11. Compact refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost

11A. Compact all-refrigerators—manual defrost

12. Compact refrigerator-freezers—partial automatic defrost

13. Compact refrigerator-freezers—automatic defrost with top-mounted freezer

13I. Compact refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker

13A. Compact all-refrigerators—automatic defrost

14. Compact refrigerator-freezers—automatic defrost with side-mounted freezer

14I. Compact refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker

15. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer

15I. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker

Growth Parameter Assumptions

	slow	medium	fast
p	0.006	0.012	0.031
q	0.130	0.255	0.335
p+q	0.136	0.267	0.366
start year	5	5	5

The growth parameters are quartiles of the naturally occurring market adoption (NOMAD) Bass curve parameters for evaluated federal and Title 20 standards (see "Evaluated NOMAD" section for complete list of standards and parameters). The p and q values express the rates of technology innovation and technology imitation, with higher values indicating greater innovation and higher levels of competition. The start year parameter describes the number of years (prior to the forecast start year) a technology has been commercially available to consumers.

For the p and q values, the "slow" values are the first quartile p and q across all evaluated standards, the "medium" values are the median across all evaluated standards, and the "fast" values are the third quartile. This is representative of evaluated NOMAD for appliance energy efficiency measures and enables a quantification of Bass curve parameters from qualitative assessments of the product rates of competition and innovation.

The start year for all three scenarios is the first quartile for all evaluated Title 20 standards. The first quartile was used because all ESRPP measure levels are based on the voluntary ENERGY STAR specifications, which are more stringent and forward-looking than the

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2005 T-20	Std 1	Commercial Refrigeration Equipment, Solid Door	1995	0.009	0.433
2005 T-20	Std 2	Commercial Refrigeration Equipment, Transparent Door	1995	0.002	0.507
2005 T-20	std 3	Commercial Ice Maker Equipment	1995	0.005	0.535
2005 T-20	std 4	Walk-In Refrigerators / Freezers	1995	0.011	0.248
2005 T-20	std 5	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2005 T-20	std 6	Large Packaged Commercial Air-Conditioners, Tier 1	1990	0.000	0.500
2005 T-20	std 7	Large Packaged Commercial Air-Conditioners, Tier 2	1990	0.000	0.353
2005 T-20	std 8	Residential Pool Pumps, High Eff Motor, Tier 1	1965	0.001	0.045
2006 T-20	std 9	Residential Pool Pumps, 2-speed Motors, Tier 2	1975	0.000	0.202
2005 T-20	std 10	Portable Electric Spas			
2005 T-20	std 11a	General Service Incandescent Lamps, Tier 1	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2010)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2011)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2012)	1970	0.000	0.213
2005 T-20	std 12a	Pulse Start Metal Halide HID Luminaires, Tier 1	1992	0.001	0.348
2005 T-20	std 12b	Pulse Start Metal Halide HID Luminaires, Tier 2	1992	0.001	0.348
2005 T-20	std 13	Modular Furniture Task Lighting Fixtures	2000	0.132	0.198
2005 T-20	std 14	Hot Food Holding Cabinets	2000	0.008	0.480
2005 T-20	std 15	External Power Supplies, Tier 1	2000	0.025	0.356
2005 T-20	std 16	External Power Supplies, Tier 2	2000	0.012	0.386
2005 T-20	std 17	Consumer Electronics - Audio Players	2000	0.040	0.431
2005 T-20	std 18a	Consumer Electronics - TVs	2000	0.054	0.503
2005 T-20	std 18b	Consumer Electronics - DVDs	2000	0.126	0.099
2005 T-20	std 19	Water Dispensers	2000	0.037	0.343
2005 T-20	std 20	Unit Heaters and Duct Furnaces	1965	0.007	0.097
2005 T-20	std 21	Commercial Dishwasher Pre-Rinse Spray Valves	2003	0.039	0.389
2006 T-20	std 22a	BR, ER and R20 Incandescent Reflector Lamps: Residential	2000	0.023	0.145
2006 T-20	std 22b	BR, ER and R20 Incandescent Reflector Lamps: Commercial	2000	0.023	0.145
2008 T-20	std 23	Metal Halide Fixtures	2000	0.003	0.366
2008 T-20	std 24	Portable Lighting Fixtures	2000	0.002	0.498
2008 T-20	std 25	General Purpose Lighting -- 100 watt	2000	0.004	0.346

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2008 T-20	std 26	General Purpose Lighting -- 75 watt	2000	0.007	0.294
2008 T-20	std 27	General Purpose Lighting -- 60 and 40 watt	2000	0.011	0.255
2008 T-20		General Service Lamps (EISA Phase 2)	2000	0.003	0.220
2009 T-20	std 28a	Televisions - Tier 1	2000	0.004	0.534
2009 T-20	std 28b	Televisions - Tier 2	2000	0.008	0.380
2011 T-20	Std 29	Small Battery Chargers - Tier 1 (consumer with no USB charger or USB charger <20 watt-ho	2000	0.007	0.321
	Std 30	Small Battery Chargers - Tier 2 (consumer with USB charger >=20 watt-hours)	2000	0.012	0.241
2011 T-20	Std 31	Small Battery Chargers - Tier 3 (non-consumer)	2000	0.004	0.263
2011 T-20	Std 32	Large Battery Chargers (>=2kW rated input)	2000	0.003	0.275
2010-12 Fed App	Fed 1	Electric Motors 1-200HP	2000	0.030	0.030
2010-12 Fed App	Fed 2	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2010-12 Fed App	Fed 3	Commercial Refrigeration	1995	0.008	0.360
	Fed 4	ASHRAE Products (Commercial boilers)	1965	0.007	0.097
2010-12 Fed App	Fed 5	Residential Electric & Gas Ranges	1965	0.007	0.097
2010-12 Fed App	Fed 6	Incandescent Reflector Lamps	2008	0.008	0.292
2010-12 Fed App	Fed 7	General Service Fluorescent Lamps	2000	0.010	0.330
2013-15 Fed App	Fed 8	Commercial Clothes Washers	1970	0.017	0.167
2013-15 Fed App	Fed 9	Residential Pool Heaters	1895	0.010	0.001
2013-15 Fed App	Fed 10	Residential Direct Heating Equipment	1950	0.065	0.168
2013-15 Fed App	Fed 11	Residential Refrigerators & Freezers	2005	0.011	0.247
2013-15 Fed App	Fed 12	Residential Room AC	2005	0.018	0.214
2013-15 Fed App	Fed 13	Fluorescent Ballasts	2000	0.014	0.173
2013-15 Fed App	Fed 14	Small Commercial Package Air-Conditioners >=65 and <135 kBtu/h	1980	0.100	0.001
2013-15 Fed App	Fed 15	Large and Very Large Commercial Package Air-Conditioners >=135 kBtu/h	1986	0.100	0.001
2013-15 Fed App	Fed 16	Computer Room Acs >=65,000 Btu/h and < 760,000 Btu/h	2005	0.700	0.020
2013-15 Fed App	Fed 17	Residential Dishwashers	1960	0.019	0.238
2013-15 Fed App	Fed 18	Residential Clothes Dryers	1970	0.047	0.107
2013-15 Fed App	Fed 19	Residential Gas-fired water heater	1915	0.005	0.020
2013-15 Fed App	Fed 20	Residential Electric storage water heater	1988	0.003	0.338
2013-15 Fed App	Fed 21	Residential Gas-fired instantaneous water heater	2015	1.000	1.000
2013-15 Fed App	Fed 22	Residential Oil-fired storage water heater	1988	0.050	0.002

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2013-15 Fed App	Fed 23	Small Electric Motors	2009	0.054	0.263
2013-15 Fed App	Fed 24	Residential Clothes Washers (Front Loading)	2015	0.031	0.152
2013-15 Fed App	Fed 25	Residential Clothes Washers (Top Loading) Tier I	2015	0.031	0.152
2013-15 Fed App	Fed 26	Residential Central AC, Heat Pumps and Furnaces	2003	0.011	0.222

Subject Matter Expert Input

QUESTION
1. Please describe your background, including the main organizations that you are and have been affiliated with, your role(s), and how many years you worked with each organization.
2. Can you give your best estimate of the current [energy efficiency measure level, e.g., ESME 2016] market share for California? What sources inform your estimate?
3. Are you aware of any differences between brick-and-mortar vs. online sales for [product]? Do you think that sales from the participating big-box ESRPP retailers are likely to be representative of the [product] market in California?
4. Are you aware of any upcoming technology innovations that would impact energy efficiency? Do you see major market barriers to their adoption?
5. Are there any major manufacturers that do not seem to be invested in incorporating energy efficiency into their products?
a. If yes: Would you predict changes in the current manufacturer market share distribution?

Subject Matter Expert Input

QUESTION
6. Are you aware of residential product subclasses (e.g., for washers, agitator top-loaders), applications, or size bins where you would expect very low (< 5%) market penetration at the measure level by 2030?
a. If yes: Would you predict changes in the current balance of market share for product subcategories?
b. If no: Would it be feasible without ESRPP or EPA intervention for market penetration at the measure level to reach ~100% by 2030?
7. Do you think that [energy efficiency measure level] products could eventually reach 100% saturation in the market? Why?
a. If no: Do you have an estimate for the maximum saturation level?
8. When would you expect to see 25% [energy efficiency measure level] market penetration? 50%? 75%?
9. Do you think the rate of innovation in the [product] market is roughly the same as it was 5 – 10 years ago, or has it increased/decreased?
10. Compared to 5 – 10 years ago, how likely do you think manufacturers are to imitate/proliferate EE innovations?

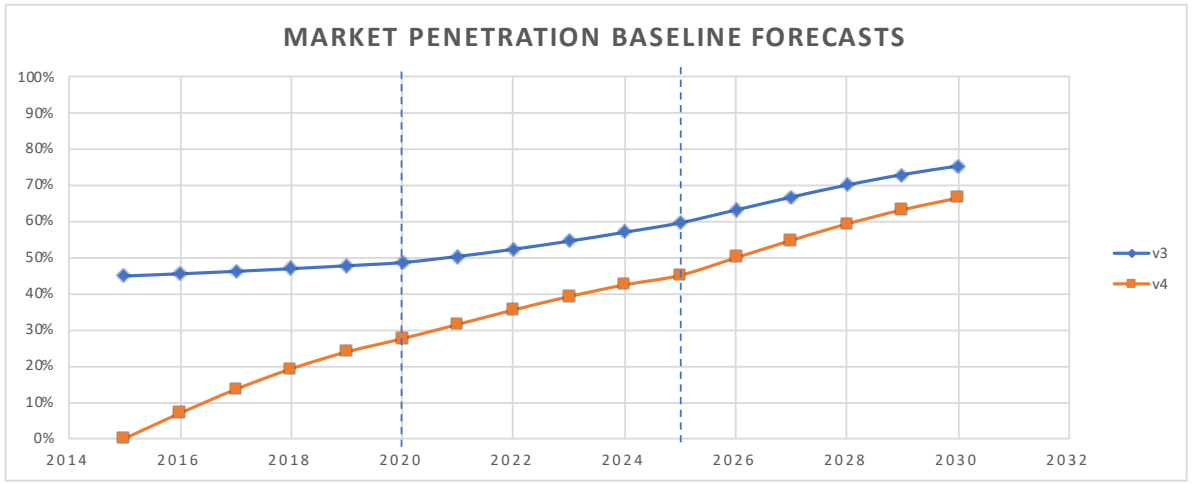
Subject Matter Expert Input

QUESTION
11. How do the current market barriers compare to the historical market barriers for meeting what is now the federal standard level?
12. What are the typical adoption trends (in terms of growth rates for efficient products) you observe when no DOE rulemaking is in effect, between adoption and the effective date, and shortly after the effective date? Do you forecast similar trends when the EPA specifications are revised?
13. For experts with insight into regulations: When do you expect major regulatory events (DOE rulemakings and/or EPA specification revisions) to occur for this product? Do you expect regulations to proceed according to the posted schedules?
14. For experts with insight into retail: When a code change or ENERGY STAR revision occurs, do retailers begin altering their stock and marketing when the change is announced, when the change becomes effective, or (for voluntary specifications) after the change becomes effective?
Interview Citations

Room AC Baseline Summary

Last Updated: January 30, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Baseline Market Share	
	ENERGY STAR v3	ENERGY STAR v4
2015	45%	0%
2016	45%	7%
2017	46%	14%
2018	47%	19%
2019	48%	24%
2020	49%	28%
2021	50%	32%
2022	52%	36%
2023	55%	39%
2024	57%	42%
2025	60%	45%
2026	63%	50%
2027	67%	55%
2028	70%	59%
2029	73%	63%
2030	75%	66%



How to interpret the charts in this document:

These charts represent the 15-year forecast of market penetration values of the program-qualifying ENERGY STAR v3 and ENERGY STAR v4 levels absent program intervention. The charts only show forecasts for the given measure levels and do not forecast market penetration for future revisions of ENERGY STAR.

Derivation:

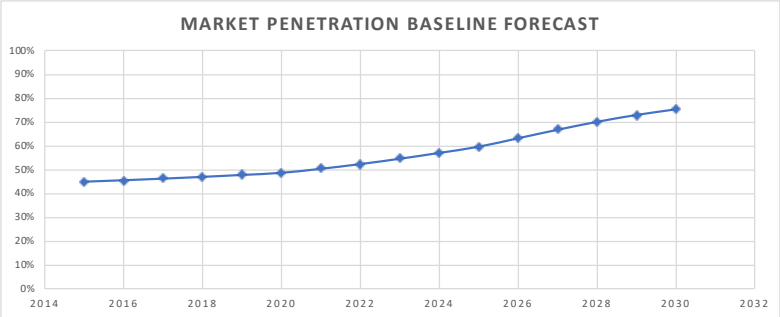
The baselines are calculated in segments, which are divided by significant non-program-related events such as changes to federal standards. For each segment, four key parameters describe the curve: the initial market share, the maximum potential market share, the qualitative growth rate, and the segment start and end years. The parameters are informed by the best available ESRPP program and market sales data alongside subject matter expert opinion. Since market conditions change over time, it is recommended that these charts are reviewed each year and updated as necessary to reflect changes in market conditions.

Contents:

ENERGY STAR v3 Room AC Baseline

Last Updated: January 10, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2015	45%
2016	45%
2017	46%
2018	47%
2019	48%
2020	49%
2021	50%
2022	52%
2023	55%
2024	57%
2025	60%
2026	63%
2027	67%
2028	70%
2029	73%
2030	75%



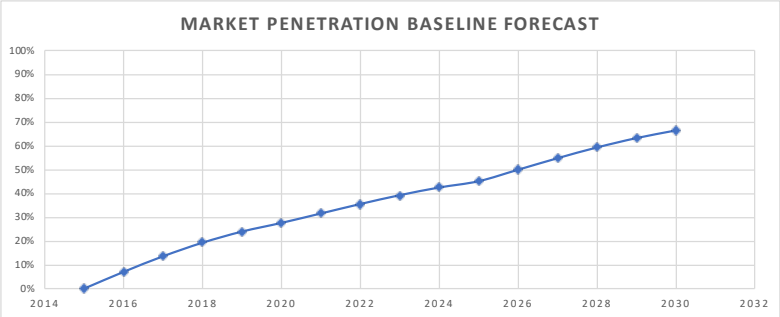
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2015	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	45%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	100%	After the new specification is effective, there is no obvious limitation on the maximum market potential.	If there remains a significant incremental cost between the lowest-cost DOE-compliant models and the ENERGY STAR v3 level, this value might be decreased.
	Growth Rate*	slow	Models qualifying for ENERGY STAR v4 had 0% of the market when the specification was introduced in 2015, and most manufacturers replaced v3 models with v4 models rather than adding v4 models to the existing product mix, so v3 and v4 market shares are expected to converge.	We do not expect to update this value in future years.
	End Year	2020	SME input suggests that the EPA will likely revise the ENERGY STAR specification to v5 within a few years. The effective date of the ENERGY STAR v5 specification will end segment 1.	If the effective date of a new ENERGY STAR specification does not occur in 2020, this value should be amended to reflect the actual effective date.
Segment 2	Maximum Market Penetration Potential	100%	After the new specification is effective, there is no obvious limitation on the maximum market potential.	If there remains a significant incremental cost between the lowest-cost DOE-compliant models and the ENERGY STAR v3 level, this value might be decreased.
	Growth Rate*	medium	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement. However, without a DOE specification change, it is unclear whether market share of v3 will be significantly affected, because SMEs indicate that manufacturers prefer to design to minimally meet a code or current specification level.	We might decrease the growth rate if manufacturers drop v3 and/or v4 models to introduce v5 models.
	End Year	2025	We expect a new standard to go into effect in 2025. The effective date of the DOE regulatory cycle will end segment 2.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed effective date.
Segment 3	Maximum Market Penetration Potential	100%	After the new standard is effective, there is no obvious limitation on the maximum market potential.	If there remains a significant incremental cost between the lowest-cost DOE-compliant models and the ENERGY STAR v3 level, this value might be decreased.
	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might decrease the growth rate if the new DOE standard level is lower than the ENERGY STAR v3 level.
	End Year	2030	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR v4 Room AC Baseline

Last Updated: January 10, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2015	0%
2016	7%
2017	14%
2018	19%
2019	24%
2020	28%
2021	32%
2022	36%
2023	39%
2024	42%
2025	45%
2026	50%
2027	55%
2028	59%
2029	63%
2030	66%



		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2015	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	0%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	73%	Multiple SMEs noted that there is a niche for low-cost models without regard to EE, and the Navigant SME suggested that small-capacity units would make up most of this market. In the ESRPP sales, product class 1 (the smallest-capacity class) has almost no sales of v4 units.	We do not expect to update this value in future years.
Segment 1	Growth Rate*	fast	The v4 specification was became effective in 2015, and manufacturer participation in the ENERGY STAR program required introduction of models qualifying for v4.	We do not expect to update this value in future years.
Segment 1	End Year	2020	SME input suggests that the EPA will likely revise the ENERGY STAR specification to v5 within a few years. The effective date of the ENERGY STAR v5 specification will end segment 1.	If the effective date of a new ENERGY STAR specification does not occur in 2020, this value should be amended to reflect the actual effective date.
Segment 2	Maximum Market Penetration Potential	73%	Multiple SMEs noted that there is a niche for low-cost models without regard to EE, and the Navigant SME suggested that small-capacity units would make up most of this market. In the ESRPP sales, product class 1 (the smallest-capacity class) has almost no sales of v4 units.	If the incremental cost of meeting ENERGY STAR v4 declines for small-capacity room ACs, we might increase this value.
Segment 2	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement, and this segment begins with an ENERGY STAR revision.	We might decrease the growth rate if manufacturers drop v4 models to introduce v5 models.
Segment 2	End Year	2025	We expect a new standard to go into effect in 2025. The effective date of the DOE regulatory cycle will end segment 2.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed effective date.
Segment 3	Maximum Market Penetration Potential	100%	After the new standard is effective, there is no obvious limitation on the maximum market potential.	If there remains a significant incremental cost between the lowest-cost DOE-compliant models and the ENERGY STAR v4 level, this value might be decreased.
Segment 3	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement, and this segment begins with a DOE standard update.	We might decrease the growth rate if the new DOE standard level is lower than the ENERGY STAR v3 level.
Segment 3	End Year	2030	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ESRPP Data

2015 - 2018 ESRPP Market Penetration from ESRPP Data in PG&E Territory

These inputs to the baselines come directly from the ESRPP sales data:

2015 Market Penetration of ENERGY STAR v3	2015 Market Penetration of ENERGY STAR v4	Market Share of Product Class 1 (2015-2018)	v4 Market Penetration within Product Class 1 (2015-2018)
44.9%	0.00%	27.33%	0.01%

Description of DOE Product Class 1:

Without reverse cycle, with louvered sides, and less than 6,000 Btu/h

Growth Parameter Assumptions

	slow	medium	fast
p	0.006	0.012	0.031
q	0.130	0.255	0.335
p+q	0.136	0.267	0.366
start year	5	5	5

The growth parameters are quartiles of the naturally occurring market adoption (NOMAD) Bass curve parameters for evaluated federal and Title 20 standards (see "Evaluated NOMAD" section for complete list of standards and parameters). The p and q values express the rates of technology innovation and technology imitation, with higher values indicating greater innovation and higher levels of competition. The start year parameter describes the number of years (prior to the forecast start year) a technology has been commercially available to consumers.

For the p and q values, the "slow" values are the first quartile p and q across all evaluated standards, the "medium" values are the median across all evaluated standards, and the "fast" values are the third quartile. This is representative of evaluated NOMAD for appliance energy efficiency measures and enables a quantification of Bass curve parameters from qualitative assessments of the product rates of competition and innovation.

The start year for all three scenarios is the first quartile for all evaluated Title 20 standards. The first quartile was used because all ESRPP measure levels are based on the voluntary ENERGY STAR specifications, which are more stringent and forward-looking than the

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2005 T-20	Std 1	Commercial Refrigeration Equipment, Solid Door	1995	0.009	0.433
2005 T-20	Std 2	Commercial Refrigeration Equipment, Transparent Door	1995	0.002	0.507
2005 T-20	std 3	Commercial Ice Maker Equipment	1995	0.005	0.535
2005 T-20	std 4	Walk-In Refrigerators / Freezers	1995	0.011	0.248
2005 T-20	std 5	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2005 T-20	std 6	Large Packaged Commercial Air-Conditioners, Tier 1	1990	0.000	0.500
2005 T-20	std 7	Large Packaged Commercial Air-Conditioners, Tier 2	1990	0.000	0.353
2005 T-20	std 8	Residential Pool Pumps, High Eff Motor, Tier 1	1965	0.001	0.045
2006 T-20	std 9	Residential Pool Pumps, 2-speed Motors, Tier 2	1975	0.000	0.202
2005 T-20	std 10	Portable Electric Spas			
2005 T-20	std 11a	General Service Incandescent Lamps, Tier 1	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2010)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2011)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2012)	1970	0.000	0.213
2005 T-20	std 12a	Pulse Start Metal Halide HID Luminaires, Tier 1	1992	0.001	0.348
2005 T-20	std 12b	Pulse Start Metal Halide HID Luminaires, Tier 2	1992	0.001	0.348
2005 T-20	std 13	Modular Furniture Task Lighting Fixtures	2000	0.132	0.198
2005 T-20	std 14	Hot Food Holding Cabinets	2000	0.008	0.480
2005 T-20	std 15	External Power Supplies, Tier 1	2000	0.025	0.356
2005 T-20	std 16	External Power Supplies, Tier 2	2000	0.012	0.386
2005 T-20	std 17	Consumer Electronics - Audio Players	2000	0.040	0.431
2005 T-20	std 18a	Consumer Electronics - TVs	2000	0.054	0.503
2005 T-20	std 18b	Consumer Electronics - DVDs	2000	0.126	0.099
2005 T-20	std 19	Water Dispensers	2000	0.037	0.343
2005 T-20	std 20	Unit Heaters and Duct Furnaces	1965	0.007	0.097
2005 T-20	std 21	Commercial Dishwasher Pre-Rinse Spray Valves	2003	0.039	0.389
2006 T-20	std 22a	BR, ER and R20 Incandescent Reflector Lamps: Residential	2000	0.023	0.145
2006 T-20	std 22b	BR, ER and R20 Incandescent Reflector Lamps: Commercial	2000	0.023	0.145
2008 T-20	std 23	Metal Halide Fixtures	2000	0.003	0.366
2008 T-20	std 24	Portable Lighting Fixtures	2000	0.002	0.498
2008 T-20	std 25	General Purpose Lighting -- 100 watt	2000	0.004	0.346

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2008 T-20	std 26	General Purpose Lighting -- 75 watt	2000	0.007	0.294
2008 T-20	std 27	General Purpose Lighting -- 60 and 40 watt	2000	0.011	0.255
2008 T-20		General Service Lamps (EISA Phase 2)	2000	0.003	0.220
2009 T-20	std 28a	Televisions - Tier 1	2000	0.004	0.534
2009 T-20	std 28b	Televisions - Tier 2	2000	0.008	0.380
2011 T-20	Std 29	Small Battery Chargers - Tier 1 (consumer with no USB charger or USB charger <20 watt-ho	2000	0.007	0.321
	Std 30	Small Battery Chargers - Tier 2 (consumer with USB charger >=20 watt-hours)	2000	0.012	0.241
2011 T-20	Std 31	Small Battery Chargers - Tier 3 (non-consumer)	2000	0.004	0.263
2011 T-20	Std 32	Large Battery Chargers (>=2kW rated input)	2000	0.003	0.275
2010-12 Fed App	Fed 1	Electric Motors 1-200HP	2000	0.030	0.030
2010-12 Fed App	Fed 2	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2010-12 Fed App	Fed 3	Commercial Refrigeration	1995	0.008	0.360
	Fed 4	ASHRAE Products (Commercial boilers)	1965	0.007	0.097
2010-12 Fed App	Fed 5	Residential Electric & Gas Ranges	1965	0.007	0.097
2010-12 Fed App	Fed 6	Incandescent Reflector Lamps	2008	0.008	0.292
2010-12 Fed App	Fed 7	General Service Fluorescent Lamps	2000	0.010	0.330
2013-15 Fed App	Fed 8	Commercial Clothes Washers	1970	0.017	0.167
2013-15 Fed App	Fed 9	Residential Pool Heaters	1895	0.010	0.001
2013-15 Fed App	Fed 10	Residential Direct Heating Equipment	1950	0.065	0.168
2013-15 Fed App	Fed 11	Residential Refrigerators & Freezers	2005	0.011	0.247
2013-15 Fed App	Fed 12	Residential Room AC	2005	0.018	0.214
2013-15 Fed App	Fed 13	Fluorescent Ballasts	2000	0.014	0.173
2013-15 Fed App	Fed 14	Small Commercial Package Air-Conditioners >=65 and <135 kBtu/h	1980	0.100	0.001
2013-15 Fed App	Fed 15	Large and Very Large Commercial Package Air-Conditioners >=135 kBtu/h	1986	0.100	0.001
2013-15 Fed App	Fed 16	Computer Room Acs >=65,000 Btu/h and < 760,000 Btu/h	2005	0.700	0.020
2013-15 Fed App	Fed 17	Residential Dishwashers	1960	0.019	0.238
2013-15 Fed App	Fed 18	Residential Clothes Dryers	1970	0.047	0.107
2013-15 Fed App	Fed 19	Residential Gas-fired water heater	1915	0.005	0.020
2013-15 Fed App	Fed 20	Residential Electric storage water heater	1988	0.003	0.338
2013-15 Fed App	Fed 21	Residential Gas-fired instantaneous water heater	2015	1.000	1.000
2013-15 Fed App	Fed 22	Residential Oil-fired storage water heater	1988	0.050	0.002

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2013-15 Fed App	Fed 23	Small Electric Motors	2009	0.054	0.263
2013-15 Fed App	Fed 24	Residential Clothes Washers (Front Loading)	2015	0.031	0.152
2013-15 Fed App	Fed 25	Residential Clothes Washers (Top Loading) Tier I	2015	0.031	0.152
2013-15 Fed App	Fed 26	Residential Central AC, Heat Pumps and Furnaces	2003	0.011	0.222

Subject Matter Expert Input

QUESTION	SME Responses
1. Please describe your background, including the main organizations that you are and have been affiliated with, your role(s), and how many years you worked with each organization.	3 years experience in HVAC product development, 4 years experience with AHAM, 3 years experience consulting for EPA ENERGY STAR 25 years experience with Nationwide's marketing, 20 years experience outside of Nationwide as a buyer or sales manager 8 years experience consulting to support DOE rulemakings 3 years experience with Home Depot, 9 years experience with Ecova 12 years experience in market analysis; 15 years experience in energy efficiency; 18 years experience in product development and energy efficiency
2. Can you give your best estimate of the current [energy efficiency measure level, e.g., ESME 2016] market share for California? What sources inform your estimate?	Cited EPA Unit Shipment Data, noted that the California ESRPP sales are mostly representative of overall California sales (though they are not necessarily nationally representative). See the ESRPP sales, understanding the fraction of the market that RPP makes up using data from AHAM. Other SMEs did not make an estimate.
3. Are you aware of any differences between brick-and-mortar vs. online sales for [product]? Do you think that sales from the participating big-box RPP retailers are likely to be representative of the [product] market in California?	Not sure, though room ACs are readily available through both streams. PG&E ESRPP sales are likely generally representative and are a significant portion of the California sales. Nationwide and big-box retailers cover more than 80%, and there aren't significant online sales of room ACs. Not sure. We assume the ESRPP sales are representative.
4. Are you aware of any upcoming technology innovations that would impact energy efficiency? Do you see major market barriers to their adoption?	There are new EPA Emerging Technology Award (https://www.energystar.gov/about/awards/energy-star-emerging-technology-award) winning variable-speed models, ~35% better than DOE. This is a leap forward in efficiency compared to the ~10-12% that most ENERGY STAR models typically have been. There are other manufacturers who make variable-speed but haven't brought it to the US. Manufacturers able to produce these products already have a significant portion of the market. There are no IP issues. The reason variable-speed (compressors and motors) are now available in Room AC is because the technology is now physically small enough to fit in the constraints of a Room AC chassis. This tech does cost a little more, but every indication is it will continue to grow in the market. I do not track the technology components at all. Variable-speed compressors are slowly beginning to enter the room AC market. As variable-speed compressors become more sized for this application, they will be brought into premier products. The technology is not manufacturer-specific or proprietary. Variable-speed/inverter compressors There's constant change, but I'm not aware of anything specific.
5. Are there any major manufacturers that do not seem to be invested in incorporating energy efficiency into their products?	No one's going out of their way to not make ENERGY STAR products Manufacturers aim to hit minimum standards for DOE compliance or ENERGY STAR, and the federal administration's deregulation approach enables manufacturers to take an approach separate from engagement. Other SMEs did not list manufacturers that limit EE.
a. If yes: Would you predict changes in the current manufacturer market share distribution?	-
6. Are you aware of residential product subclasses (e.g., for washers, agitator top-loaders), applications, or size bins where you would expect very low (< 5%) market penetration at the measure level by 2030?	There will always be some products that aim to fill the lowest-cost niche without EE as a concern. Other SMEs did not list subclasses that limit EE.

Subject Matter Expert Input

QUESTION	SME Responses
a. If yes: Would you predict changes in the current balance of market share for product subcategories?	No changes predicted
b. If no: Would it be feasible without RPP or EPA intervention for market penetration at the measure level to reach ~100% by 2030?	No Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR. It could be possible without RPP intervention, but DOE and EPA intervention would be needed. Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE.
7. Do you think that [energy efficiency measure level] products could eventually reach 100% saturation in the market? Why?	Across all products, 100% won't happen within the timeline forecast unless DOE or States set the current ENERGY STAR level (or ESRPP basic tier level) as a mandatory minimum. Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. It's technically feasible as long as there are ENERGY STAR models for all product classes, but we should not expect that the incremental cost will be warranted for all products or occur naturally. It could be possible without RPP intervention, but DOE and EPA intervention would be needed. Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR.
a. If no: Do you have an estimate for the maximum saturation level?	No estimates
8. When would you expect to see 25% [energy efficiency measure level] market penetration? 50%? 75%?	If there is an ENERGY STAR revision in 2020, the market share of v4 could reach 50% in 2022. Other SMEs did not make an estimate.
9. Do you think the rate of innovation in the [product] market is roughly the same as it was 5 – 10 years ago, or has it increased/decreased?	Similar to 5 - 10 years ago Innovation seems to be driven mostly by economic growth and health, and has definitely increased over the past 5 years. There was an uptick during the previous federal administration when they increased R&D funding. In the past, there were many incremental improvements, and although there remain various methods to improve efficiency, one key innovation to improve efficiency is implementing a variable-speed compressor.
10. Compared to 5 – 10 years ago, how likely do you think manufacturers are to imitate/proliferate EE innovations?	There are only a few OEMs and therefore there is very little competition, but innovation will have an immediate presence on the market since most OEMs have a significant market share. Similar to 5 - 10 years ago Variable-speed compressors are likely to be adopted by more manufacturers in the future.
11. How do the current market barriers compare to the historical market barriers for meeting what is now the federal standard level?	The increasing changes in the retailer landscape may cause some EE promoting retailers to shift their priorities, which could limit an ally for overcoming barriers in the past. For room ACs, capacity is the consumer's first consideration, followed by price. EE is only considered after capacity and price.

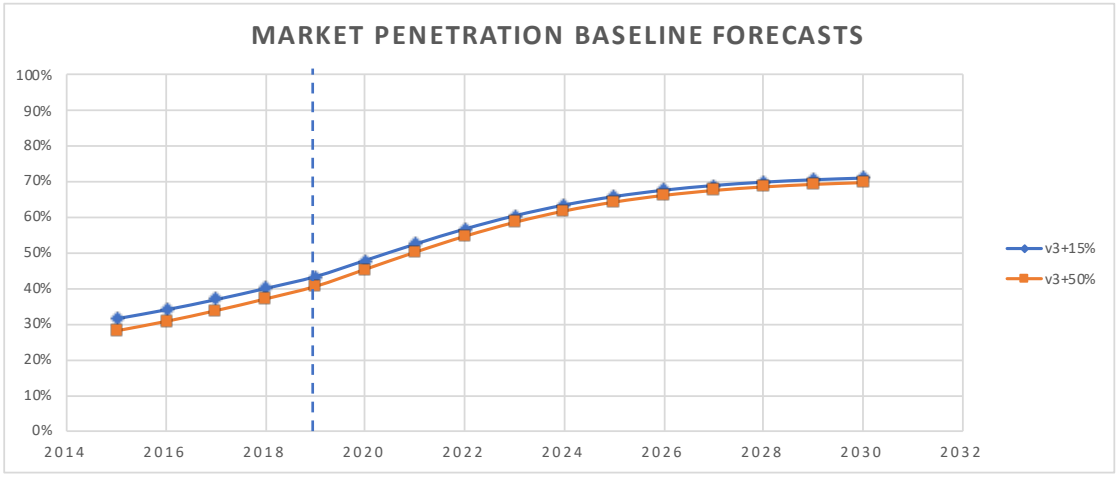
Subject Matter Expert Input

QUESTION	SME Responses
12. What are the typical adoption trends (in terms of growth rates for efficient products) you observe when no DOE rulemaking is in effect, between adoption and the effective date, and shortly after the effective date? Do you forecast similar trends when the EPA specifications are revised?	What helps drive efficiency is either if it has other features for consumers or if there were product redesigns happening for other reasons. There are also some other drivers, e.g., EPA's SNAP rule will require a refrigerant update across all lines. If products are federally regulated, there's always a tendency to go more efficient during a redesign if possible. For products that aren't federally regulated, increasing efficiency would not be a primary driver during a product redesign. Manufacturers will develop products with features to help sell a product and any increase in efficiency as part of a redesign is likely an ancillary benefit. In general, if building managers are buying appliances in bulk, efficiency will likely be a consumer preference. If efficiency is a way to differentiate their products from competitors, that's something that companies will use to sell it and maybe leading to moderate market share growth. Another driver in the market is consolidation (in manufacturers, product lines, suppliers, or other), which could drive efficiency one way or another. There is manufacturer resistance to quicker-than-planned change due to sunk costs on capital investments. There's a little bit of growth even when there's no regulation. Adoption does not typically grow significantly in the absence of regulations. We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs. I need to be thinking a year in advance. The baseline market adoption assumes minimal growth. Growth starts with either a new ENERGY STAR specification or the federal government opening their rulemaking process.
13. For experts with insight into regulations: When do you expect major regulatory events (DOE rulemakings and/or EPA specification revisions) to occur for this product? Do you expect regulations to proceed according to the posted schedules?	Cited the Fall 2018 Unified Agenda of Regulatory and Deregulatory Actions for DOE: https://www.reginfo.gov/public/do/eAgendaMain?operation=OPERATION_GET_AGENCY_RULE_LIST&currentPub=true&agencyCode=&showStage=active&agencyCd=1900&Image58.x=68&Image58.y=7. EPA typically revises when the market share is high enough. DOE's regulatory efforts for room ACs are summarized on the Building Technologies Office website: https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=52&action=viewlive. NEEA models predict a new ENERGY STAR specification in 2020 and a new DOE standard effective in 2025.
14. For experts with insight into retail: When a code change or ENERGY STAR revision occurs, do retailers begin altering their stock and marketing when the change is announced, when the change becomes effective, or (for voluntary specifications) after the change becomes effective?	We try to be ready around the time of the effective date, maybe a little earlier for DOE, maybe a little after the effective date for ENERGY STAR. We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs.
Interview Citations	Christianson, A. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Leritz, N. December 20, 2018 Phone interview with T. Kisch. Leybourn, S. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Singerman, N. December 17, 2018. Phone interview with A. Mytelka. Steinhoff, C. and Moran, D. June 5, 2018. Phone interview with A. Mytelka and T. Kisch. Weinberg, R. December 10, 2018. Phone interview with A. Mytelka and T. Kisch.

Sound Bar Baseline Summary

Last Updated: January 30, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Baseline Market Share	
	ENERGY STAR v3+15%	ENERGY STAR v3+50%
2015	31%	28%
2016	34%	31%
2017	37%	34%
2018	40%	37%
2019	43%	41%
2020	48%	45%
2021	52%	50%
2022	57%	55%
2023	60%	59%
2024	63%	62%
2025	66%	64%
2026	68%	66%
2027	69%	67%
2028	70%	68%
2029	70%	69%
2030	71%	70%



How to interpret the charts in this document:

These charts represent the 15-year statewide forecast of market penetration values of the program-qualifying ENERGY STAR v3+15% and ENERGY STAR v3+50% levels absent program intervention. The charts only show forecasts for the given measure levels and do not forecast market penetration for future revisions of ENERGY STAR. Caveat: the sound bar statewide baselines may be less reliable than baselines for other ESRPP products given the significant online sales for this product, which might have sales trends distinct from the trends seen in ESRPP retailers.

Derivation:

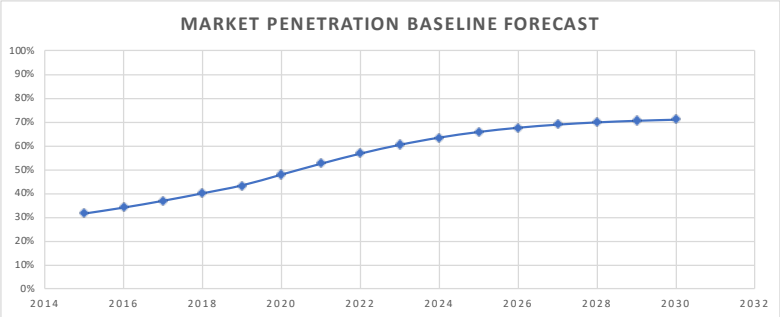
The baselines are calculated in segments, which are divided by significant non-program-related events such as changes to federal standards. For each segment, four key parameters describe the curve: the initial market share, the maximum potential market share, the qualitative growth rate, and the segment start and end years. The parameters are informed by the best available ESRPP program and market sales data alongside subject matter expert opinion. Since market conditions change over time, it is recommended that these charts are reviewed each year and updated as necessary to reflect changes in market conditions.

Contents:

ENERGY STAR v3+15% Sound Bar Baseline

Last Updated: January 11, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2015	31%
2016	34%
2017	37%
2018	40%
2019	43%
2020	48%
2021	52%
2022	57%
2023	60%
2024	63%
2025	66%
2026	68%
2027	69%
2028	70%
2029	70%
2030	71%



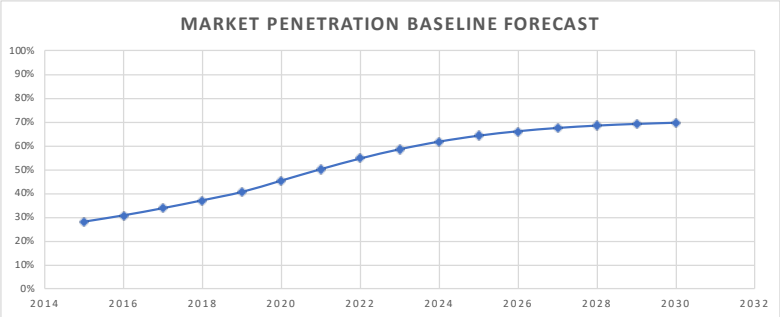
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2015	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	31%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	95%	NEEA SMEs indicate that ENERGY STAR cannot reach products with subwoofers, which are roughly 5% of the market.	If an incremental cost study shows a significant cost to ENERGY STAR v3, this value might be decreased.
Segment 1	Growth Rate*	medium	SME input suggests that innovation in consumer electronics is largely driven by economic health and has significantly increased over the past 5 years.	We do not expect to update this value in future years.
Segment 1	End Year	2019	SME input suggests that the EPA will likely revise the ENERGY STAR specification to v4 soon, given that the revision process is already ongoing. The effective date of the ENERGY STAR v4 specification will end segment 1.	If the effective date of a new ENERGY STAR specification does not occur in 2019, this value should be amended to reflect the actual effective date.
Segment 2	Maximum Market Penetration Potential	95%	NEEA SMEs indicate that ENERGY STAR cannot reach products with subwoofers, which are roughly 5% of the market.	If an incremental cost study shows a significant cost to ENERGY STAR v3, this value might be decreased.
Segment 2	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement, and this segment starts with an ENERGY STAR update.	We might decrease the growth rate if manufacturers focus less on the v3 EE metrics after the new specification is released, given that the new specification is expected to provide a more comprehensive account of energy consumption.
Segment 2	End Year	2030	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR v3+50% Sound Bar Baseline

Last Updated: January 11, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2015	28%
2016	31%
2017	34%
2018	37%
2019	41%
2020	45%
2021	50%
2022	55%
2023	59%
2024	62%
2025	64%
2026	66%
2027	67%
2028	68%
2029	69%
2030	70%



		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2015	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	28%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	95%	NEEA SMEs indicate that ENERGY STAR cannot reach products with subwoofers, which are roughly 5% of the market.	If an incremental cost study shows a significant cost to ENERGY STAR v3, this value might be decreased.
Segment 1	Growth Rate*	medium	SME input suggests that innovation in consumer electronics is largely driven by economic health and has significantly increased over the past 5 years.	We do not expect to update this value in future years.
Segment 1	End Year	2019	SME input suggests that the EPA will likely revise the ENERGY STAR specification to v4 soon, given that the revision process is already ongoing. The effective date of the ENERGY STAR v4 specification will end segment 1.	If the effective date of a new ENERGY STAR specification does not occur in 2019, this value should be amended to reflect the actual effective date.
Segment 2	Maximum Market Penetration Potential	95%	NEEA SMEs indicate that ENERGY STAR cannot reach products with subwoofers, which are roughly 5% of the market.	If an incremental cost study shows a significant cost to ENERGY STAR v3, this value might be decreased.
Segment 2	Growth Rate*	fast	Product subject matter experts note that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement, and this segment starts with an ENERGY STAR update.	We might decrease the growth rate if manufacturers focus less on the v3 EE metrics after the new specification is released, given that the new specification is expected to provide a more comprehensive account of energy consumption.
Segment 2	End Year	2030	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ESRPP Data

2015 ESRPP Market Penetration from ESRPP Data in PG&E Territory

These inputs to the baselines come directly from the ESRPP sales data:

2015 Market Penetration of ENERGY STAR v3+15%	2015 Market Penetration of ENERGY STAR v3+50%
31.5%	28.11%

Growth Parameter Assumptions

	slow	medium	fast
p	0.006	0.012	0.031
q	0.130	0.255	0.335
p+q	0.136	0.267	0.366
start year	5	5	5

The growth parameters are quartiles of the naturally occurring market adoption (NOMAD) Bass curve parameters for evaluated federal and Title 20 standards (see "Evaluated NOMAD" section for complete list of standards and parameters). The p and q values express the rates of technology innovation and technology imitation, with higher values indicating greater innovation and higher levels of competition. The start year parameter describes the number of years (prior to the forecast start year) a technology has been commercially available to consumers.

For the p and q values, the "slow" values are the first quartile p and q across all evaluated standards, the "medium" values are the median across all evaluated standards, and the "fast" values are the third quartile. This is representative of evaluated NOMAD for appliance energy efficiency measures and enables a quantification of Bass curve parameters from qualitative assessments of the product rates of competition and innovation.

The start year for all three scenarios is the first quartile for all evaluated Title 20 standards. The first quartile was used because all ESRPP measure levels are based on the voluntary ENERGY STAR specifications, which are more stringent and forward-looking than the

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2005 T-20	Std 1	Commercial Refrigeration Equipment, Solid Door	1995	0.009	0.433
2005 T-20	Std 2	Commercial Refrigeration Equipment, Transparent Door	1995	0.002	0.507
2005 T-20	std 3	Commercial Ice Maker Equipment	1995	0.005	0.535
2005 T-20	std 4	Walk-In Refrigerators / Freezers	1995	0.011	0.248
2005 T-20	std 5	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2005 T-20	std 6	Large Packaged Commercial Air-Conditioners, Tier 1	1990	0.000	0.500
2005 T-20	std 7	Large Packaged Commercial Air-Conditioners, Tier 2	1990	0.000	0.353
2005 T-20	std 8	Residential Pool Pumps, High Eff Motor, Tier 1	1965	0.001	0.045
2006 T-20	std 9	Residential Pool Pumps, 2-speed Motors, Tier 2	1975	0.000	0.202
2005 T-20	std 10	Portable Electric Spas			
2005 T-20	std 11a	General Service Incandescent Lamps, Tier 1	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2010)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2011)	1970	0.000	0.213
2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2012)	1970	0.000	0.213
2005 T-20	std 12a	Pulse Start Metal Halide HID Luminaires, Tier 1	1992	0.001	0.348
2005 T-20	std 12b	Pulse Start Metal Halide HID Luminaires, Tier 2	1992	0.001	0.348
2005 T-20	std 13	Modular Furniture Task Lighting Fixtures	2000	0.132	0.198
2005 T-20	std 14	Hot Food Holding Cabinets	2000	0.008	0.480
2005 T-20	std 15	External Power Supplies, Tier 1	2000	0.025	0.356
2005 T-20	std 16	External Power Supplies, Tier 2	2000	0.012	0.386
2005 T-20	std 17	Consumer Electronics - Audio Players	2000	0.040	0.431
2005 T-20	std 18a	Consumer Electronics - TVs	2000	0.054	0.503
2005 T-20	std 18b	Consumer Electronics - DVDs	2000	0.126	0.099
2005 T-20	std 19	Water Dispensers	2000	0.037	0.343
2005 T-20	std 20	Unit Heaters and Duct Furnaces	1965	0.007	0.097
2005 T-20	std 21	Commercial Dishwasher Pre-Rinse Spray Valves	2003	0.039	0.389
2006 T-20	std 22a	BR, ER and R20 Incandescent Reflector Lamps: Residential	2000	0.023	0.145
2006 T-20	std 22b	BR, ER and R20 Incandescent Reflector Lamps: Commercial	2000	0.023	0.145
2008 T-20	std 23	Metal Halide Fixtures	2000	0.003	0.366
2008 T-20	std 24	Portable Lighting Fixtures	2000	0.002	0.498
2008 T-20	std 25	General Purpose Lighting -- 100 watt	2000	0.004	0.346

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2008 T-20	std 26	General Purpose Lighting -- 75 watt	2000	0.007	0.294
2008 T-20	std 27	General Purpose Lighting -- 60 and 40 watt	2000	0.011	0.255
2008 T-20		General Service Lamps (EISA Phase 2)	2000	0.003	0.220
2009 T-20	std 28a	Televisions - Tier 1	2000	0.004	0.534
2009 T-20	std 28b	Televisions - Tier 2	2000	0.008	0.380
2011 T-20	Std 29	Small Battery Chargers - Tier 1 (consumer with no USB charger or USB charger <20 watt-ho	2000	0.007	0.321
	Std 30	Small Battery Chargers - Tier 2 (consumer with USB charger >=20 watt-hours)	2000	0.012	0.241
2011 T-20	Std 31	Small Battery Chargers - Tier 3 (non-consumer)	2000	0.004	0.263
2011 T-20	Std 32	Large Battery Chargers (>=2kW rated input)	2000	0.003	0.275
2010-12 Fed App	Fed 1	Electric Motors 1-200HP	2000	0.030	0.030
2010-12 Fed App	Fed 2	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2010-12 Fed App	Fed 3	Commercial Refrigeration	1995	0.008	0.360
	Fed 4	ASHRAE Products (Commercial boilers)	1965	0.007	0.097
2010-12 Fed App	Fed 5	Residential Electric & Gas Ranges	1965	0.007	0.097
2010-12 Fed App	Fed 6	Incandescent Reflector Lamps	2008	0.008	0.292
2010-12 Fed App	Fed 7	General Service Fluorescent Lamps	2000	0.010	0.330
2013-15 Fed App	Fed 8	Commercial Clothes Washers	1970	0.017	0.167
2013-15 Fed App	Fed 9	Residential Pool Heaters	1895	0.010	0.001
2013-15 Fed App	Fed 10	Residential Direct Heating Equipment	1950	0.065	0.168
2013-15 Fed App	Fed 11	Residential Refrigerators & Freezers	2005	0.011	0.247
2013-15 Fed App	Fed 12	Residential Room AC	2005	0.018	0.214
2013-15 Fed App	Fed 13	Fluorescent Ballasts	2000	0.014	0.173
2013-15 Fed App	Fed 14	Small Commercial Package Air-Conditioners >=65 and <135 kBtu/h	1980	0.100	0.001
2013-15 Fed App	Fed 15	Large and Very Large Commercial Package Air-Conditioners >=135 kBtu/h	1986	0.100	0.001
2013-15 Fed App	Fed 16	Computer Room Acs >=65,000 Btu/h and < 760,000 Btu/h	2005	0.700	0.020
2013-15 Fed App	Fed 17	Residential Dishwashers	1960	0.019	0.238
2013-15 Fed App	Fed 18	Residential Clothes Dryers	1970	0.047	0.107
2013-15 Fed App	Fed 19	Residential Gas-fired water heater	1915	0.005	0.020
2013-15 Fed App	Fed 20	Residential Electric storage water heater	1988	0.003	0.338
2013-15 Fed App	Fed 21	Residential Gas-fired instantaneous water heater	2015	1.000	1.000
2013-15 Fed App	Fed 22	Residential Oil-fired storage water heater	1988	0.050	0.002

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Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2013-15 Fed App	Fed 23	Small Electric Motors	2009	0.054	0.263
2013-15 Fed App	Fed 24	Residential Clothes Washers (Front Loading)	2015	0.031	0.152
2013-15 Fed App	Fed 25	Residential Clothes Washers (Top Loading) Tier I	2015	0.031	0.152
2013-15 Fed App	Fed 26	Residential Central AC, Heat Pumps and Furnaces	2003	0.011	0.222

Subject Matter Expert Input

QUESTION	
1. Please describe your background, including the main organizations that you are and have been affiliated with, your role(s), and how many years you worked with each organization.	3 years experience in HVAC product development, 4 years experience with AHAM, 3 years experience consulting for EPA ENERGY STAR 12 years experience in market analysis; 15 years experience in energy efficiency; 18 years experience in product development and energy efficiency 25 years experience with Nationwide's marketing, 20 years experience outside of Nationwide as a buyer or sales manager
2. Can you give your best estimate of the current [energy efficiency measure level, e.g., ESME 2016] market share for California? What sources inform your estimate?	Cited EPA Unit Shipment Data, noted that the California ESRPP sales are mostly representative of overall California sales (though they are not necessarily nationally representative). See the ESRPP sales, understanding the fraction of the market that ESRPP makes up using data from NPD.
3. Are you aware of any differences between brick-and-mortar vs. online sales for [product]? Do you think that sales from the participating big-box ESRPP retailers are likely to be representative of the [product] market in California?	PG&E ESRPP sales are likely generally representative and are a significant portion of the California sales. We assume the ESRPP sales are representative, but for sound bars they might account for less than 80% of all sales. Nationwide and big-box retailers cover most products, but there are significant online sales.
4. Are you aware of any upcoming technology innovations that would impact energy efficiency? Do you see major market barriers to their adoption?	Nothing major in the market. There's constant change, but I'm not aware of anything specific.
5. Are there any major manufacturers that do not seem to be invested in incorporating energy efficiency into their products?	Manufacturers aim to hit minimum standards for ENERGY STAR, and the federal administration's deregulation approach enables manufacturers to take an approach separate from engagement. No one's going out of their way to not make ENERGY STAR products, but one sound bar manufacturer didn't turn in their products for ENERGY STAR certification.
a. If yes: Would you predict changes in the current manufacturer market share distribution?	-
6. Are you aware of residential product subclasses (e.g., for washers, agitator top-loaders), applications, or size bins where you would expect very low (< 5%) market penetration at the measure level by 2030?	ENERGY STAR cannot reach the market for sound bars that include subwoofers, which are estimated as 5% of the market. Also, there will always be some products that aim to fill the lowest-cost niche without EE as a concern. Other SMEs did not list subclasses that limit EE.
a. If yes: Would you predict changes in the current balance of market share for product subcategories?	-

Subject Matter Expert Input

QUESTION	
b. If no: Would it be feasible without ESRPP or EPA intervention for market penetration at the measure level to reach ~100% by 2030?	No Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. It could be possible without ESRPP intervention, but DOE and EPA intervention would be needed, and currently the product is not federally regulated.
7. Do you think that [energy efficiency measure level] products could eventually reach 100% saturation in the market? Why?	Across all products, 100% won't happen within the timeline forecast unless DOE or States set the current ENERGY STAR level (or ESRPP basic tier level) as a mandatory minimum. It could be possible without ESRPP intervention, but DOE and EPA intervention would be needed, and currently the product is not federally regulated. Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE.
a. If no: Do you have an estimate for the maximum saturation level?	No estimates
8. When would you expect to see 25% [energy efficiency measure level] market penetration? 50%? 75%?	No estimates
9. Do you think the rate of innovation in the [product] market is roughly the same as it was 5 – 10 years ago, or has it increased/decreased?	Innovation seems to be driven mostly by economic growth and health, and has definitely increased over the past 5 years. Similar
10. Compared to 5 – 10 years ago, how likely do you think manufacturers are to imitate/proliferate EE innovations?	There appears to be a lot of imitation – EE technologies don't have to be from one of the market leaders. The technology side of things (connectivity, better features) is quicker than fundamental technology change. Consumer electronics are less mature than other ESRPP product categories and so they move much more quickly with more imitation. Similar
11. How do the current market barriers compare to the historical market barriers for meeting what is now the federal standard level?	The increasing changes in the retailer landscape may cause some EE promoting retailers to shift their priorities, which could limit an ally for overcoming barriers in the past.

Subject Matter Expert Input

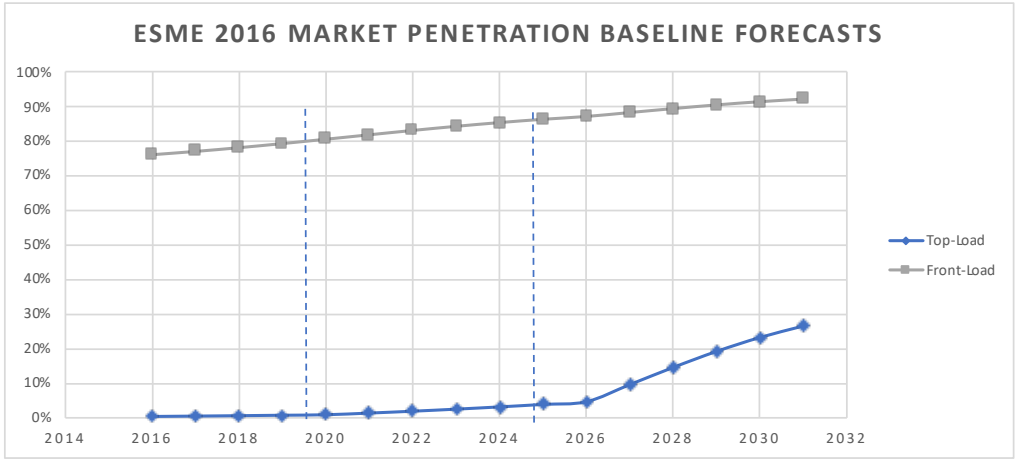
QUESTION	
12. What are the typical adoption trends (in terms of growth rates for efficient products) you observe when no DOE rulemaking is in effect, between adoption and the effective date, and shortly after the effective date? Do you forecast similar trends when the EPA specifications are revised?	Knowledge and awareness of upcoming change is important. Organizations should clearly understand what the levels are and what the change is going to be. Manufacturer understanding of their target market influences how quickly they come up to speed. For high end appliances, they may have already integrated it into their products because they could afford to or it provides features. They can offer that in higher margin products. There's a little bit of growth even when there's no regulation. What helps drive efficiency is either if it has other features for consumers or if there were product redesigns happening for other reasons. There are also some other drivers, e.g., EPA's SNAP rule will require a refrigerant update across all lines. If products are federally regulated, there's always a tendency to go more efficient during a redesign if possible. For products that aren't federally regulated, increasing efficiency would not be a primary driver during a product redesign. Manufacturers will develop products with features to help sell a product and any increase in efficiency as part of a redesign is likely an ancillary benefit. In general, if building managers are buying appliances in bulk, efficiency will likely be a consumer preference. If efficiency is a way to differentiate their products from competitors, that's something that companies will use to sell it and maybe leading to moderate market share growth. Another driver in the market is consolidation (in manufacturers, product lines, suppliers, or other), which could drive efficiency one way or another. There is manufacturer resistance to quicker-than-planned change due to sunk costs on capital investments.
13. For experts with insight into regulations: When do you expect major regulatory events (DOE rulemakings and/or EPA specification revisions) to occur for this product? Do you expect regulations to proceed according to the posted schedules?	NEEA assumes an ENERGY STAR revision will occur in 2019, as the revision process is already ongoing. The current ENERGY STAR specification allows products to qualify on idle power only, which is problematic.
14. For experts with insight into retail: When a code change or ENERGY STAR revision occurs, do retailers begin altering their stock and marketing when the change is announced, when the change becomes effective, or (for voluntary specifications) after the change becomes effective?	We try to be ready around the time of the effective date, maybe a little after the effective date for ENERGY STAR.
Interview Citations	Leritz, N. December 20, 2018 Phone interview with T. Kisch. Leybourn, S. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Steinhoff, C. and Moran, D. June 5, 2018. Phone interview with A. Mytelka and T. Kisch. Weinberg, R. December 10, 2018. Phone interview with A. Mytelka and T. Kisch.

Clothes Washer Baseline Summary

Last Updated: January 30, 2019

Updated By: Ari Mytelka, Energy Solutions

	Baseline Market Share	
Year	Top-Load ESME 2016	Front-Load ESME 2016
2016	0%	76%
2017	1%	77%
2018	1%	78%
2019	1%	79%
2020	1%	80%
2021	1%	82%
2022	2%	83%
2023	3%	84%
2024	3%	85%
2025	4%	86%
2026	5%	87%
2027	10%	88%
2028	15%	89%
2029	19%	90%
2030	23%	91%
2031	27%	92%



How to interpret the charts in this document:

These charts represent the 15-year statewide forecast of market penetration values of the program-qualifying ENERGY STAR Most Efficient measure level absent program intervention. Top-load and front-load washer configurations are forecast separately, but the curves can be combined into a forecast for all washers by taking the weighted average of the two curves using the distribution from the "ESRPP Data" tab. The charts only show forecasts for the given measure levels and do not forecast market penetration for future revisions of ENERGY STAR.

Derivation:

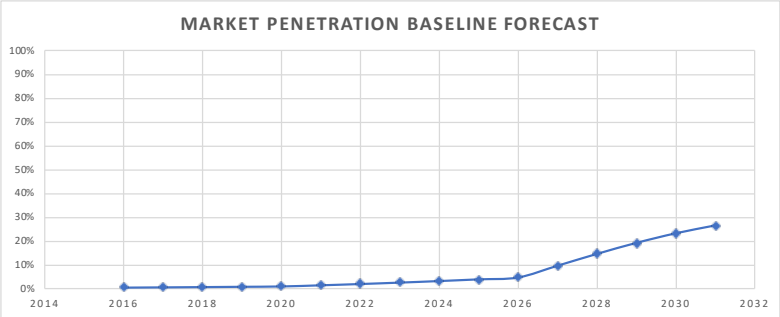
The baselines are calculated in segments, which are divided by significant non-program-related events such as changes to federal standards. For each segment, four key parameters describe the curve: the initial market share, the maximum potential market share, the qualitative growth rate, and the segment start and end years. The parameters are informed by the best available ESRPP program and market sales data alongside subject matter expert opinion. Since market conditions change over time, it is recommended that these charts are reviewed each year and updated as necessary to reflect changes in market conditions.

Contents:

ENERGY STAR Most Efficient 2016 Top-Load Washer Baseline

Last Updated: January 13, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	0%
2017	1%
2018	1%
2019	1%
2020	1%
2021	1%
2022	2%
2023	3%
2024	3%
2025	4%
2026	5%
2027	10%
2028	15%
2029	19%
2030	23%
2031	27%



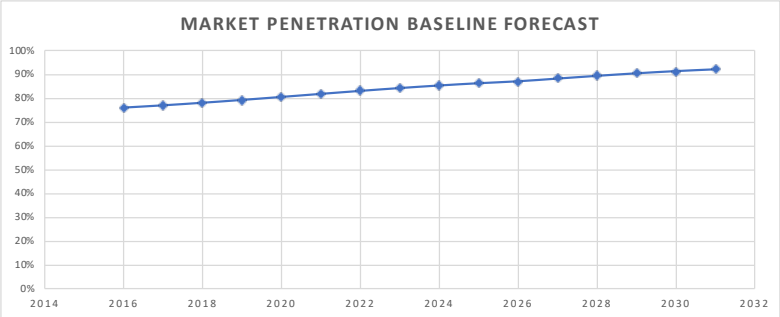
		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	0%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	10%	Only one manufacturer has qualified any top-load models that meet the ESME 2016 level, and no manufacturers have top-load models that meet ESME 2018. We expect that other manufacturers will not break into the ESME space without intervention.	If other manufacturers qualify models that meet the ESME 2016 level prior to the end year of this segment, we might increase this value.
Segment 1	Growth Rate*	slow	With no competition among manufacturers to product top-load ESME models, we expect slow growth. A product subject matter expert confirms that there is little competition for improving energy efficiency in the top-load market.	We might increase the growth rate if the ENERGY STAR specification opens prior to the beginning of the next DOE regulatory cycle, and this accelerated schedule is not attributable to RPP advocacy.
Segment 1	End Year	2020	The DOE federal standards process expected to open in 2020. The start of the DOE regulatory cycle will end segment 1.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed opening of the DOE standard.
Segment 2	Maximum Market Penetration Potential	50%	A subject matter expert expects that roughly half of the total top-load market and none of the agitator market segment can reach the ESME 2016 level in the near term.	If agitator washers that can meet ESME emerge, we might increase this value. If we receive updated information on the agitator market share of top-load washers, we would incorporate that information.
Segment 2	Growth Rate*	slow	The baseline increases slowly in anticipation of the new standard. A product subject matter expert confirms that the typical market adoption pattern is a step function with slow or negligible growth in the absence of codes & standards enhancement.	We might increase the growth rate if a new ENERGY STAR specification becomes effective prior to the finalization of a new DOE standard, and this accelerated schedule is not attributable to RPP advocacy.
Segment 2	End Year	2026	We expect a new standard to go into effect in 2026.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed DOE effective date.
Segment 3	Maximum Market Penetration Potential	61%	Based on input from a product subject matter expert, agitator washers will not be able to meet ESME. The agitator washers market share is determined according to RPP program data, and various sources suggest this market share has stabilized (Sutherland, T. October 30, 2018. Phone interview with A. Mytelka and T. Kisch), (DOE 2012: Department of Energy, Technical Support Document: Residential Clothes Washers, April 2012, https://www.regulations.gov/document?D=EERE-2008-BT-STD-0019-0047), (RECS: U.S. Energy Information Administration, Residential Energy Consumption Survey, 2015, https://www.eia.gov/consumption/residential/).	If agitator washers that can meet ESME emerge, we might increase this value. If we receive updated information on the agitator market share of top-load washers, we would incorporate that information.
Segment 3	Growth Rate*	fast	With an updated DOE standard and an updated ENERGY STAR specification, we expect market share of the current ESME level to increase rapidly. A product subject matter expert confirms that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might decrease the growth rate if the ENERGY STAR specification does not update at the time the new DOE standard goes into effect or the new DOE standard level is lower than anticipated.
Segment 3	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ENERGY STAR Most Efficient 2016 Front-Load Washer Baseline

Last Updated: January 13, 2019
Updated By: Ari Mytelka, Energy Solutions

Year	Market Penetration
2016	76%
2017	77%
2018	78%
2019	79%
2020	80%
2021	82%
2022	83%
2023	84%
2024	85%
2025	86%
2026	87%
2027	88%
2028	89%
2029	90%
2030	91%
2031	92%



		Inputs	Derivation	Future Adjustments
	Baseline Year for RPP	2016	This is the year before the first incentives were offered.	We do not expect to update this value in future years.
	Initial Market Penetration	76%	RPP market penetration for the first year of sales data. We assume that prior to intervention RPP retailers matched the market as a whole. This assumes RPP sales are representative of the California market, which SMEs corroborated.	Occasionally, there are updates to the historical RPP sales data, e.g., when a new retailer joins the program. This value will be updated if the historical sales data are updated. May also be modified to incorporate third-party market-level data.
Segment 1	Maximum Market Penetration Potential	100%	Based on program data, the ESME market penetration is already > 75%, and the basic ENERGY STAR penetration is 100%. This suggests there is not a limit to the maximum market penetration potential.	We do not expect to update this value in future years.
Segment 1	Growth Rate*	medium	Market historical data unit shipment data from ENERGY STAR (https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives) suggest that market share is not moving quickly without outside intervention.	We might increase the growth rate if the ENERGY STAR specification opens prior to the beginning of the next DOE regulatory cycle, and this accelerated schedule is not attributable to RPP advocacy.
Segment 1	End Year	2026	We expect a new standard to go into effect in 2026. The effective date of the new DOE standard will end segment 1. This subcategory baseline includes only two segments because the initial market share is already high enough that we would not expect market share increases in years anticipating the standard.	If the DOE regulatory cycle is delayed, this segment should be extended to end one year before the delayed DOE effective date.
Segment 2	Maximum Market Penetration Potential	100%	Based on program data, the ESME market penetration is already > 75%, and the basic ENERGY STAR penetration is 100%. This suggests there is not a limit to the maximum market penetration potential.	If a new feature or sub-category of front-load washers arises that cannot meet ESME, we might decrease this value.
Segment 2	Growth Rate*	fast	The least-efficient front-load washers are removed from the market when the new standard takes effect. A product subject matter expert confirms that the typical market adoption pattern is a step function with rapid growth in market share in conjunction with codes & standards enhancement.	We might decrease the growth rate if the ENERGY STAR specification does not update at the time the new DOE standard goes into effect, if less-efficient technology enters the market and slows adoption, or the new DOE standard level is lower than anticipated.
Segment 2	End Year	2031	We end the baseline forecast 15 years after the start of incentives.	We do not expect to update this value in future years.

*** The growth rates define a section of a Bass Curve. See the "Growth Parameters" section for the curve parameters.**

ESRPP Data

2015-2018 ESRPP Market Penetration from ESRPP Data in PG&E Territory

These inputs to the baselines come directly from the ESRPP sales data:

2016 Market Penetration of ENERGY STAR Most Efficient within the Top-Load Configuration	2016 Market Penetration of ENERGY STAR Most Efficient within the Front-Load Configuration	% of Top-Load Washers Using Agitator Technology in 2016
0.4%	76.0%	39.0%

These distribution percentages come directly from the ESRPP sales data and can be used to determine the weighted average:

Market Share of the Top-Load Configuration	Market Share of the Front-Load Configuration
65.1%	34.94%

Growth Parameter Assumptions

	slow	medium	fast
p	0.006	0.012	0.031
q	0.130	0.255	0.335
p+q	0.136	0.267	0.366
start year	5	5	5

The growth parameters are quartiles of the naturally occurring market adoption (NOMAD) Bass curve parameters for evaluated federal and Title 20 standards (see "Evaluated NOMAD" section for complete list of standards and parameters). The p and q values express the rates of technology innovation and technology imitation, with higher values indicating greater innovation and higher levels of competition. The start year parameter describes the number of years (prior to the forecast start year) a technology has been commercially available to consumers.

For the p and q values, the "slow" values are the first quartile p and q across all evaluated standards, the "medium" values are the median across all evaluated standards, and the "fast" values are the third quartile. This is representative of evaluated NOMAD for appliance energy efficiency measures and enables a quantification of Bass curve parameters from qualitative assessments of the product rates of competition and innovation.

The start year for all three scenarios is the first quartile for all evaluated Title 20 standards. The first quartile was used because all ESRPP measure levels are based on the voluntary ENERGY STAR specifications, which are more stringent and forward-looking than the

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2006 T-20	td 11b_201	General Service Incandescent Lamps, Tier 2 (2012)	1970	0.000	0.213
2005 T-20	std 12a	Pulse Start Metal Halide HID Luminaires, Tier 1	1992	0.001	0.348
2005 T-20	std 12b	Pulse Start Metal Halide HID Luminaires, Tier 2	1992	0.001	0.348
2005 T-20	std 13	Modular Furniture Task Lighting Fixtures	2000	0.132	0.198
2005 T-20	std 14	Hot Food Holding Cabinets	2000	0.008	0.480
2005 T-20	std 15	External Power Supplies, Tier 1	2000	0.025	0.356
2005 T-20	std 16	External Power Supplies, Tier 2	2000	0.012	0.386
2005 T-20	std 17	Consumer Electronics - Audio Players	2000	0.040	0.431
2005 T-20	std 18a	Consumer Electronics - TVs	2000	0.054	0.503
2005 T-20	std 18b	Consumer Electronics - DVDs	2000	0.126	0.099
2005 T-20	std 19	Water Dispensers	2000	0.037	0.343
2005 T-20	std 20	Unit Heaters and Duct Furnaces	1965	0.007	0.097
2005 T-20	std 21	Commercial Dishwasher Pre-Rinse Spray Valves	2003	0.039	0.389
2006 T-20	std 22a	BR, ER and R20 Incandescent Reflector Lamps: Residential	2000	0.023	0.145
2006 T-20	std 22b	BR, ER and R20 Incandescent Reflector Lamps: Commercial	2000	0.023	0.145
2008 T-20	std 23	Metal Halide Fixtures	2000	0.003	0.366
2008 T-20	std 24	Portable Lighting Fixtures	2000	0.002	0.498
2008 T-20	std 25	General Purpose Lighting -- 100 watt	2000	0.004	0.346

Evaluated Codes & Standards NOMAD Parameters

Compiled by Yanda Zhang of ZYD Energy, Inc. from CPUC Evaluation Reports
Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2008 T-20	std 26	General Purpose Lighting -- 75 watt	2000	0.007	0.294
2008 T-20	std 27	General Purpose Lighting -- 60 and 40 watt	2000	0.011	0.255
2008 T-20		General Service Lamps (EISA Phase 2)	2000	0.003	0.220
2009 T-20	std 28a	Televisions - Tier 1	2000	0.004	0.534
2009 T-20	std 28b	Televisions - Tier 2	2000	0.008	0.380
2011 T-20	Std 29	Small Battery Chargers - Tier 1 (consumer with no USB charger or USB charger <20 watt-ho	2000	0.007	0.321
	Std 30	Small Battery Chargers - Tier 2 (consumer with USB charger >=20 watt-hours)	2000	0.012	0.241
2011 T-20	Std 31	Small Battery Chargers - Tier 3 (non-consumer)	2000	0.004	0.263
2011 T-20	Std 32	Large Battery Chargers (>=2kW rated input)	2000	0.003	0.275
2010-12 Fed App	Fed 1	Electric Motors 1-200HP	2000	0.030	0.030
2010-12 Fed App	Fed 2	Refrigerated Beverage Vending Machines	1998	0.014	0.584
2010-12 Fed App	Fed 3	Commercial Refrigeration	1995	0.008	0.360
	Fed 4	ASHRAE Products (Commercial boilers)	1965	0.007	0.097
2010-12 Fed App	Fed 5	Residential Electric & Gas Ranges	1965	0.007	0.097
2010-12 Fed App	Fed 6	Incandescent Reflector Lamps	2008	0.008	0.292
2010-12 Fed App	Fed 7	General Service Fluorescent Lamps	2000	0.010	0.330
2013-15 Fed App	Fed 8	Commercial Clothes Washers	1970	0.017	0.167
2013-15 Fed App	Fed 9	Residential Pool Heaters	1895	0.010	0.001
2013-15 Fed App	Fed 10	Residential Direct Heating Equipment	1950	0.065	0.168
2013-15 Fed App	Fed 11	Residential Refrigerators & Freezers	2005	0.011	0.247
2013-15 Fed App	Fed 12	Residential Room AC	2005	0.018	0.214
2013-15 Fed App	Fed 13	Fluorescent Ballasts	2000	0.014	0.173
2013-15 Fed App	Fed 14	Small Commercial Package Air-Conditioners >=65 and <135 kBtu/h	1980	0.100	0.001
2013-15 Fed App	Fed 15	Large and Very Large Commercial Package Air-Conditioners >=135 kBtu/h	1986	0.100	0.001
2013-15 Fed App	Fed 16	Computer Room Acs >=65,000 Btu/h and < 760,000 Btu/h	2005	0.700	0.020
2013-15 Fed App	Fed 17	Residential Dishwashers	1960	0.019	0.238
2013-15 Fed App	Fed 18	Residential Clothes Dryers	1970	0.047	0.107
2013-15 Fed App	Fed 19	Residential Gas-fired water heater	1915	0.005	0.020
2013-15 Fed App	Fed 20	Residential Electric storage water heater	1988	0.003	0.338
2013-15 Fed App	Fed 21	Residential Gas-fired instantaneous water heater	2015	1.000	1.000
2013-15 Fed App	Fed 22	Residential Oil-fired storage water heater	1988	0.050	0.002

Evaluated Codes & Standards NOMAD Parameters

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Zhang, Y. March 6, 2018. Email attachment to E. Rubin.

C&S Group		Standards	Starting Year	p	q
2013-15 Fed App	Fed 23	Small Electric Motors	2009	0.054	0.263
2013-15 Fed App	Fed 24	Residential Clothes Washers (Front Loading)	2015	0.031	0.152
2013-15 Fed App	Fed 25	Residential Clothes Washers (Top Loading) Tier I	2015	0.031	0.152
2013-15 Fed App	Fed 26	Residential Central AC, Heat Pumps and Furnaces	2003	0.011	0.222

Subject Matter Expert Input

QUESTION	SME Responses
1. Please describe your background, including the main organizations that you are and have been affiliated with, your role(s), and how many years you worked with each organization.	12 years experience in market analysis; 15 years experience in energy efficiency; 18 years experience in product development and energy efficiency 3 years experience in HVAC product development, 4 years experience with AHAM, 3 years experience consulting for EPA ENERGY STAR 3 years experience with Home Depot, 9 years experience with Ecova 10 years experience consulting to support DOE rulemakings 25 years experience with Nationwide's marketing, 20 years experience outside of Nationwide as a buyer or sales manager
2. Can you give your best estimate of the current [energy efficiency measure level, e.g., ESME 2016] market share for California? What sources inform your estimate?	Cited EPA Unit Shipment Data, noted that the California ESRPP sales are mostly representative of overall California sales (though they are not necessarily nationally representative). Based on published ESTAR sales data, and model counts for ESME: Top-load: Basic ENERGY STAR is ~1/3 and ME is in the low single digits or even less (maybe close to zero). Front-load: ENERGY STAR is close to 100% (the label has a huge impact on front-load sales) and ESME is ~30%. See the ESRPP sales, understanding the fraction of the market that RPP makes up using data from AHAM. Other SMEs did not make an estimate.
3. Are you aware of any differences between brick-and-mortar vs. online sales for [product]? Do you think that sales from the participating big-box ESRPP retailers are likely to be representative of the [product] market in California?	ESRPP sales data is likely to be representative and might be more reliable than data sources that only have the model count. Brick-and-mortar big-box retailers likely have a lower selection than online retailers due to floor space constraints. Nationwide and big-box retailers cover more than 80%, and there aren't significant online sales. Not sure PG&E ESRPP sales are likely generally representative and are a significant portion of the California sales. We assume the ESRPP sales are representative.
4. Are you aware of any upcoming technology innovations that would impact energy efficiency? Do you see major market barriers to their adoption?	There's constant change, but I'm not aware of anything specific. I do not track the technology components at all. Will continue to see innovations from the major manufacturers. Changes in market share by manufacturer will likely have the biggest impact on ME market share. Lots of innovation in all-in-one washer-dryer products, but that category is likely to remain at relatively low market share in the USA.

Subject Matter Expert Input

QUESTION	SME Responses
5. Are there any major manufacturers that do not seem to be invested in incorporating energy efficiency into their products?	No one's going out of their way to not make ENERGY STAR products. Some of the smaller manufacturers have minimal investment in EE because they have limited resources. Some of the major manufacturers compete at the low end of the price range, where it is much more difficult to offer high efficiency due to intense price competition. Other SMEs did not list manufacturers that limit EE. Manufacturers aim to hit minimum standards for DOE compliance or ENERGY STAR, and the federal administration's deregulation approach enables manufacturers to take an approach separate from engagement.
a. If yes: Would you predict changes in the current manufacturer market share distribution?	-
6. Are you aware of residential product subclasses (e.g., for washers, agitator top-loaders), applications, or size bins where you would expect very low (< 5%) market penetration at the measure level by 2030?	Side-mount refrigerators are likely to gradually decline as French-door bottom-mount refrigerators become more popular, and if the trend continues, manufacturers are less likely to innovate in that product configuration. Compacts are not eligible for ME right now. There will always be some products that aim to fill the lowest-cost niche without EE as a concern. Other SMEs did not list subclasses that limit EE.
a. If yes: Would you predict changes in the current balance of market share for product subcategories?	The market seems relatively stable.
b. If no: Would it be feasible without ESRPP or EPA intervention for market penetration at the measure level to reach ~100% by 2030?	Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. There are some price points that can't be hit when the only incentivized measure level is ESME. Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR. Consumers expect EE, but only some customers are willing to pay extra for it. No It could be possible without ESRPP intervention, but DOE and EPA intervention would be needed.

Subject Matter Expert Input

QUESTION	SME Responses
7. Do you think that [energy efficiency measure level] products could eventually reach 100% saturation in the market? Why?	Across all products, 100% won't happen within the timeline forecast unless DOE or States set the current ENERGY STAR level (or ESRPP basic tier level) as a mandatory minimum. It is infeasible to expect total market share to reach ~100% ESTAR level. For front-load, most of the market ends up following the ESTAR level. But for top-load, ~50-60% of the market is conventional-style agitator (at the low end of efficiency), and due to price competition, consumer preferences, etc. it is unlikely that this segment of the market would naturally gravitate to the ESTAR level without EE programs or regulation requiring it. It could be possible without ESRPP intervention, but DOE and EPA intervention would be needed. Without an [ESRPP] emphasis on EE and ENERGY STAR, left to their own devices, consumers don't necessarily opt for EE. There are some price points that can't be hit when the only incentivized measure level is ESME. Consumers won't go beyond basic ENERGY STAR unless there's a program, and the opening price point model probably won't be ENERGY STAR. Consumers expect EE, but only some customers are willing to pay extra for it.
a. If no: Do you have an estimate for the maximum saturation level?	The maximum top-load penetration is probably all of the impeller market.
8. When would you expect to see 25% [energy efficiency measure level] market penetration? 50%? 75%?	For top-load, market segmentation seems pretty stable. Unlikely to get to 50% without programs. For front-load, much more market share at EE levels and most of the market follows the ESTAR level already. Other SMEs did not make an estimate.
9. Do you think the rate of innovation in the [product] market is roughly the same as it was 5 – 10 years ago, or has it increased/decreased?	There is more competition now than there was ~10 years ago. Similar A lot more innovation and competition in the past 5-10 years, especially in the front-load market. Some of the innovation, particularly in top-load, is not as much related to EE. Appears to be a lot of imitation – doesn't have to be one of the market leaders, not always the biggest player. Innovation seems less likely in the well-established, major appliance categories. These are much slower adoption cycles, so imitation takes much longer to achieve. The technology side of things (connectivity, better features) is quicker, but fundamental technology change is much slower.
10. Compared to 5 – 10 years ago, how likely do you think manufacturers are to imitate/proliferate EE innovations?	Similar The washer industry has experienced much more intense competition the past 5-10 years than previously, and this is likely to continue into the next 5-10 years. There is more competition now than there was ~10 years ago.

Subject Matter Expert Input

QUESTION	SME Responses
11. How do the current market barriers compare to the historical market barriers for meeting what is now the federal standard level?	The increasing changes in the retailer landscape may cause some EE promoting retailers to shift their priorities, which could limit an ally for overcoming barriers in the past. We think about selling washers paired with dryers, so it's important to have efficient washers that have a dryer pair. Similar There is an issue with lack of dryers to match efficient washers.
12. What are the typical adoption trends (in terms of growth rates for efficient products) you observe when no DOE rulemaking is in effect, between adoption and the effective date, and shortly after the effective date? Do you forecast similar trends when the EPA specifications are revised?	What helps drive efficiency is either if it has other features for consumers or if there were product redesigns happening for other reasons. There are also some other drivers, e.g., EPA's SNAP rule will require a refrigerant update across all lines. If products are federally regulated, there's always a tendency to go more efficient during a redesign if possible. For products that aren't federally regulated, increasing efficiency would not be a primary driver during a product redesign. Manufacturers will develop products with features to help sell a product and any increase in efficiency as part of a redesign is likely an ancillary benefit. In general, if building managers are buying appliances in bulk, efficiency will likely be a consumer preference. If efficiency is a way to differentiate their products from competitors, that's something that companies will use to sell it and maybe leading to moderate market share growth. Another driver in the market is consolidation (in manufacturers, product lines, suppliers, or other), which could drive efficiency one way or another. There is manufacturer resistance to quicker-than-planned change due to sunk costs on capital investments. There's a little bit of growth even when there's no regulation. The baseline market adoption assumes minimal growth. Growth starts with either a new ENERGY STAR specification or the federal government opening their rulemaking process. We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs. I need to be thinking a year in advance.
13. For experts with insight into regulations: When do you expect major regulatory events (DOE rulemakings and/or EPA specification revisions) to occur for this product? Do you expect regulations to proceed according to the posted schedules?	Cited the Fall 2018 Unified Agenda of Regulatory and Deregulatory Actions for DOE (https://www.reginfo.gov/public/do/eAgendaMain?operation=OPERATION_GET_AGENCY_RULE_LIST&currentPub=true&agencyCode=&showStage=active&agencyCd=1900&Image58.x=68&Image58.y=7). DOE's schedule is based on the published federal regulatory agenda. The law requires looking at standards every 7 years. The NEEA models predict the federal rulemaking process will open in 2020 and a new standard will be effective 2026. The ENERGY STAR specification might also update in 2020.
14. For experts with insight into retail: When a code change or ENERGY STAR revision occurs, do retailers begin altering their stock and marketing when the change is announced, when the change becomes effective, or (for voluntary specifications) after the change becomes effective?	We try to be ready around the time of the effective date, maybe a little earlier for DOE, maybe a little after the effective date for ENERGY STAR. We know the worst thing would be to have noncompliant products after the DOE effective date, we try to think about lead time and get EE products on the shelf around the time the spec/code changes, maybe a little earlier for mandatory codes, maybe a little later for voluntary specs.

Subject Matter Expert Input

QUESTION	SME Responses
Interview Citations	Christianson, A. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Leritz, N. December 20, 2018 Phone interview with T. Kisch. Leybourn, S. December 7, 2018. Phone interview with A. Mytelka and T. Kisch. Steinhoff, C. and Moran, D. June 5, 2018. Phone interview with A. Mytelka and T. Kisch. Sutherland, T. October 30, 2018. Phone interview with A. Mytelka and T. Kisch. Weinberg, R. December 10, 2018. Phone interview with A. Mytelka and T. Kisch.

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