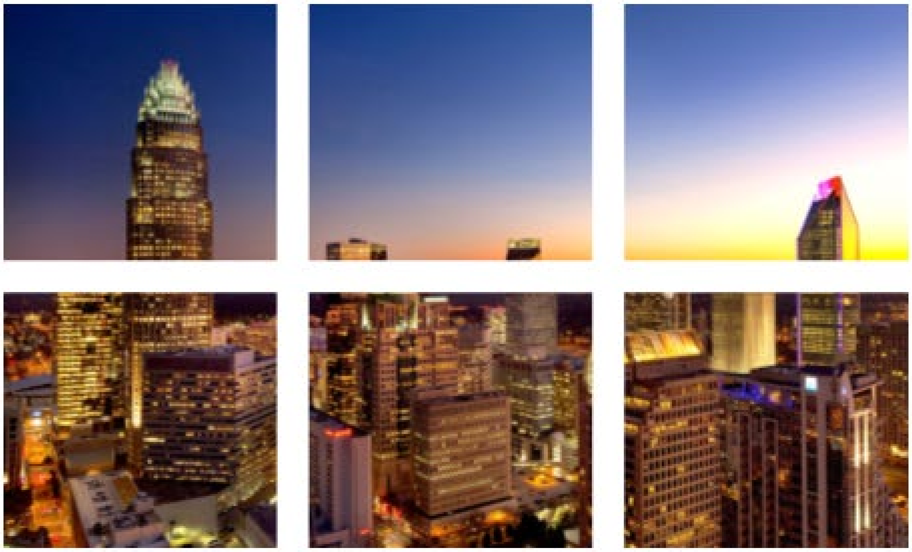

PY2018 SMALL/MEDIUM COMMERCIAL (SMB) SECTOR ESPI IMPACT EVALUATION

Final Report

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California Public Utilities Commission

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1 EXECUTIVE SUMMARY

1.1 NEED FOR THE STUDY

The overall goal of this study is to evaluate energy savings from selected technologies in the investor owned utilities' (IOUs') 2018 energy efficiency programs in the non-residential sector including small and medium commercial buildings and industrial and agricultural applications. This study focuses on technologies that have an assumed or estimated savings for that technology, as opposed to projects where the savings are calculated and very specific to a particular site. The results of this study address CPUC regulatory reporting requirements. The results are also used to inform decision makers if our energy efficiency programs are meeting savings goals or helping to meet the state's climate goals.

1.2 ENERGY EFFICIENCY TECHNOLOGIES STUDIED

This study evaluates a number of commercial, industrial or agricultural energy efficiency technologies for which the CPUC cannot forecast, with a high level of certainty, the expected energy savings. These technologies include the following:

- Process Pumping Variable Frequency Drives (VFDs) – installation of pump motor speed controls for pumps on farms that are used to irrigate crops
- Refrigeration Case Lighting – replacement of lighting in store refrigeration displays that hold cold retail shelf products for sale
- Agricultural Irrigation – drip irrigation solutions applied in agriculture
- Tankless Water Heaters – installation of high efficiency instantaneous water heaters in commercial buildings

1.3 APPROACH

The study conducts original research to verify the savings reported by the IOUs and/or develop revised estimates of savings for each technology studied. This study addresses both electric (kWh, kW) and gas (therm) savings provided over the lifetime of the technology. The primary mechanism for collecting data include telephone surveys and site visits which were conducted with a sample of customers that installed at least one of the study technologies. The data collected as part of these activities include information on how the technology was installed, and how the technology affects the site's energy consumption.

This evaluation then compares the savings estimates developed using data collected from participant sites with the energy savings estimates reported by IOUs. The ratio of the evaluation results to the IOUs' reported savings estimates is referred to as the "realization rate."

We also examine how successful the IOU programs were in influencing program participants to install energy efficient equipment that would not have been installed if the programs had not existed. Participants that would have installed the same energy efficient equipment in the absence of the program are referred to as "free riders," because they are receiving incentives from the programs for actions they would have undertaken without the program's existence. The total amount of savings derived among all participants, including free riders, is referred to as "gross savings," and the amount of savings excluding free riders is referred to as "net savings."

Evaluated gross savings estimates differ from the IOUs reported savings estimates due to differences in the modeling approach and measured inputs and other assumptions being applied by the evaluation team. Furthermore, the evaluated net savings estimates include all such gross savings adjustments AND net savings adjustments associated with measured free ridership. The gross savings realization rate is the ratio of the evaluation gross savings to the IOUs reported gross savings estimates, while the net realization rate is a similar ratio using the two net savings estimates.

Finally, we developed estimates of the ratio between the evaluated net and gross levels of savings (the net-to-gross ratio or NTGR). A NTGR equal to 100 percent or 1.0 means the IOU-sponsored program completely influenced the installation of the energy efficient equipment, and any value less than one represents the netting out of free ridership; for example, 25 percent free ridership would yield a NTGR of 0.75 – so the closer the NTGR is to 1, the lower the free ridership. To estimate this ratio, we used a telephone survey that includes several questions regarding the program's influence on the participant's decision to install the energy efficient equipment. The survey examines various factors related to the program and asks the participant what they would likely have done in the absence of the program.

1.4 RESULTS

The results of this evaluation establish the gross and net energy savings of the four technologies studied over the life of the installed equipment (lifecycle).

The tables below show the evaluated and reported energy savings values for each technology studied. Therms are shown in Table 1-1 for gas saving technologies, and MWhs and MWs are shown in Table 1-2 for electric saving technologies. Also provided are the ratios of evaluated savings to the IOUs' reported savings and the corresponding net-to-gross ratios.[1] All four technologies showed much lower energy savings than reported, and therefore resulted in lower gross savings. Furthermore, some technologies studied showed that the program had only a moderate influence on the installation of the equipment, as participants would have installed the equipment anyway (hence the low NTGR and lower net savings for some measures).

TABLE 1-1: REPORTED (IOU) AND EVALUATED LIFECYCLE THERM SAVINGS, REALIZATION RATES AND NTGRS FOR EVALUATED GAS TECHNOLOGIES

	Evaluated Therm Savings			
Technology	**Reported**	**Evaluated**	**Realization Rate Evaluated / Reported**	**Net-to-Gross Ratio**
	Lifecycle Gross Savings			
Tankless Water Heater	38,252,824	20,132,595	0.53	
	Lifecycle Net Savings			
Tankless Water Heater	24,073,536	12,046,096	0.50	0.60

TABLE 1-2: REPORTED (IOU) AND EVALUATED MWH AND MW LIFECYCLE SAVINGS, REALIZATION RATES AND NTGRS FOR EVALUATED ELECTRIC TECHNOLOGIES

	Evaluated MWh Savings			Evaluated MW Savings			
Technology	**Reported**	**Evaluated**	**Realization Rate Evaluated / Reported**	**Reported**	**Evaluated**	**Realization Rate Evaluated / Reported**	**Net-to-Gross Ratio**
	Lifecycle Gross Savings						
Process Pumping VFD	68,745	70,475	1.03	33	9	0.28	
Refrigeration Case Lighting	64,562	12,381	0.19	14	3	0.2	
Agricultural Irrigation	40,610	2,843	0.07	32	4	0.12	
	Lifecycle Net Savings						
Process Pumping VFD	44,698	31,588	0.71	21	4	0.19	0.45
Refrigeration Case Lighting	42,048	8,420	0.20	9	2	0.20	0.68
Agricultural Irrigation	26,397	1,848	0.07	21	3	0.12	0.65

[1] Please note that all net savings and net-to-gross ratios include the 0.05 market effects adder.

Finally, we provide some high-level findings and recommendations that stem from the evaluation, organized by technology. More details can be found in section 8 of the main report.

1.4.1 Process Pumping Variable Frequency Drives (VFD)

- **VFD controls installed through the utility programs are not being properly screened in many cases for eligibility criteria.** Commonly observed reasons for failing eligibility requirements include the installation of speed controls to pump well water into a water storage reservoir, pump settings at or near full load, or pumps that run fewer than 1,000 hours per year. In fact, some of the programs installed controls on pumps which were operational but not running and therefore did not save any energy.
  - The program's application and review process should be enhanced to better screen projects against eligibility requirements and exclusions.
- **In most cases, pump operations can be readily characterized using utility interval data, such as hourly demand measurements for a given pump that are available in the utility billing systems.**
  - While interval billing data was useful in this evaluation for determining VFD savings, the programs could also make use of this data source for characterizing pump operations, including use of those data to derive updated estimates of deemed savings for the pump VFD measure, and as screening criteria for pump run hours.
- **Tracking system improvements are needed to properly characterize the pumps on which the VFD controls are installed.** Pumps are mis-labeled with respect to the tracking data-based measure description and pump size ratings, including proper classification by motor size (horsepower) and type of pumping being performed by each pump (well pump versus booster pump).
  - The program's verification process should ensure that pump VFD installations are both valid and accurately represent the associated irrigation system.
- **Besides the potential to save energy, there are other common reasons that farmers will decide to install VFD controls on crop irrigation pumps.** In fact, some pumps cannot continue to be operated without the VFD due to operational requirements, such as the use of VFD controls to automatically adjust pump speed in response to pressure settings, or due to sand contamination in the well water column that can be controlled using VFD pump speed settings. Another common reason is that the VFD pump gives the farmer the ability to monitor and control the pump remotely, from a desk in their office. Furthermore, the VFD pumps can save on equipment maintenance and extend the life of the pump. This results in a high free ridership rate for VFD controls because a considerable number of farmers indicate that they would have installed VFD controls independent of the program / incentive.

- For these reasons the appropriate baseline condition should be revisited in advance of deemed savings updates for the agricultural pump VFD measure that are scheduled for 2020, since current deemed savings estimates assume a throttle valve flow control baseline in all cases, whereas the true baseline condition in the absence of the program is a weighted average of throttle valve and VFD controls.

1.4.2 Refrigeration Case Lighting

In this evaluation, we compared the inputs and assumptions between the reported savings model and the evaluated savings model. Some of the key differences are listed below:

- **A large participating grocery store chain that represents over one quarter of PG&E's reported savings also received rebates for new refrigeration cases in addition to the lighting rebate.** The savings PG&E claimed for the installation of the new cases also included savings for the efficient lighting that comes standard with new cases. Separately claiming savings for the refrigeration case lighting measure in addition to the new case double counts the savings associated with the new efficient lighting in the case. Therefore, savings for the lighting measure resulted in zero incremental savings for this participant, resulting in significantly lower overall gross savings.
  - The program's application review and verification process should ensure that project savings do not include double counting, in addition to other traditional roles for these program processes.
- **The IOU reported savings significantly overstate how long the equipment will last following installation.** Both SDG&E and PG&E assume the lights will last 16 years. Our evaluation results, on the other hand, support a 4-year cycle, thereby reducing the resulting lifecycle of this technology's savings by 75 percent. The 4-year life is based on the remaining useful life of the existing cases into which the lighting was installed. Because LED lighting is now standard in new cases, when the old cases into which the rebated lights were installed are replaced, the rebated lights will be replaced by the standard LED lighting in the new cases.
  - The IOUs should use a 4-year life for LED lighting being installed in existing cases, consistent with the remaining useful life of the existing cases.
- **In some instances, the IOUs assume that participants are replacing two less efficient fluorescent tubes with a single high efficiency tube.** However, participant self-report data indicates that the majority of new equipment replaces only a single fluorescent tube**.** This finding resulted in lower savings for a number of the sampled projects.
  - The program's application and review process for refrigeration case LED lighting replacements should properly capture and record the type and configuration of the removed

lighting equipment, and ensure that savings calculations reflect the appropriate removed equipment baseline**.**

1.4.3 Agricultural Irrigation

- **We found that nine of the 17 sampled projects in this evaluation were ineligible for program participation.** Each of these nine farms grow deciduous crops (crops that shed leaves annually), such as almonds and walnuts, which were excluded from the program beginning in 2018. Drip irrigation is new standard practice in farms growing deciduous crops, and allowing ongoing participation for those crops would otherwise lead to very high free ridership rates among participants. These ineligible projects resulted in zero savings and significantly reduced program savings.
  - The program's application and review process should be enhanced to screen projects against all eligibility criteria, and selected auditing or verification should be performed to ensure that only valid installations are claimed.
- **IOU models for estimating savings were found to lack key parameters critical for accurately characterizing irrigation needs and resulting savings.** These gaps generally led to a reduction in evaluated savings relative to IOU reported savings. For example, almost all of the 17 evaluated drip irrigation projects were a unique combination of the following parameters which were not considered in IOUs' reported savings calculation: pre-project crop type, pre-project irrigation method, and post-project crop type. Each of these parameters can significantly affect irrigation requirements and subsequent savings from drip irrigation installations. Therefore, because the IOUs' reported savings did not consider these factors, the savings values were inaccurate and generally overstated.
  - Future workpaper revisions, ex-ante models, and impact claims should incorporate recent evaluation data and results. This information should be used for revising parameter-level assumptions and improving the accuracy of ex-ante claims**.**
- **The IOU reported savings overstated how long the equipment will last following installation.** PG&E assumes the equipment will last 20 years. We found that the irrigation systems are often replaced much earlier due to factors such as switching crops or crop rotation.
  - The utilities should make improvements to claimed EULs where warranted.

1.4.4 Tankless Water Heaters

- **We determined that three of the 25 evaluated projects either never saved energy or no longer save energy.** One claimed project was in a facility that has since gone out of business, one project was in a facility that uses electricity for water heating but the program reported a gas appliance installation, and one project was at a service address that had no evidence of a recent tankless water heater installation. These projects resulted in zero savings and significantly reduced overall program savings.

- For any measures delivered midstream through distributor rebates, such as the tankless water heater measure, the programs must require participating distributors and partnering contractors to submit more comprehensive installation documentation (e.g., invoices, commissioning reports) and photographs to prove measure installation, quantity, size, fuel source, and efficiency.

- **11 of the 25 evaluated projects applied incorrect per-unit savings values or misclassified the type of facility in which the measure was installed.** Correcting these errors results in lower estimated savings.

  - Deemed measures in the small/medium commercial sector should conform with workpapers active at the time of installation. Claimed savings should reflect the product of total installed size with workpaper-recommended unit energy savings (UES) for the most appropriate facility type. In these 11 cases, evaluators found that the ex-ante savings did not reflect the DEER-modeled unit energy savings value (UES) based on facility type, climate zone, water heater size, and efficiency tier.

- We found that water heaters operated at different temperatures than assumed in the reported savings, which negatively affected the savings estimates. However, we also found that the water heaters operated more efficiently than assumed**.** Overall, the negative effects due to correcting the temperature assumptions were greater than the positive effects due to the increased efficiency, resulting in an overall reduction in savings.

  - Future workpaper revisions should incorporate recent evaluation results. This will ensure better alignment between ex-ante claims and ex-post savings moving forward.

- **For many of the tankless water heaters evaluated, program tracking data did not provide sufficient information.** For approximately 85 percent of projects in the population, we did not have sufficient participant contact data to verify water heater installation or evaluate savings. As a result, we were not able to evaluate as many sites as planned.

  - For any measures delivered midstream through distributor rebates, or for any other offering where the IOUs are providing support and incentives through the state's energy efficiency programs, such as the tankless water heater measure, program administrators should require participating distributors and partnering contractors to collaboratively collect and submit basic information for each customer ultimately receiving the equipment or other support. This basic information is critical for the utilities, the CPUC, and its contractors to verify installations and maintain the integrity of ratepayer incentive dollars.

1.5 CONTACT INFORMATION

The ED Project Manager for this study was Ms. Mona Dzvova. Itron served as the Prime Contractor managing this study, led by Mr. Kris Bradley.

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2 INTRODUCTION AND OVERVIEW OF STUDY

This report documents the activities and results of the Nonresidential Small and Medium Commercial Sector Impact Evaluation of the 2018 California Investor Owned Utilities (IOU) energy efficiency programs. The overall goal of this study is to perform an impact evaluation on specific nonresidential deemed measures[2] that were identified in the Efficiency Savings and Performance Incentive (ESPI) Uncertain Measure List for program year (PY) 2018.[3] The ESPI mechanism was adopted on September 5, 2013 in D.13-09-023 and provides monetary incentives to IOUs for performance in resource and non-resource program activities.

This evaluation focuses on energy efficiency (EE) resource program savings – measured in net ex-post lifecycle energy savings – realized by IOU programs in PY2018. The evaluation team collected and analyzed primary data from PY2018 participants to develop net ex-post lifecycle savings estimates and to satisfy impact evaluation requirements for measures on the PY2018 Uncertain List. This report details the goals and objectives of the impact evaluation to meet those requirements. Likewise, the report discusses the researchable issues, information on the measure groups' technologies evaluated, as well as the data sources used, the approach for sampling, the verification analysis and the methods used to determine ex-post net lifecycle energy impacts. Finally, the report presents the results and findings from the analysis that can be used to update the Net-to-Gross Ratios (NTGRs) and gross/net first year and lifecycle savings for the measures detailed in the ESPI decision.

2.1 RESEARCH OBJECTIVES

The objective of this study is to perform a measure or measure-parameter impact evaluation – utilizing existing evaluation data and new primary evaluation data – to update ex-ante gross and net savings estimates and inform future savings values for measures identified in the PY2018 ESPI decision. Attachment A of the PY2018 uncertain measure list provides an overview of the measure groups (i.e., food service equipment, pipe insulation, etc.) and the energy resource (i.e., electric, gas) that have been identified as potentially requiring ex-post verification. The impact parameters that could be studied and measured include installation/verification rates, Unit Energy Savings (UES), NTGRs, gross and net energy savings values, effective useful life (EUL) and impact load shapes. The measure groups detailed in Attachment A were selected for ex-post verification primarily based on the following two criteria:

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[2] Note that nonresidential deemed lighting measures are covered under the Lighting Sector evaluations.

[3] https://pda.energydataweb.com/api/view/1947/2018%20Uncertain%20Measures%20List%20Memo.pdf

- Ex-ante savings for the measure are substantially uncertain
- Ex-ante savings for the measure represent a significant proportion of program administrator (PA) portfolio savings

The final 2018 ESPI Uncertain List identifies several portfolio measures related to the Small and Medium Commercial Sector that are subject to some level of ex-post evaluation for PY2018. Below is a list of the measure groups identified in that decision. Note that the parameters associated with these measures represent potential areas of focus and that the ex-post evaluation is not limited in scope to any specific parameters. The evaluation team has determined which measures and measure-parameters are subject to ex-post evaluation. This determination is based on several factors, which will be detailed throughout this report.

Table 2-1 lists the PY2018 small and medium commercial sector uncertain measure groups. Due to budgetary and time constraints, not all measure groups were evaluated, as will be discussed in more detail below. In-scope evaluation activities are identified using bolding in the table, and the "G" and "N" designations indicate gross and net impact evaluation scope, respectively.

TABLE 2-1: 2018 UNCERTAIN MEASURE LIST AND PARAMETERS RELEVANT TO THE SMALL/MEDIUM COMMERCIAL SECTOR

Measure Group	2018 Impact Evaluation Scope*	
Process Pumping VFD	**G / N**	Installation Rate, Unit Energy Savings (UES), Net-to-Gross Ratio (NTGR), Expected Useful Life (EUL)
Refrigeration Case LED Lighting	**G / N**	Installation Rate, UES, NTGR, EUL
Water Heating Boiler	X	Installation Rate, UES, NTGR, EUL
Water Heating Storage Water Heater	X	Installation Rate, UES, NTGR, EUL
Water Heating Tankless Water Heater	**G / N**	Installation Rate, UES, EUL
Agricultural Irrigation	**G / N**	Installation Rate, Gross Impact Realization Rate (GRR), NTGR, EUL

Source: Hansen, R., 2017. 2018 Efficiency Savings and Performance Incentive (ESPI) Uncertain Measures List. October 31, 2017.

* "X" designation indicates ESPI measures that are not being selected for evaluation. Bolded "G" and "N" designations indicate ESPI measures that are being selected for evaluation, with "G" identifying gross impact evaluation scope and "N" indicating net impact evaluation scope.

Rather than develop a full, comprehensive analysis on all uncertain measures, this evaluation focuses on evaluating specific parameters within the savings algorithms for some measures while implementing a more comprehensive analysis on others.

Key Research Questions: Our evaluation will investigate the six key research questions below in order to develop net and gross ex-post impacts for the measures detailed above. These research questions have been addressed either by leveraging existing data from past evaluation efforts or collecting new primary data from participant telephone surveys and on-site visits. Our proposed research questions (and supporting primary deliverables) are:

1. **What is the installation rate?** We confirmed installations (verification) using onsite-based verification of measure installations.
2. **What are key impact parameters that affect measure energy use?** We estimated key impact parameters for both the baseline (both pre-retrofit and code based) and replacement (post-retrofit) conditions – equipment specifications, operating hours, operating conditions and interactions, and use shapes to support the estimate of gross energy savings values and 8760 impact load shapes.
3. **What is the net-to-gross ratio?** We estimated participant free ridership to support the development of net-to-gross ratios and net savings values.
4. **What is the remaining useful life and effective useful life of program installed equipment?** We estimated remaining useful life values, and updated effective useful life estimates where necessary.
5. **What are the first year and lifetime ex-post gross and net savings impacts (kWh, kW and therms)?** Based on the above, we estimated first year and lifetime gross and net ex-post impacts (kWh, kW and therms) for selected measures.
6. **How can program administrators improve program performance?** We identified measure-specific program delivery recommendations that will improve the corresponding energy efficiency programs. We based all recommendations on the findings that stem from this evaluation.

2.2 STUDIED MEASURE GROUPS

Table 2-2 presents the full list of PY2018 ESPI measures that fall under the Small/Medium Commercial sector impact evaluation and identifies the three electric measures that were in scope for this evaluation. These three measures were selected because they comprise nearly all the electric savings among the 2018 Small/Medium Commercial uncertain measures. These measures include the process pumping VFD, refrigeration case LED lighting and agricultural irrigation measure groups.

TABLE 2-2: PY2018 PARTICIPATION SUMMARY – EXPECTED NET LIFECYCLE ELECTRIC SAVINGS (GWH), SHARE OF SMALL/MEDIUM COMMERCIAL SECTOR SAVINGS BY ESPI MEASURE GROUP, AND IN-SCOPE IMPACT EVALUATION

PY2018 ESPI Small/Medium Commercial Measure Group	PY2018 Tracking System Records*	PY2018 Unique Applications by Measure Group**	Expected Net Lifecycle GWh Savings***	Percent of Savings	PY2018 In-Scope ESPI**** Electric Measures
Process Pumping VFD	598	535	44.7	40%	G / N
Refrigeration Case LED Lighting	444	322	42.0	38%	G / N
Water Heating Boiler	8	3	-0.1	0%	
Agricultural Irrigation	26	24	26.4	24%	G / N
Water Heating Storage Water Heater	161	96	-1.5	-1%	
Water Heating Tankless Water Heater	12	7	0.1	0%	
Total	**1,249**	**987**	**111.6**	**100%**	

Sources:

Hansen, R., 2017. Final 2018 Efficiency Savings and Performance Incentive (ESPI) Uncertain Measures List. October 31, 2017.

CEDARS, 2017. Confirmed Claims Dashboards for 2017 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of records with non-zero electric savings; both positive and negative.

** Count of applications with records of non-zero electric savings; both positive and negative.

*** The 0.05 market effects adder is not included in the net savings values.

**** ESPI measures selected for evaluation. "G" and "N" designations indicate ESPI measures that are being selected for PY2018 evaluation, with "G" identifying gross impact evaluation scope and "N" indicating net impact evaluation scope.

Similarly, Table 2-3 presents the PY2018 ESPI gas-focused measures, including expected gas savings and associated participation statistics. The single gas-focused measure selected for evaluation is the tankless water heater measure which was selected because it comprises 68 percent of gas savings. It is notable that one of the electric-focused measures, refrigeration case LED lighting, also accounts for a small contribution of negative gas impacts (associated with interactive effects). Likewise, the gas-focused measure, tankless water heaters, also accounts for a small contribution to expected electric savings and associated participation statistics.

TABLE 2-3: PY2018 PARTICIPATION SUMMARY – EXPECTED NET LIFECYCLE GAS SAVINGS (MMTHERM), SHARE OF SMALL/MEDIUM COMMERCIAL SECTOR SAVINGS BY ESPI MEASURE GROUP, AND IN-SCOPE IMPACT EVALUATION

PY2018 ESPI Small/Medium Commercial Measure Group	PY2018 Tracking System Records*	PY2018 Unique Applications by Measure Group**	Expected Net Lifecycle MMThm Savings***	Percent of Savings	PY2018 In-Scope ESPI**** Gas Measures
Process Pumping VFD	-	-	-	-	
Refrigeration Case LED Lighting	388	286	-0.5	-1%	
Water Heating Boiler	109	48	2.6	7%	
Agricultural Irrigation	-	-	-	-	
Water Heating Storage Water Heater	1,526	1,096	9.4	26%	
Water Heating Tankless Water Heater	1,177	644	24.1	68%	G / N
Total	**3,200**	**2,062**	**35.5**	**100%**	

Sources:

Hansen, R., 2017. Final 2018 Efficiency Savings and Performance Incentive (ESPI) Uncertain Measures List. October 31, 2017.

CEDARS, 2018. Confirmed Claims Dashboards for 2018 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of records with non-zero gas savings; both positive and negative.

** Count of applications with records of non-zero gas savings; both positive and negative.

*** The 0.05 market effects adder is not included in the net savings values.

**** ESPI measures selected for evaluation. "G" and "N" designations indicate ESPI measures that are being selected for PY2018 evaluation, with "G" identifying gross impact evaluation scope and "N" indicating net impact evaluation scope.

The remainder of this report includes the following:

- Section 3 discusses the data sources that were utilized to estimate each of the individual measure parameters, the sample design, and resulting data used in the evaluation.
- Section 4 discusses the overall gross impact methodology and how first year and lifecycle ex-post savings were developed for each measure.
- Section 5 discusses the development of each of the gross impact parameters, such as installation rates, pre-and post-retrofit wattages, operating hours and effective useful life (EUL) and presents the resulting gross realization rates.
- Section 6 discusses the net-to-gross (NTG) evaluation methods and results.
- Section 7 presents the final study results including the first year and lifecycle, gross and net realization rates and savings values.
- Section 8 presents the conclusions and recommendations.
- Appendix AA presents standardized high-level savings for both gross and net first year and lifecycle.
- Appendix AB presents standardized per unit savings for both gross and net first year and lifecycle.
- Appendix AC presents the summary of recommendations for the Response to Recommendations (RTR).
- Appendix A presents the telephone survey instruments.
- Appendix B presents the on-site survey instruments.
- Appendix C presents the ESPI measure mapping from measure name in the tracking data.
- Appendix D presents supporting material for the net-to-gross methodology.
- Appendix E presents evaluator responses to comments received on the draft report.

3 DATA SOURCES, SAMPLE DESIGN AND DATA COLLECTION

3.1 DATA SOURCES

The evaluation team utilized a variety of data sources to support the development of ex-post net and gross savings for the ESPI uncertain measures in this study. These data sources were obtained from both past impact evaluation activities and new primary data collection. Each data source is listed below and we describe the specifics of each data source in greater detail throughout this subsection:

- Primary data sources:
  - On-site data collection
  - Participant telephone surveys for all except the Water Heating Tankless Water Heater measure
  - Distributor telephone surveys for the Water Heating Tankless Water Heater measure
  - Program manager interviews
- Secondary data sources:
  - Program tracking data and CIS billing data
  - IOU Workpapers and DEER
  - Industry sources

Table 3-1 presents the key primary data sources and ex-post impact evaluation updates for each of the measures discussed in Section 2.

TABLE 3-1: DATA SOURCES AND EX-POST UPDATE FOR PY2018 ESPI MEASURES

	Data Sources		Ex-Post Update	
2018 ESPI Measure	**Phone Surveys**	**Onsites**	**NTG**	**Gross**
Process Pumping VFD	X	X	X	X
Refrigeration Case LED Lighting	X	X	X	X
Agricultural Irrigation	X	X	Pass Through	X
Tankless Water Heater	X*	X	X	X

* Phone surveys were only performed for distributors for the Tankless Water Heater program, which was offered as a midstream program.

3.1.1 Program Manager Interviews

The evaluation established a working relationship with various PA staff, based on their expertise with the measures selected for evaluation. To build those relationships and learn details regarding program implementation, the evaluation fielded program manager interviews with each PA associated with the largest program/measure combinations represented in the evaluation. These interviews ensured that the evaluation data collection and methods development efforts were built from a solid base of understanding and did not mistakenly misinterpret various program delivery realities, including future plans and past lessons learned.

For this 2018 evaluation, interviews were designed to supplement the information collected in the previous 2017 evaluation. Under that effort, interviews were completed in early November 2018 of managers of the five largest program/measure combinations. The supplemental interviews conducted in this evaluation included the following entities:

- ClearResult staff – the implementer of the Energy Smart Grocer program – in early September 2019
- PG&E Commercial Deemed Incentive Program Manager (Tankless Water Heating measure) – in early September 2019
- SCG Commercial Deemed Incentive Program Manager (Tankless Water Heating measure) – in late September 2019

3.1.2 Program Tracking and CIS Billing Data

Each of the IOUs upload program tracking and CIS billing data onto a centralized server that were downloaded by the evaluation team. The evaluation team analyzed, cleaned, re-categorized, reformatted, and merged these separate datasets into one integrated program tracking database. The purpose of this exercise was to gain insight into the number of program participants receiving rebates for program year 2018 ESPI measures, understand the portfolio-level savings attributable to those rebated measures, and inform the sampling plan for ex-post evaluation.

CIS billing data was also used to support billing analysis for the Agricultural Irrigation measures, and both AMI and CIS data were used in support of gross impact model calibration for the pumping VFD measure.

3.1.3 On-Site Verification

For this evaluation, we collected on-site verification data for all four evaluated measures. On-site surveyors gathered installation and operational characteristics, collected data relevant to specific parameters that support the estimation of impacts, performed spot watt and end-use metering, and gathered information from Energy Management System (EMS) logs. Table 3-2 provides the details of the data that were collected on-site.

TABLE 3-2: SUMMARY OF PRIMARY SITE-SPECIFIC GROSS IMPACT DATA COLLECTION EFFORTS – SMALL COMMERCIAL IMPACT EVALUATION

Parameter	Ag Irrigation	Process Pumping VFD	Refrigeration Case LED Lighting	Tankless Water Heater
Installation and operation characteristics		Inspectors recorded the crop type, acreage and irrigation approach for each pump in the sample. Equipment Nameplate: A photograph of the pump, motor and VFD was taken. The inspector also recorded the information on the nameplates. Operating Characteristics: Inspectors collected the operating schedules and key operating settings, such as pump speed, VFD setting and pump control approach. The site contact was also asked specifically for monthly operation data, crop water requirements and water sources.	Inspectors collected length and quantity of LEDs installed. The inspectors also collected self-report lighting schedules from the site contact, as well as installing lighting loggers to verify case lighting schedules.	
Specific parameters of interest	Pump control sequences, crop type, pre-installation crop and irrigation method.	Pumping part-load profiles, well depth, pump capacity, pump settings, seasonality-based variability in loads	New equipment specifications, removed equipment specifications, presence of gas heating, presence of waste heat recovery, case lighting usage profiles, evidence of program induced early replacement	Building type, loads served, setpoints, occupancy schedule, units served, eligibility, rated efficiency
Spot measurements	N/A	Observed load, Hz	N/A	Inlet and outlet temperatures
End-use metering	N/A	N/A	Lighting loggers for the onsite sample	N/A
EMS logs	N/A	N/A	N/A	N/A
Billing data	Usually a dedicated billing meter supports billing analysis for the Ag measures	AMI/ dedicated billing meter	N/A	N/A

Process Pumping VFD

The pumping VFD measures included in the PY2018 savings claims constitutes 40 percent of the expected net lifecycle electric savings among all small/medium commercial ESPI measures and 10 percent of the small/medium commercial sector savings overall. The bulk of the records and associated expected savings claims have measure descriptions that indicate they are agricultural pumps, used in both booster pump and well pumping applications. Tracking system-based measure descriptions also indicate the pump capacity in horsepower. Of the more than five hundred measure records, the vast majority are tracked as being retrofit add-on (REA) applications, with a small number of SCE applications shown as being replace on burnout/new construction (ROBNC). During evaluation data collection for the on-site sample, the evaluation field staff independently determined the relevance or not of REA and ROBNC claim categories, as this has important implications for the relevant evaluation-based baseline determination, the EUL derivation and for the evaluation approach that can be applied.

Evaluators assessed each sampled project for installation/operability, operating schedule, operating conditions, secondary literature review, targeted interviews, eligibility, baseline, EUL determination and GRR and savings derivation. Savings determination incorporated information from the following sources: project file reviews, on-site data collection, reported operating characteristics, various known operating points and AMI/CIS billing analysis. As described in the subsequent sampling section, the impact evaluation assessed a sample of 49 pumps installed in PY2018.

Field data collection included discussions with farmers/pump operators regarding usage patterns, flow rates, well depth, booster pump operations for crop irrigation, crop type, pump capacity, type and make and model, and other factors needed for modeling pump usage. These data were obtained on a retrospective basis, both before and following VFD installation, based on data collection spanning September 2019 through January 2020. Follow-up calls were placed where warranted. AMI records were obtained for a period of nearly three years, ending in August or September of 2019. The utility meter for the affected pump is often isolated in the field, and therefore AMI data provides sufficiently granular kW data; additional short-term measurement was not needed. Assigned field engineers also obtained any available trend data from the VFD or other sources, such as pump run hours, cumulative kWh since installation and even water volume pumped throughout the year.

Evaluators used a combination of telephone interviews and on-site verifications to collect key parameters required for accurate modeling of pump usage. Information to be collected on-site or over the telephone includes:

- Project details: installation date, acreage affected, irrigation “sets”
- Logged pump production statistics
- Installed irrigation characteristics: irrigation approach, rated gpm
- Pump make and model and key pumping characteristics: rated horsepower, well depth, pressure setpoint, pump capacity, pump HP, pump flow rate
- Daily, monthly and seasonal well pumping and irrigation pumping patterns
- Pre and post crop types
- Pre and post crop ages
- Preexisting conditions: irrigation system, pumping and irrigation pumping patterns, operability, pressure setpoint, sets
- Age and condition of the existing pump

For cases where REA is confirmed, the participant contact was asked about the pre-existing pump controls that were in place for consideration in baseline determination. Where throttling controls were replaced with a VFD, the removed controls form the baseline. Regarding common practice at the time of pump replacement and use of secondary sources for the purposes of establishing baseline; the gross impact evaluation used the program established throttling control baseline; thus leaving determination of naturally occurring levels of VFD adoption to be settled by the free ridership assessment/NTGR evaluation. This includes the investigation of the necessity or not of VFD controls in order to meet pumping requirements and the decision to not use that data to further inform an appropriate baseline. For VFD replacement projects where the previous controls were equivalent in performance to a VFD, such as AFD controls, the VFD was set as baseline and the resulting gross impacts were set to zero.

Refrigeration Case LED Lighting

According to 2018 claims data, PG&E, SCE and SDG&E all offered LED lamp measures for refrigeration cases, and this accounts for 38 percent of expected net lifecycle electric savings among small/medium commercial ESPI measures and 9 percent of the small/medium commercial sector savings overall. Programs treat these as early retirement claims, and set the EUL savings equal to the RUL of the existing refrigeration case. That is, the lamps will only last as long as the case, and the eventual case replacement will result in lack of persistence of savings for the lamps installed.

The gross impact evaluation for PY2018 will utilize data collected using a combination of on-sites and telephone surveys. On-site data collection will utilize a set of forms, and activities will also involve the deployment of time-of-use lighting loggers that capture the run-time of refrigeration case LED lighting systems. The on-site field data and loggers combined will support collection of the following:

- The schedule of LED lighting operation
- Self-report LED lighting schedules for those same stores
  - Daily by day of the week (if variable)
  - Variability, if any, by product stored in cases
  - Whether or not there are periods where the case lighting is completely off
  - If a lower level of illumination is used, and how that is achieved (dimming versus fraction turned on)
- Participating store LED make and model numbers supporting lighting connected loads
- Participating store refrigeration system specifications in support of EER assessment/interactive effects determination, for compressor and condenser systems
- The lamp type removed in support of baseline assessment, including the lamp profile (single or multiple)
- Trends in LED case lighting adoption in support of industry standard practice assessment and the continued role for the programs
- Specifics of the case in which the LEDs are installed – low temperature cases, medium or dairy; with or without doors; width and height; defrost method; etc.
- Age and condition of the existing case

Agricultural Irrigation

The agricultural irrigation measure had appeared on prior uncertain measure lists and was evaluated in the PY2013-15 and PY2017 ESPI cycles. This measure has evolved since prior cycles and, per the applicable PG&E workpaper (PGECOAGR111 Revision 6[4]), now only allows farms with a crop classification of "field crop/vegetable" to participate. Other crop types, such as deciduous crops (fruit and nut trees) and vineyards, were previously eligible in PY2013-15 but were not eligible in PY2017 and beyond.

[4] All active and archived workpapers can be downloaded at http://deeresources.net/workpapers.

Additionally, the agricultural irrigation measure currently only allows upgrades from sprinkler nozzle irrigation to drip irrigation. Prior cycles had allowed low-pressure nozzles or “micronozzles” as high-efficiency replacements but have since been sunset, as reflected in the current PG&E workpaper.

The gross impact evaluation for PY2018 supports the March 2020 Bus Stop by leveraging evaluation methods used in PY13-17: a billing analysis of electric consumption and/or AMI data, incorporating participant survey data in support of the regression modeling effort. Monthly and AMI utility data for the population of PY2018 participants were supplied by PG&E for all PY2018 participants.

Based on recruitment dispositions in prior evaluation cycles for this measure group, we designed a sample of 14 PY2018 projects; however, due to some instances of non-response or refusal, evaluators recruited all high- and medium-impact projects among the population of 24 farms, resulting in 16 evaluated projects.

Evaluators employed a combination of telephone interviews and on-site verifications to collect key parameters to normalize pre- and post-project utility data for appropriate comparison, including:

- Project details: installation date, acreage affected, irrigation “sets”
- Installed drip tape characteristics: make/model, rated gpm
- Irrigation system: quantity of pumps, rated horsepower, control methods, pressure setpoint
- Recent pump commissioning tests, if available
- Pre and post crop types
- Pre and post crop ages
- Preexisting conditions: irrigation system, operability, pressure setpoint, sets
- Irrigation schedule: hours per day, frequency per month
- Irrigation patterns by month

Selected projects received an on-site assessment to confirm telephone survey information and physically verify the installation and operation of the rebated drip tape and affected irrigation pump. As the utility meter for the affected pump is often isolated in the irrigated field, AMI data provided sufficiently granular kW data; additional measurement was not required.

Tankless Water Heaters

The measure involves the installation of both small (≤ 200 kBtuh) and large high-efficiency instantaneous water heaters. The minimum efficiency for small instantaneous water heaters is split into two tiers; 0.81 to 0.86 UEF for tier one, ≥ 0.87 UEF for tier two. The minimum efficiency for larger instantaneous water heaters is also split into two tiers; the first tier is ≥ 80 percent thermal efficiency, and tier two is ≥ 90 percent thermal efficiency.

The commercial tankless water heater (TWH) measure contributes 68 percent of PY2018 gas savings among all ESPI measures falling within the small/medium commercial sector and has not been previously studied as part of the ESPI evaluations. For these reasons, an enhanced rigor evaluation will be conducted in PY2018. Evaluators plan to assess each sampled project for installation/operability, eligibility, percent of expected savings (PES), and NTGR through project file reviews, on-site data collection, and spot measurement. As described in the subsequent sampling section, the impact evaluation was originally designed to assess a sample of 36 projects completed in PY2018. However, due to tracking data gaps and inconsistencies resulting from the measure’s midstream, distributor-facing design, evaluators were able to assess 24 projects.

During each site visit, field engineers collected information on the following:

- installed make and model
- nameplate information: max gpm, UEF, rated capacity, etc.
- installation date
- facility type
- hot water use and possible seasonal fluctuations
- inventory of hot water fixtures and rated gpms
- preexisting conditions: WH type, age, operation condition
- inventory of all gas meters at facility
- inventory of all gas uses at facility, by season, with estimates of gas usage share

Data collection was leveraged to inform ongoing EUL research when possible. Namely, information on preexisting water heater age, condition, and estimated remaining useful life was collected and shared with concurrent Group A research on water heater EULs.

Field engineers also performed spot temperature measurements on the entering and exiting piping for each rebated TWH. Evaluators used the temperature measurements, along with the verified TWH size and nameplate efficiency as bulleted above, to recreate the unit energy savings (UES) originating from DEER prototype models.[5] By comparing the DEER modeling assumptions with field-verified and measured data, analysts calculated evaluated UES (therm per kBtu/h installed) and subsequent evaluated savings.

3.1.4 Participant Phone Surveys

We also conducted telephone surveys to support the Net to Gross analysis and 1) confirm with the program participant the measure installation, 2) estimate free-ridership and 3) gather a variety of data useful to the program assessment, gross impact and ex-ante workpaper review activities.

A market research firm was used to conduct telephone surveys with a representative sample of participants. The questions asked of interviewees were designed to gather information to allow the evaluation team to estimate participant free-ridership to support the development of Net-to-Gross and net savings values. We asked a standard battery of Net-to-Gross questions of all telephone survey respondents.

A subset of the telephone interviews was conducted by professional staff when a single contact was responsible for a large portion of the (weighted) program savings across multiple sites. Large farms installing Process Pumping VFDs across multiple locations provides one such example. In such cases, a given location is typically represented by a single program application, but a single corporate entity and decision maker might be associated with multiple applications.

In addition to interviewing participants, distributors were also interviewed for the Tankless Water Heater measure. These measures were offered through a midstream program, so a different approach to estimating the NTGR was performed which relied on surveying distributors involved with the program.

3.1.5 IOU Workpapers and DEER

The evaluation team also conducted a comparative analysis using ex-ante parameter estimates from the following sources: IOU workpapers, data received directly from the IOUs, data downloaded from DEER and the gross ex-post impacts developed using evaluation data sources. The ex-ante gross impacts for deemed measures are developed with unit energy savings values.

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5 Tankless Water Heater ex-ante savings reflect PG&E and SCG workpapers active in PY2018: PGECODHW101 Revision 7 and SCGNRWH120206 Revision 7. Both workpapers rely on DEER prototype modeling for savings derivation. All active and archived workpapers can be downloaded at http://deeresources.net/workpapers.

Lifecycle savings are calculated by multiplying the annual unit energy savings by the effective useful life of the measure. The evaluation team compared the ex-ante to the ex-post estimates for each of the measure-parameters to better understand which parameters are driving the gross realization rates for each measure.

3.1.6 Industry Sources

Industry sources were used to supplement other evaluation data sources, especially in cases where it is impractical for the evaluation to independently collect data and establish comparable results due to time and budget limitations, or where industry sources have already adequately established a given parameter or result. Industry sources were used to establish robust methods for estimating savings. Some examples include:

- Use of the Uniform Methods Protocols to derive savings estimates
- Use of manufacturer equipment specifications to establish parameters
- Use of theoretical irrigation requirements by crop type and climate
- Use of market assessment or market share tracking study results
- Use of literature or interviews with industry experts to establish industry standard practice

3.2 SAMPLE DESIGN AND DATA COLLECTION

3.2.1 Onsite Sample Design

Sampling across measure groups shares a common approach, involving on-site data collection for a sample of points, and conducting M&V for that representative sample following data collection. M&V activities were used to derive independent estimates of ex-post impact estimates and ESPI deliverables, and informed improvements needed to ex-ante impact, EUL and load shape estimates, as well as improvements that can be made to the programs themselves.

Process Pumping VFD Measure Group

The process pumping VFD measure group is an important contributor to electric savings within the measures included in this evaluation, contributing 40 percent of electric savings. Furthermore, we note the following important observations:

- PG&E and SCE contribute the largest share of savings in the process pumping VFD measure group, at 80 and 20 percent, respectively, and SDG&E contributes just a small minority of savings. **Implication**: only sampled among PG&E and SCE applications, and transferred evaluation results to SDG&E savings where feasible.
- For both PG&E and SCE there is substantial variability in project size (in terms of expected savings) across applications. **Implication**: the sample pull was stratified on project size and quotas were set for each strata by PA. This ensured that the resulting stratified random sample would represent each strata.
- Following the sample pull, additional stratification was incorporated within the design as follows:
  - The process pumping VFD measure group consists of largely VFDs installed in agricultural pumping applications – consisting of a mix of booster pumps used for irrigation (34 percent of tracking system records and 21 percent of savings) and well pumps used to draw water to the surface (65 percent of tracking system records and 77 percent of savings). A small minority of applications involve glycol pumps used in industrial process applications. **Implication**: The evaluation approach featured a data collection strategy designed to yield an appropriate mix of booster and well pumps.
  - PG&E applications feature a number of repeat customers that participate on more than one occasion. **Implication**: during the sample pull process the population was linked by customer representative to ensure efficient recruitment for on-sites and coordination with the NTGR team, and to ensure that a given decision maker was not inadvertently harassed.

Table 3-3 presents a summary of information surrounding the process pumping VFD measure group, and the resulting on-site and M&V sample design along with the number of completed onsites.

TABLE 3-3: PROCESS PUMPING VFD MEASURE GROUP GROSS IMPACT SAMPLE DESIGN AND COMPLETED ONSITES

Process Pumping VFD Measure Grouping	PY2018 Tracking Population		Sample Design and Data Collection (Records)		Achieved Data Collection (% of Population)	
	Records*	Ex-Ante Net Lifecycle Savings (GWh)**	Target	Actual	% Records	% GWh
PG&E						
Booster	170	7.0		8	5%	7%
Well-Large	71	13.2		9	13%	12%
Well-Small	271	15.3		10	4%	5%
Subtotal	**512**	**35.5**	**24**	**27**	**5%**	**8%**
SCE						
Booster	32	2.4		6	19%	13%
Well-Large	20	4.0		7	35%	33%
Well-Small	33	2.6		9	27%	36%
Subtotal	**85**	**9.1**	**18**	**22**	**26%**	**29%**
SDG&E						
Subtotal	**2**	**0.1**	**0**	**0**	**0%**	**0%**
PG&E and SCE Total						
Total	**597**	**44.6**	**42**	**49**	8%	12%

Source:

CEDARS, 2018. Confirmed Claims Dashboards for 2018 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of records of non-zero savings; both positive and negative.

** The 0.05 market effects adder is not included in the net savings values.

Initially it was thought that only one pump record in any given recruited application would be evaluated. However, upon further reflection it was decided to analyze all pumps within a given application, where feasible, in order to maximize the number of pumps in the resulting sample and, importantly, to ensure that the variety of pumps in a given application were represented in the gross impact results – in particular that both booster and well pumps were captured where available. This resulted in a greater number of individual pumps being analyzed for gross impacts than was originally designed, both for PG&E and SCE.

Refrigeration Case LED Lighting

The refrigeration case LED lighting measure group is an important contributor to electric savings within the measures included in this evaluation, contributing 38 percent of electric savings. Furthermore, we note the following important observations:

- The refrigeration case LED lighting measure group is both an electric and gas ESPI measure. Furthermore, only the electric saving claims are positive, with the gas saving claims being negative and associated with interactive effects. Also, only PG&E estimates include the negative gas saving claims. **Implication**: relative importance for sampling purposes, and weights associated with downstream analysis, will be based on electric saving estimates only.
- PG&E and SDG&E contribute all of the expected electric savings in the refrigeration case LED lighting measure group, at 85 and 15 percent, respectively. Furthermore, most of the sample frame in terms of number of sites is associated with several hundred PG&E participating businesses and just 35 SDG&E businesses. **Implication**: sample both PG&E and SDG&E sites, with a greater allocation for PG&E.
- The participants in the refrigeration case LED lighting measure group consist of a mix of both major chain stores and participating mom and pop businesses. **Implication**: stratify the PG&E sample on chain and mom and pop businesses. The tracking system records can be used to identify several chain participants, and the resulting sample mix of chains and mom and pop businesses.
- The remaining non-chain participants consist of a mix of grocery stores and other smaller establishments. It is hypothesized, based on past evaluation experience, that the grocery stores will be larger users of electricity and operate refrigeration case LED lighting for a greater number of hours than the other businesses in the sample frame. **Implication**: stratify the remaining businesses on electric usage.

The evaluation will feature the use of ratio estimation to aggregate strata-level results back to each full PA refrigeration case LED lighting population.

Table 3-4 presents a summary of information surrounding the refrigeration case LED lighting measure group, and the resulting on-site and M&V sample design along with the number of completed onsites. We were successful in meeting all of our on-site targets.

TABLE 3-4: REFRIGERATION CASE LED LIGHTING MEASURE GROUP GROSS IMPACT SAMPLE DESIGN AND COMPLETED ONSITES

Refrigeration Case LED Lighting Measure Grouping	PY2018 Tracking Population		Sample Design and Data Collection (Applications)		Achieved Data Collection (% of Population)	
	Applications*	Ex-Ante Net Lifecycle Savings (GWh)**	Target	Actual	% Applications	% GWh
PG&E						
Other Chain Stores	25	5.8	8	8	32%	30%
Largest Participating Chain Store	32	11.9	8	8	25%	43%
Remaining Large Electric Users	80	8.8	17	17	21%	17%
Remaining Small Electric Users	144	10.5	17	17	12%	11%
Subtotal	**281**	**37.1**	**50**	**50**	**18%**	**26%**
SDG&E						
Subtotal	**35**	**5.0**	**10**	**10**	**29%**	**36%**
PG&E and SDG&E Total						
Total	**316**	**42.0**	**60**	**60**	**19%**	**27%**

Source:

CEDARS, 2018. Confirmed Claims Dashboards for 2018 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of sites with records of non-zero savings; both positive and negative.

** The 0.05 market effects adder is not included in the net savings values.

Agricultural Irrigation

The agricultural irrigation measure group contributes 24 percent of electric savings and no gas savings within the measures included in this evaluation. Please note that we have interpreted the agricultural irrigation measure group to include only the sprinkler-to-drip replacement measure; agricultural pump VFD measures are addressed within the process pumping VFD measure group in PY2018. For the agricultural drip irrigation measure we note the following observations:

- The agricultural irrigation measure group is an electric ESPI measure, and as discussed above, only electric savings were claimed for this measure in PY2018. **Implication**: the full population of applications/projects was included in the sample frame.
- PG&E contributes all of the electric saving claims in the agricultural irrigation measure group. **Implication**: The gross sample consisted only of PG&E projects.
- The agricultural irrigation measure program delivery is via downstream provision of deemed participating customer rebates. **Implication**: The sample design need not segment by delivery method. Reasonable customer contact information was available in the program tracking data and sufficed for the purposes of on-site recruitment efforts. Evaluators used all available means to reach selected participant sample points.

The PY2018 sample frame consists of 24 unique applications, all of which are PG&E customers with measures classified as "sprinkler-to-drip irrigation" among field vegetables. Table 3-5 illustrates how the sample frame was stratified among four total strata to ensure the most economical design possible.

TABLE 3-5: AGRICULTURAL IRRIGATION MEASURE GROUP GROSS IMPACT SAMPLE DESIGN AND COMPLETED ONSITES

Agricultural Irrigation Measure Grouping	PY2018 Tracking Population		Sample Design and Data Collection (Applications)		Achieved Data Collection (% of Population)	
	Applications*	Ex-Ante Net Lifecycle Savings (GWh)**	Target	Actual	% Applications	% GWh
PG&E						
Stratum 1 – Large Savers	2	8.57	2	2	100%	32%
Stratum 2	6	8.44	5	3	50%	17%
Stratum 3	14	8.88	7	10	71%	23%
Stratum 4 – Small Savers	2	0.51	0	1	50%	1%
Total	**24**	**26.40**	**14**	**16**	**58%**	**73%**

Source:

CEDARS, 2018. Confirmed Claims Dashboards for 2018 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of sites with records of non-zero savings; both positive and negative.

** The 0.05 market effects adder is not included in the net savings values.

Four strata, from highest savers (stratum 1) to lowest savers (stratum 4), allowed us to strategically divide the sample frame to maximize the sample's precision. We assumed a coefficient of variation of 0.8, due to high variability in site-specific results in prior cycles.

As shown in the table, Strata 1 and 3 targets were met or exceeded, while Stratum 2 included three customers that were either unresponsive or refused participation in the study. In order to preserve the target relative precision overall, evaluators elected to pursue additional sites in Strata 3 and 4. As a result, evaluators assessed 16 projects, two greater than the original target of 14 projects. The 16 projects comprise 73 percent of PY2018 GWh savings for the agricultural irrigation measure.

Tankless Water Heating

The tankless water heater measure group contributes 66 percent of PY2018 natural gas savings and no electric savings within the measures included in this evaluation. In the context of sample design, we note the following observations:

- The tankless water heater measure group is a gas ESPI measure, primarily claiming gas savings in PY2018. **Implication**: the full population of applications/projects is included in the sample frame.
- PG&E and SCG contribute all of the gas saving claims in the tankless water heater measure group, at 75 and 25 percent, respectively. **Implication**: The sample design segments by PA, to ensure sufficient representation from each PA in the evaluation sample.
- Delivery method correlates closely with PA. All but one of PG&E's 490 applications involved midstream delivery; all but one of SCG's 154 applications were labeled as upstream. Based on conversations with SCG program administrators, evaluators believe that SCG's TWH measures were in fact delivered via midstream channels. **Implication**: Segmenting the sample by PA essentially segments by delivery method as well; separate segmentation by delivery method is not necessary.
- The programs' midstream design led to tracking data gaps and inconsistencies, particularly for end-user contact information. **Implication**: Evaluators used all available means to reach selected participant sample points; however, recruitment was challenging and led to fewer completed sample points than targeted.

The tankless water heater measure had appeared on the 2017 uncertain measure list but was not evaluated in prior ESPI cycles. The applicable tankless water heater workpaper (SCGNRWH120206B Revision 8) differentiates between small (less than 200 kBtu/h) and large water heaters (200 kBtu/h or greater). The evaluation team did not segment the sample by water heater size, as some applications include both large and small water heaters. However, the initial sample draw summarized in Table 3-6 confirmed sufficient representation of large (45 percent of sampled records) and small water heaters (55 percent) for post-hoc analysis.

TABLE 3-6: TANKLESS WATER HEATER MEASURE GROUP GROSS IMPACT SAMPLE DESIGN AND COMPLETED ONSITES

Tankless Water Heater Measure Grouping by PA	PY2018 Tracking Population		Sample Design and Data Collection (Applications)		Achieved Data Collection (% of Stratum Total)	
	Applications*	Ex-Ante Net Lifecycle Savings (MMThm)**	Target	Actual	% Applications	% MMThm
PG&E						
Stratum 1 – Large Savers	15	4.276	4	2	13%	18%
Stratum 2	26	4.413	5	2	8%	7%
Stratum 3	69	4.381	5	2	3%	3%
Stratum 4	252	4.403	5	9	4%	3%
Stratum 5 – Small Savers	128	0.537	0	0	0%	0%
PG&E Subtotal	**490**	**18.011**	**19**	**15**	**3%**	**7%**
SCG						
Stratum 1 – Large Savers	8	1.470	3	2	25%	29%
Stratum 2	18	1.508	4	0	0%	0%
Stratum 3	33	1.484	5	3	9%	9%
Stratum 4	78	1.422	5	4	5%	4%
Stratum 5 – Small Savers	17	0.179	0	0	0%	0%
SCG Subtotal	**154**	**6.063**	**17**	**9**	**6%**	**10%**
Total	**644**	**24.074**	**36**	**24**	**4%**	**8%**

Source:

CEDARS, 2018. Confirmed Claims Dashboards for 2018 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of sites with records of non-zero savings; both positive and negative.

** The 0.05 market effects adder is not included in the net savings values.

PY2018 featured 644 unique applications with non-zero gas savings from the tankless water heater measure. Wide variation in savings claim magnitude among the measure population caused the evaluators to stratify the sample by reported net lifecycle therms. Stratification optimizes the value of each sample point by ensuring high-impact projects are included in the sample, resulting in a more economical design. Five savings strata were used within each PA segment. The lowest-saving stratum (stratum 5) was omitted from the sample, as it constituted less than three percent of the lifetime therm savings within each segment. As the tankless water heater measure has not been evaluated in prior ESPI activities, evaluators assumed a coefficient of variation (COV) of 0.5 in the sample design.

Table 3-6 indicates that evaluators fell short of the target count of sampled projects. Recruitment of PY2018 TWH participants proved extremely difficult due to tracking data gaps and inaccuracies for both PG&E and SCG. Because of the TWH measure group's midstream, distributor-facing design, distributors and contractors do not necessarily submit basic end-user contact data to program administrators. The evaluation team filed follow-up data requests with PG&E and SCG to attempt to fill these data gaps; however, in the end, approximately 75 percent of the PY2018 population did not include sufficient end-user data for evaluation recruitment.

Due to these recruitment challenges, the evaluation team pursued all sampled and backup sites within strata 1-4. PG&E Stratum 4 led to nine completed on-sites as compared with the targeted five. Otherwise, all other strata led to fewer completed on-sites than originally targeted for both PAs. The impacts of these reduced counts on the results and statistical precision are examined in Section 5.

3.2.2 Telephone Survey Sample Design

Sampling across measure groups involves a common data collection and analysis approach, involving telephone surveys for a sample of points, and, following data collection, estimating net-to-gross (NTG) using established calculations/procedures for each representative sample point. Resulting sample-based NTG estimates are used to derive independent estimates of evaluation-based net impacts, which will be used to inform ESPI deliverables and possibly expected NTG parameter updates, as well as to inform improvements that can be made to the programs themselves.

Process Pumping VFD

A total of 50 telephone survey points were allocated to the process pumping VFD measure group. Several of the observations already discussed above are also relevant here, and so portions of the following discussion are repeated here, including the relevant implications of several important observations:

- PG&E and SCE contribute the largest share of savings in the process pumping VFD measure group, at 80 and 20 percent, respectively, and SDG&E contributes just a small minority of savings. **Implication**: only PG&E and SCE applications were sampled, and evaluation results were transferred to SDG&E savings.
- The process pumping VFD measure group consists of largely VFDs installed in agricultural pumping applications – consisting of a mix of booster pumps used for irrigation (34 percent of tracking system records and 21 percent of savings) and well pumps used to draw water to the surface (65 percent of tracking system records and 77 percent of savings). A small minority of applications involve glycol pumps used in industrial process applications. **Implication**: for PG&E the sample frame was further stratified to isolate the well pump and booster pump applications. Glycol pumps were not sampled. For SCE, given that sampling targets represent an aggressive 25 percent

of the available sample frame, or 1 out of 4 completes, the design was not further stratified on project pump type.

Table 3-7 presents a summary of participation and the resulting telephone survey sample design for the Process Pumping VFD measure, along with the number of completed phone surveys.

TABLE 3-7: PROCESS PUMPING VFD MEASURE GROUP NET IMPACT SAMPLE DESIGN AND COMPLETED SURVEYS

Process Pumping VFD Strata	PY2018 Tracking Population		Sample Design and Data Collection (Applications)		Achieved Data Collection (% of Population)	
	Applications*	Ex-Ante Net Lifecycle Savings (GWh)**	Target	Actual	% Applications	% GWh
PG&E						
Well Pumps	323	27.8	20	49	15%	17%
Booster Pumps	151	7.0	9	29	19%	22%
Glycol Pumps	2	0.8	0	---	---	---
Subtotal	**453**	**35.5**	**29**	**73*** **	**16%**	**18%**
SCE						
Subtotal	**80**	**9.1**	**21**	**25**	**31%**	**31%**
SDG&E						
Subtotal	**2**	**0.1**	**0**	**0**	**---**	**---**
PG&E and SCE Total						
Total	**533**	**44.6**	**50**	**98**	**18%**	**21%**

Source:

CEDARS, 2018. Confirmed Claims Dashboards for 2018 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of applications with records of non-zero electric savings; both positive and negative.

** The 0.05 market effects adder is not included in the net savings values.

*** Note that some applications had both Well and Booster pumps. Therefore the sum of the applications for these two measures exceeds the total, as the total includes unique applications.

For all strata, the number of applications represented by completed surveys exceeded the target number of applications. The PG&E Well and Booster pump strata in particular were well over the target quotas that had been set. Overall, at the statewide level, the actuals in terms of the number of applications represented was nearly double than the targets set.

Refrigeration Case LED Lighting

A total of 72 telephone survey points were allocated to the refrigeration case LED lighting measure group. Furthermore, we note the following important observations:

- The refrigeration case LED lighting measure group is both an electric and gas ESPI measure. Furthermore, only the electric saving claims are positive, with the gas saving claims being negative and associated with interactive effects. Also, only PG&E estimates include the negative gas saving claims. **Implication**: relative importance for sampling purposes, and weights associated with downstream analysis, were based on electric saving estimates only.
- PG&E and SDG&E contribute all of the expected electric savings in the refrigeration case LED lighting measure group, at 85 and 15 percent, respectively. Furthermore, most of the sample frame in terms of number of applications is associated with several hundred PG&E applications and just 35 SDG&E applications. **Implication**: sample both PG&E and SDG&E applications, with a greater allocation for PG&E.
- PG&E program delivery is via downstream and direct installation approaches, with downstream delivery via a third-party program called EnergySmart Grocer, and DI delivery via an array of LGP programs and one third party program called the Hospitality Program. Furthermore, both delivery channels for PG&E represent a substantial participation channel for the refrigeration case LED lighting measure, and represents a substantial level of expected electric savings. For each delivery approach it is hypothesized that contractors, third-party implementers and utility personnel who are engaged with customers and participate in the program delivery process, can have a large influence on the selection of program qualifying equipment in lieu of other available choices in the marketplace. Furthermore, the participants that make up the two third-party programs are largely major chain stores, while the LGP programs largely serve the mom and pop market. **Implication**: the evaluation drew sample points from each of these key PG&E program segments, and during telephone surveys with customers concerning their purchase decision, we probed on various influences, both program and non-program.

Table 3-8 presents a summary of participation and the resulting telephone survey sample design for the refrigeration case LED lighting measure group, along with the number of completed surveys.

TABLE 3-8: REFRIGERATION CASE LED LIGHTING MEASURE NET IMPACT SAMPLE DESIGN AND COMPLETED SURVEYS

Refrigeration Case LED Lighting Strata	PY2018 Tracking Population		Sample Design and Data Collection (Applications)		Achieved Data Collection (% of Population)	
	Applications*	Ex-Ante Net Lifecycle Savings (GWh)**	Target	Actual	% Applications	% GWh
PG&E						
EnergySmart Grocer (Downstream)	74	17.0	25	44	59%	77%
Hospitality Program (Direct Installation)	24	5.5	8	24	100%	100%
LGP Group (Direct Installation)	188	14.6	30	19	10%	10%
Subtotal	**286**	**37.0**	**63**	**87**	**30%**	**54%**
SDG&E						
Subtotal	**36**	**5.0**	**9**	**1**	**3%**	**5%**
PG&E and SDG&E Total						
Total	**322**	**42.0**	**72**	**88**	**27%**	**48%**

Source:

CEDARS, 2018. Confirmed Claims Dashboards for 2018 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of applications with records of non-zero savings; both positive and negative.

** The 0.05 market effects adder is not included in the net savings values.

For several of the strata, such as the LGP group and SDG&E categories, the number of applications represented by completed surveys fell short of the target quantities. For others, namely the Hospitality program stratum, the actuals surpassed the target quantity. Overall, on a statewide basis, the number of applications represented by completed surveys exceeded the target quantity.

Agricultural Irrigation

Evaluators attempted net surveys among the 16 participants assessed for gross savings as outlined in Table 3-5. Five of the 16 customers did not sufficiently complete the net survey, due to unresponsiveness or refusal by the decision-maker. As a result, evaluators completed 11 net surveys for the agricultural irrigation measure.

As detailed in Section 5, eight evaluated projects resulted in zero savings due to ineligibility by crop type, reducing the count to three completed NTG surveys for eligible projects. Therefore, evaluators adopted the stipulated net-to-gross ratio of 0.60 as recommended by the applicable workpaper in PY2018.

Tankless Water Heating

Tankless water heater measures are delivered through midstream channels by offering rebates to distributors to stock and sell high-efficiency equipment to contractors, who in turn install those systems among commercial customers. The customers are typically unaware that they participated in an efficiency program; in theory, the utility rebates have reduced the equipment capital cost from distributor to contractor to customer, accelerating market adoption of high-efficiency alternatives.

Program influence is therefore most evident among participating distributors. The evaluation team conducted professional interviews among six distributors representing 76 percent of PY2018 savings, as detailed in Table 3-9, to quantify the programs' influence on tankless water heater installations.

TABLE 3-9: TANKLESS WATER HEATER MEASURE GROUP DISTRIBUTOR INTERVIEWS

	PY2018 Tracking Population		Completed Distributor Interviews		
Tankless Water Heater Program Administrator	Distributor Counts	Ex-Ante Net Lifecycle Savings (MMThm)**	Counts	% Applications	% MMThm
PG&E	6	18.0	4	93%	83%
SCG	10	6.1	2	64%	56%
Total	**16**	**24.1**	**6**	**86%**	**76%**

Source:

CEDARS, 2018. Confirmed Claims Dashboards for 2018 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of sites with records of non-zero savings; both positive and negative.

** The 0.05 market effects adder is not included in the net savings values.

In order to quantify NTGR for the TWH measure group, professional interviewers sought the following information from participating distributors:

- Strategies used to market program-rebated, high-efficiency systems
- Importance of various factors (incentive, promotional materials, training, utility bill savings, etc.) in the contractor's/customer's decision to purchase high-efficiency equipment
- Importance of the utility program benefits (incentive, program services and information) in the distributor's decision to recommend high-efficiency equipment to contractors or customers
- Likelihood of recommending identical equipment without program affiliation or incentives
- Share of total annual sales influenced by program incentive or other benefits

4 GROSS IMPACT EVALUATION METHODOLOGY

This section provides an overview of the methods used to estimate the gross savings for each of the evaluated PY2018 ESPI measures.

4.1 REFRIGERATION LED CASE LIGHTING MEASURES

The gross impact evaluation of PY2018 Refrigeration Case LED lighting measures included on-site verification, installation of data loggers, tracking data review, and engineering analysis activities. The goals of the evaluation were to develop gross realization rates for the measure using primary data collected on-site related to several parameters in the IOU workpaper deemed savings calculations that the ESPI team flagged as data points with a relatively high level of uncertainty.

The sampled measures and their ex-ante unit energy savings are shown in Table 4-1.

TABLE 4-1: REFRIGERATION CASE LED LIGHTING MEASURE CODES AND EX-ANTE SAVINGS

Code	IOU	Measure Description	UES kW	UES kWh	Unit
LB07	PG&E	Linear foot of Tier 2 LED Lightbar, <= 5-foot unit, no occupancy sensor control replacing single lamp profile	0.00	22.1	Length of existing lamps
LB09	PG&E	Linear foot of Tier 2 LED Lightbar, > 5-foot unit, no occupancy sensor control replacing single lamp profile	0.02	86.6	Length of existing lamps
LC03	PG&E	Linear foot of Tier 1 LED Lightbar, > 5-foot unit, no occupancy sensor control replacing multiple lamp profile	0.05	210.0	Length of existing lamps
LC09	PG&E	Linear foot of Tier 3 LED Lightbar, <= 5-foot unit, no occupancy sensor control replacing multiple lamp profile	0.01	56.4	Length of existing lamps
402270	SDG&E	Lighting - Premium Tier 5-foot Case Door	0.03	183	Door
402271	SDG&E	Lighting - Premium Tier 6-foot Case Door	0.16	990	Door

Ex-ante claims are based upon IOU-specific, well-documented, workpaper-based approaches that were reproduced by the evaluation team, and then subsequently used to provide comparisons against ex-post methods throughout this section.[6] PG&E and SDG&E use different unit basis for each of their programs. PG&E reports delta watts, demand reductions and energy savings per linear foot, whereas, SDG&E reports savings on a per door basis. The general IOU approach is to calculate a delta watt between pre and post lighting and apply interactive effect multiplier, DEER hours of use, and DEER coincident factor variables to arrive at a demand and energy savings (UES) per measure unit. The uncertainty parameters include existing pre-retrofit lighting system characteristics and wattage, annual hours of use, and assumptions related to refrigeration system nameplate efficiency used in interactive effect calculations.

The PY2018 evaluation utilized primary data collected from 60 PY2018 participants by the evaluators in 2019. These existing data sources consist of evaluation samples that were fielded but had not subsequently been used to estimate program impacts for LED case lighting until this effort. The evaluators installed TOU lighting loggers in refrigeration cases and fielded surveys to collect:

- The schedule of LED lighting operation for 60 distinct participating store schedules
- Self-report LED lighting schedules for those same stores
- Participating store LED make and model numbers supporting lighting connected loads
- Participating store self-report data on baseline lamp type
- Participating store refrigeration system specifications in support of EER assessment/interactive effects determination, for compressor and condenser systems

The evaluators calculated demand and energy impacts by modifying the algorithms in the IOU workpapers for this measure with data driven adjustments to the following: baseline lighting assumptions (pre-lighting), verified measure counts and wattage (post lighting), and either self-reported hours of use or logger-based hours of use for the case LED lighting system.

First, the evaluators successfully re-calculated the ex-ante UES, 1st year ex-ante savings, and lifecycle savings for all sampled projects and measure codes using tracking data quantities and IOU specific work paper calculations. Starting from there the evaluation process was to add each site verified parameter iteratively to derive the final evaluated savings. These include the measure lamp wattage, baseline lamp technology, wattage, lamp profile resulting in existing lighting fixture wattage, self-reported annual hours of use, and finally the logger-based annual hours of use. The final step in the evaluation gross impact analysis was to calculate gross impacts results across all IOU's using the measure lamp quantity as the unit of measure and assuming a one to one replacement of existing fixtures with measure fixtures. This

[6] SCE impacts are based on workpaper SCE13LG098.2, PG&E uses PGECOLTG174 R1, and SDG&E uses WPSDGENRLG0082-Rev02-Msr003

addresses some assumptions related to assumed number of fixtures per refrigerated case embedded in the deemed savings calculations.

The final evaluated first year kW demand reduction was calculated using the following formula:

$$kW\ Demand\ Reduction = \Delta Watts\ Final\ \times Refrigeration\ Compressor\ Factor \times Coincident\ Demand\ Factor / 1000$$

Where,

ΔWatts Final = (Watts of existing fixture – watts of measure fixture) x total quantity of measure lamps as verified through field work.

Refrigeration Compressor Factor = the IOU specific workpaper assumption related to interactive effects of refrigeration system needing to refrigerate less due to reduced heat gain of efficient lamps

Coincident Demand Factor = percent lights that are on during peak period calculated with logger data, where available.

The final evaluated first year kWh energy savings was calculated using the following formula:

$$kWh\ Energy\ Savings = \Delta Watts\ Final\ \times DEER\ Energy\ Interactive\ Effects\ \times Annual\ Hours\ of\ Use / 1000$$

Where,

ΔWatts Final = (Watts of existing fixture – watts of measure fixture) x total quantity of measure lamps as verified through field work.

DEER Energy Interactive Effects = the IOU specific workpaper assumption related to HVAC interactive effects.

Annual Hours of Use = the number of hours the lighting equipment operates in a year, calculated with logger data, where available.

4.2 PROCESS PUMPING VFD MEASURES

The primary objective of the impact evaluation was to perform a measure and measure-parameter impact evaluation, utilizing new primary evaluation data, in order to independently derive first year and lifecycle gross savings estimates for process pumping VFD measures, and to contribute method and parameter findings in support of ex-ante workpaper revisions scheduled for 2020. In particular, workpaper revisions are planned for agricultural pump VFD measures. The vast majority of PY2018 savings claims for the process pumping VFD measure are associated with agricultural pumps, with a minority of glycol pumps serving industrial processes. The evaluation focused exclusively on agricultural pumping applications – specifically pumps used to irrigate fields/crops – both booster pumps and well pumps.

The claimed measures and their ex-ante unit energy savings are shown in Table 4-2.

TABLE 4-2: PROCESS PUMPING VFD MEASURE CODES AND TRACKING DATA-BASED EX-ANTE SAVINGS VALUES

Code	IOU	Measure Description	UES kW	UES kWh	Unit
IR006	PG&E	Variable Frequency Drive on Agricultural Well Pumps (<=300hp)	0.121	256.6	Rated HP
IR007	PG&E and SCE	Variable Frequency Drive on Agricultural Booster Pumps (<=150hp)	0.122	226.65	Rated HP
IR012	PG&E	Agr Well Pumps (<=75HP) VFD - Enhanced Specifications	0.12	284	Rated HP
IR013	PG&E	Booster Pumps (<=75HP) VFD - Enhanced Specifications, Retrofit and New Construction	0.1	237	Rated HP
IR014	PG&E	Well Pumps (>75HP to <=600HP) VFD – Enhanced Specifications, Retrofit and New Construction	0.177	276	Rated HP
IR015	PG&E	Booster Pumps (>75HP to <=150HP) VFD - Enhanced Specifications, Retrofit and New Construction	0.108	257	Rated HP
MA5	PG&E	Glycol Pump VFD- 5HP	0	11,548.45	Each
MA8	PG&E	Glycol Pump VFD- 15HP	0	33,312.84	Each
MA9	PG&E	Glycol Pump VFD- 20HP	0	44,417.13	Each
PR-12484	SCE	VFD on Agricultural Well Pumps (<=300hp) Pump	0.121	256.6	Rated HP
PR-12497	SCE	VFD on Agricultural Booster Pumps (<=150hp) Pump	0.122	226.65	Rated HP
PR-18922	SCE	VFD on Ag Well Pumps (<=300hp) NEW Express Pump	0.121	256.6	Rated HP
PR-18923	SCE	VFD on Ag Booster Pumps (<=150hp) NEW Express Pump	0.122	226.65	Rated HP
463777	SDG&E	VFD on Agricultural Booster Pumps for 150 HP and below	0.122	226.65	Rated HP

Ex-ante claims are based upon workpapers, and the evaluation team checked whether or not tracking data-based claims were properly reported for all agricultural pump VFD measures. Unit-energy savings (UES) claims were verified in all instances examined, with the only exception being PG&E measure code IR014, where it was found that the UES for kW demand savings was entered as 0.177 instead of the correct workpaper-based value of 0.117.

4.2.1 Pump Modeling Description

The evaluation team elected to estimate savings based on a publicly available model for estimating VFD savings. This Excel-based tool (TRM401_energy savings calculator_pump and fan VFD_v4_1_14) is attached to the Savings Estimation Technical Reference Manual for the California Municipal Utility Association,[7] and is downloadable from their website under TRM spreadsheet number 401.[8]

The Excel-based tool used in the ex-post evaluation, adapted from the CMUA TRM 401 calculator, models the impact on input power for an irrigation pump with flow controlled by a VFD, the program condition, and the assumed baseline condition of throttle valve controls. For both control technologies the input power of the pump varies depending upon the pump load, which drops as a function of flow requirements, especially for the VFD. The VFD adjusts the pump motor speed (and flow) with reduction in load, while the motor continues to spin at a constant speed where throttle valve controls are applied. The throttle valve instead adjusts flow by incrementally closing a control valve on discharge size of the pump, thus constricting the flow through increase in friction. The reduction in power input for the VFD drops off more dramatic under lower and lower part-load conditions, when compared with the throttle valve controls, and this leads directly to the savings achieved by the VFD when deployed in appropriate applications. Pumps running fully loaded will not save energy when equipped with a VFD. The input power to speed relationship of a VFD is generally predicted by the affinity laws, with the change in input power varying as an exponent of the change in fluid velocity. For the purposes of this evaluation the affinity law exponent is set to 2.5 based on guidance for a *Fixed Geometry, Fully or Mostly Closed Water Loop* system taken from Energy Efficiency Baselines for Data Centers.[9] We revised the recommended exponent from 2.4 to 2.5 based on engineering judgement to account for observed irrigation pumping and distribution system characteristics (valves, manifolds, etc.). This is consistent with a pumping system where the load is not dominated by friction losses (significant static pressure drop), such as an irrigation system.

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7 https://www.cmua.org/files/CMUA-POU-TRM_2017_FINAL_12-5-2017%20-%20Copy.pdf

8 https://www.cmua.org/energy-efficiency-technical-reference-manual

9 Statewide Customized New Construction and Customized Retrofit Incentive Programs, March 1, 2013; https://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/hightech/data_center_baseline.pdf; page 54.

Table 4-3 is a table featured in the tool for one example sample point, and illustrates the impact of a VFD on pump loads relative to baseline throttle valve controls, and the associated impacts – as a function of pump part-load operating conditions and the frequency of each load condition.

TABLE 4-3: EVALUATION-BASED BIN/IMPACT MODEL EXAMPLE FOR PROCESS PUMPING VFD MEASURES

								Annual Hours of Operation:	1,416	1,416
Output Load Level	**Percent of Full Load Speed**	**Estimated % Time at Load**	**Baseline % Input Power**	**Proposed % Input Power**	**Baseline w/o VFD kW**	**Proposed w/VFD kW**	**Demand Savings kW**	**Baseline w/o VFD kWh**	**Proposed w/VFD kWh**	**Energy Savings kWh**
100%	100%	0%	100%	103%	18.8	19.4	(0.6)	0	0	0
95%	95%	0%	96%	91%	18.1	17.1	1.0	0	0	0
90%	90%	1%	92%	79%	17.4	14.9	2.5	199	171	28
85%	85%	1%	89%	69%	16.7	12.9	3.8	344	266	77
80%	80%	0%	85%	59%	16.0	11.1	4.9	0	0	0
75%	75%	13%	82%	50%	15.4	9.5	6.0	2,824	1,732	1,093
70%	70%	35%	79%	42%	14.9	8.0	6.9	7,393	3,953	3,440
65%	65%	0%	77%	35%	14.5	6.6	7.9	0	0	0
60%	60%	43%	75%	29%	14.2	5.4	8.8	8,659	3,308	5,350
55%	55%	1%	72%	23%	13.6	4.4	9.3	156	50	106
50%	50%	3%	70%	18%	13.3	3.4	9.8	547	141	405
45%	45%	0%	69%	14%	12.9	2.6	10.3	0	0	0
40%	40%	3%	68%	10%	12.7	2.0	10.8	525	81	444
35%	35%	0%	68%	7%	12.7	1.4	11.3	0	0	0
30%	30%	0%	68%	5%	12.7	1.0	11.8	0	0	0
25%	25%	0%	68%	3%	12.7	0.6	12.1	0	0	0
20%	20%	0%	68%	2%	12.7	0.3	12.4	0	0	0
15%	15%	0%	68%	1%	12.7	0.2	12.6	0	0	0
10%	10%	0%	68%	0%	12.7	0.1	12.7	0	0	0
5%	5%	0%	68%	0%	12.7	0.0	12.7	0	0	0
0%	0%	0%	68%	0%	12.7	0.0	12.7	0	0	0
						TOTALS	**7.7**	**20,646**	**9,702**	**10,944**

In this table we see that the model breaks up the pump load into 20 categories, from 100 percent of load down to 0 percent of load, in increments of 5 percent. The energy efficient VFD case is modeled with the understanding that pump speed will decrease proportionally with load, and with the affinity law noted above, the power input of this "proposed" VFD case will decrease dramatically as a function of reduction in load. The pump equipped with at VFD will use just 18 percent of full input power at 50 percent load, while the throttle valve will use 70 percent of full input power for that same load category. Out of a total of 1,416 hours of operation for this pump, 3 percent of loads fall into the 50 percent load bin, resulting in a kW load reduction of 9.8 for a full hour of operation and 405 kWh of savings for all of the hours having that load combined (roughly 42 hours at that load) – which illustrates the savings of a VFD relative to a throttle valve baseline.

Summer peak demand savings use operating load-based savings from this same table coupled with data on the probability of pump operation during peak hours. With peak hours defined using a DEER based Peak period definition for individual climate zones.[10]

This tool requires a number of inputs, including pump hp, percent of motor load at maximum pump load, motor rated efficiency, VFD efficiency, and hours of pump operation by load bin. Where site-specific evaluation data sources were available, the evaluation team used those, but also has default values that can be applied where needed. For example, percent of maximum motor load at maximum actual pump load is assumed to be 80 percent in the absence of better data, based upon engineering judgement for irrigation pumping systems. Also, the motor efficiency rating is defaulted to 95 percent when needed based on efficiency values listed within the US DOE Advanced Manufacturing Office's Premium Efficiency Motor Selection and Application Guide,[11] and the VFD efficiency is always assumed to be 97 percent based upon guidance from Water Management Technical Note No. 1, September 2014.[12]

Evaluation models for each site in the sample were supported by an array of data: collected on-site by the evaluation team, from the utilities (AMI, CIS and tracking data) and from various secondary sources. In general, these intermediary data were analyzed in support of the derivation of model inputs and model calibration parameters, as discussed next.

- The single most crucial input source contributing to each model, when available, was AMI data supporting a post-VFD installation kW load distribution and frequency. For example, the estimated percent time at each load bin, as shown in Table 4-2 above. The AMI data, and CIS data where AMI data were absent, also allowed for an additional calibration step to ensure that model accurately predicted annual kWh loads for the post-VFD installation case. Furthermore, the AMI data provided observed operating kW loads during the DEER-defined Peak hours and also the probability of operation during such hours. AMI and CIS data were particularly useful in instances where the utility meter was dedicated to the program affected pump, which was frequently the case, and provided the evaluation team with great confidence in the resulting impact estimates for all such pumps.

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10 https://www.pge.com/pge_global/common/pdfs/save-energy-money/facility-improvements/custom-retrofit/Customized-Policy-Procedure-Manual_2019.pdf; page 20

11 https://www.energy.gov/sites/prod/files/2014/04/f15/amo_motors_handbook_web.pdf – Table 4-6 - for Premium TEFC motors at Part-Load conditions; page 4-12

12 United States Department of Agriculture, Natural Resources Conservation Service - Water Management Technical Note No. 1, September 2014; https://directives.sc.egov.usda.gov/36264.wba; page 8

- Farmers or pump operators were interviewed to understand a number of key pumping system inputs that informed the models, such as acreage served by the pump, crop type and age, typical pump operating parameters (such as pump speed and pump water delivery rate in gallons per minute or gpm), irrigation approach applied (drip irrigation versus sprinklers versus flood, for example), irrigation operating schedule and approach, well depth, and so forth.
- On-site data collection efforts were also used to identify projects that don't save energy.
  - For VFD replacement projects where the previous controls were equivalent in performance to a VFD, such as AFD controls, the VFD was set as baseline and the resulting gross impacts were set to zero.
  - Savings were set to zero for pumps with a VFD that had no alternative flow control options, given a technical and practical requirement that a VFD be installed. For example, for one pump sand was entering the water column of the well and damaging the impeller, which was an economically impractical way to continue to operate the pump. VFD controls were installed as a remedy and no other option is apparent for solving the problem; certainly throttle valve controls are NOT an option that would prevent ongoing impeller damage.
  - Pumps with a VFD serving flood irrigation systems do not save energy, given that such systems are essentially open and therefore friction head is very low relative to total head of the system. Here the affinity law exponent is close to 1.0. In fact, the installation of a VFD for a flood irrigation application is not eligible to receive program incentives.
  - Similarly, well pumps that exclusively fill a reservoir, rather than being used to irrigate crops directly, are also ineligible. This application is also characterized as an open system, largely without friction head, and results in an affinity law exponent close to 1.0.
  - All other projects were found to be energy saving installations, and ex-post energy saving calculations assume a throttle valve for the baseline condition. Throttle valve controls also serve as the baseline condition assumed in ex-ante workpaper-based savings.

4.2.2 Effective Useful Life Estimation

A battery of questions was asked concerning the VFD installation, such as whether or not the VFD was installed on an existing pump, or if the pump was also replaced, or if both the pump and VFD were new. Queries that resulted in the conclusion that the VFD was added to an existing pump had important implications for the EUL determination for all such VFD installations, whereby the EUL is set equal to one-third of a new pump EUL in order to account for the fact that that VFD operations my cease at the time of pump replacement. This is long-standing CPUC policy in evaluations to set the EUL of add-on equipment equal to the remaining useful life of the host equipment (in this case the pump), or one-third of the pump

EUL – an industry accepted default RUL value. We find that pump EUL in DEER is a function of pump type in agricultural irrigation applications,[13] as follows:

- Centrifugal booster pumps have an EUL of 12.7 years (and yields a VFD EUL of 4.23 years)
- Submersible booster pumps have an EUL of 8.3 years (and yields a VFD EUL of 2.77 years)
- Submersible well pumps have an EUL of 6.5 years (and yields a VFD EUL of 2.17 years)
- Turbine booster pumps have an EUL of 9.3 years (and yields a VFD EUL of 3.1 years)
- Turbine well pumps have an EUL of 6.8 years (and yields a VFD EUL of 2.27 years)

For all other claims involving new pumps the ex-post EUL for the VFD is set equal to 10 years based on DEER (DEER2014-EUL-table-update_2014-02-05.xlsx).[14]

It is notable that the utility tracking system-based EULs for agricultural pumps vary as follows:

- PG&E EULs all set to 3.33 years (which is 1/3rd of the DEER-defined EUL and the reported RUL for the VFD)
- SCE EUL's for new pumps are set to 10 years and those for retrofit add-ons are set to 6.67 years
- SDG&E EUL's are set to 10 years

4.3 AGRICULTURAL IRRIGATION MEASURES

The primary objective of the impact evaluation was to perform a measure and measure-parameter impact evaluation, utilizing new primary evaluation data, in order to independently derive first-year and lifecycle gross savings estimates for agricultural drip irrigation measures and to inform parameter values for future workpaper iterations. The impact evaluation supports the March 2020 Bus Stop with both gross and net results, using telephone interviews, on-site verification, and analysis of utility consumption data.

Per PY2018 tracking data, the agricultural irrigation measure category includes agricultural pump upgrades, agricultural pump VFDs, and conversions of irrigation nozzles. The pump upgrades and VFDs are considered within the process pumping measure groups. Therefore, the PY2018 evaluation of the agricultural irrigation measure group addressed only the sprinkler-to-drip irrigation conversions, as described in the following paragraphs.

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13 Taken from DEER READI tool (v.2.5.1); applicable: 1/1/2015 - 1/1/2021

14 www.deeresources.com › DEER2014-EUL-table-update_2014-02-05

For drip irrigation conversions, electric savings arise from reduced discharge pressure at the irrigation pump (i.e., the pump is required to perform less work to irrigate the crop). The general approach used to estimate ex-post gross savings first considered all available data. As discussed, the challenge in calculating pumping savings is determining the pump head pressure (or associated loading level) of the pre-existing irrigation system's pump(s). In order to characterize the pre-conversion pump operation, evaluators relied on pre-project utility bills, when available. However, as many participating farms featured conversions in crop type and/or irrigation method at the time of the installation, a fair comparison of pre- and post-project utility meter data required normalization by the amount of water delivered after the conversion.

Two methods for normalization were employed by evaluators, depending on the availability, quality, and comparability of pre/post utility consumption data. Regardless of the site-level approach for generating gross ex-post savings values, data collection activities remained consistent for each site. For every project, evaluators administered an engineering telephone survey to collect information needed to ensure fair pre/post comparison of relevant parameters. For verification purposes, evaluators followed up with a visit at selected surveyed sites to inspect the installed equipment and confirm information collected during the phone survey. Relevant parameters for which detailed information was gathered can be found in the following section while a breakdown of all/additional parameters can be found in Appendix A.

Each of the two evaluation methods are described below, in order of preference.

1. Analysis of pre/post electric bills normalized to water consumption

The evaluator's preferred method for assessing project impacts is characterized by the following formula:

$$\Delta E = \sum_{i=1}^{12}\left[\left(\frac{E}{V}\bigg|_{pre,i} - \frac{E}{V}\bigg|_{post,i}\right) \times V_{post,i}\right]$$

Where,

ΔE = Annual electric energy savings in kWh. This parameter represents the ex-post savings objective of this study.

E_i = Monthly electric energy consumption during month i, obtained via data requested from the IOU. Pre- and post-intervention consumption values are denoted with the subscripts pre and $post$, respectively.

V_i = Total volume of water delivered to the affected field during month i, in units of *acre-feet*. As many participating farms rely on private well water rather than municipally-owned and metered water supplies, historic water usage records were typically not available. Instead, evaluators gathered detailed information on field acreage, crop type, crop age, irrigation method, and irrigation schedule (as described above) to calculate the water requirement of the crop.[15] Normalization by the required acre-feet in pre- and post-intervention cases ensured a fair comparison between pre- and post-intervention electric consumption.[16]

2. Analysis of project impacts from discharge pressure reduction

When utility consumption data was incomplete or incomparable between pre/post cases, the evaluators assessed project impacts via calculation of the change in pumping power requirement from the drip irrigation system's reduction in pumping discharge pressure, as follows:

$$\Delta E = \frac{1.0241 \times (TDH_{pre} - TDH_{post})}{OPE} \times V_{annual}$$

ΔE = Annual electric energy savings (kWh per year). This parameter represents the ex-post savings objective of this study.

1.0241 = Conversion constant (kWh / acre-foot / feet of head). Converts pump operating pressure difference and annual water requirement into electric energy impact seen at pump.

V_{annual} = Total volume (acre-feet) of water delivered per year, calculated as the sum of the twelve monthly volumes in the previous evaluation method. As many participating farms featured conversions in crop type and/or irrigation method at the time of the project installation, this value was assumed to be the water requirement of the post-project crop(s) to ensure a fair comparison of baseline and installed conditions' energy usage.

TDH_{pre} = Total dynamic head (feet) of the pre-existing irrigation pumping system. This information was not available in PA tracking data; instead, the evaluators estimated this value from customer interviews and information on irrigation method, well depth, theoretical water requirement, and irrigation operating hours.

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15 Engineers attempted to collect survey data on irrigation runtime and frequency by month of the year, to determine the site-specific irrigation operating hours and subsequent water volume. However, in some cases, the interview data was insufficient, and the engineers referenced theoretical water requirement data from various sources (as a function of crop type and location) to estimate the pre- and post-project water volumes for normalization in the energy savings calculation.

16 The normalization also took into account the different water application efficiencies (the amount of water reaching the crop over the total amount of discharged water) of various irrigation methods, per the following reference: https://www.dropbox.com/s/jqbc1j92c4ckuln/Application%20Efficiencies%20-%20UCDavis%20-%20Sandoval%20Solis%20et%20al%202013%20-%20Report.pdf

TDH_{post} = Total dynamic head (feet) of the installed (low-pressure) irrigation pumping system. Several farmers monitor this value closely and provided rich information for evaluators to determine a representative value in the savings calculation.

OPE = The pumping system's overall plant efficiency (unitless). Participating farms were required to complete an OPE assessment within a year of program application; OPEs of 45 percent or greater were required for program eligibility. Evaluators requested the most recent pump tests that would indicate post-project OPE; however, these records were typically not available from the participating farmer. OPE has been typically estimated by PAs between 45-55 percent based on field studies.

Peak-coincident demand savings (in kW/acre) was calculated using similar equations and parameters presented above, supplemented by 15-minute AMI data to determine coincidence factor.

The above values were informed by researched parameters, including operating hours, changes in irrigation pump discharge pressures, and installation rates. These parameters are discussed in more detail in Section 5, along with the resulting gross realization rates. None of these parameter-level average values are directly used to calculate the realization rates; they are presented for informational purposes only. All parameter-level averages have been weighted by project acreage, to ensure that the largest projects are fairly represented.

4.4 TANKLESS WATER HEATERS

The primary objective of the impact evaluation was to perform a measure and measure-parameter impact evaluation, utilizing new primary evaluation data, in order to independently derive first-year and lifecycle gross savings estimates and to inform parameter values for future workpaper revisions for tankless water heater measures. The impact evaluation supports the March 2020 Bus Stop with both gross and net results, using on-site metering and verification and telephone interviews with market actors.

This study group includes commercial TWH replacements as rebated by PG&E and SCG. The tankless water heater measure accounts for 66 percent of the sector's expected net lifecycle natural gas savings among ESPI measures in PY2018 and 26 percent of the small/medium commercial sector savings overall. It has not been previously studied as part of the ESPI evaluations.

Evaluators visited 25 sampled facilities that received utility-rebated TWHs in 2018. During each site visit, field engineers confirmed measure installation and operability and collected information on the installed make and model, nameplate information, facility type, TWH use, possible seasonal fluctuations, and preexisting conditions (WH type, age, operating condition). Evaluators also leveraged the on-site data collection to inform ongoing EUL research when possible, by collecting information on remaining useful life and operating condition of the preexisting water heater(s). The field engineer deployed spot-measurement equipment to characterize the **water temperatures** entering and exiting the TWH system. Change in temperature is a key component of TWH savings as described in the below equation.

Characterizing the **flowrate** of heated water (in gpm) is challenging, as TWHs are often not installed in recirculating or pumped systems. As the tankless system heats water on-demand, the flowrate can vary considerably, capped at the TWH's model's maximum rated flowrate. Because of the uncertainty and indirect nature of flow estimation, evaluation engineers performed an inventory of water fixtures associated with the installed TWHs. This information was used to adjust the ex-ante UES, as derived from DEER prototype models as a function of building type and climate zone, as follows.

$$\Delta\dot{Q} = size \ \times UES(size, \Delta T, UEF_{base}, UEF_{ee}, CZ, Bldg)$$

where,

$\Delta\dot{Q}$ = Annual hourly water heating savings (therm)

$size$ = Capacity of the installed TWH (kBtu/hr). To align with workpaper UES recommendations, both PG&E and SCG classify TWHs less than 200 kBtu/h as "small"; higher-capacity systems are classified as "large." Table 4-4, below, provides a distribution of PY2018 savings by size classification.

UES = Unit energy savings as modeled by DEER simulations among prototype buildings by climate zone, adjusted by evaluators for the parameters below. UES is normalized to produce annual therm savings as a function of water heater size in kBtu/h.

ΔT = Increase in DHW temperature between TWH inlet and outlet (°F)

UEF = Uniform Energy Factor, as established by DOE in order to equitably compare storage and tankless systems. The baseline case (subscript 'base') reflects Title 20 standards per the applicable TWH workpaper (WPSCGNRWH120206B Rev 08). Generally, the baseline for tankless systems is a similarly-sized, minimally-compliant storage water heater. The efficient (installed) case (subscript 'ee') reflects the manufacturer's EF rating converted to UEF per the methodology set forth in the workpaper. Both PG&E and SCG classify TWHs as Tier 1 or Tier 2 (highest efficiency) as a function of UEF_{ee}. Table 4-4, below, provides a distribution of PY2018 savings by efficiency tier.

CZ = Climate zone of the facility receiving the rebated TWH

$Bldg$ = Classification of the facility receiving the rebated TWH

Table 4-4 illustrates the distribution of reported savings by size and efficiency classifications.

TABLE 4-4: TANKLESS WATER HEATER PY2018 SAVINGS DISTRIBUTION BY SIZE, UEF CATEGORIES

Tankless Water Heater Type by Program Administrator	PY2018 Tracking Population		
	Count of Applications	Count of Records	Ex-Ante Net Lifecycle Savings (MMThm)**
PG&E			
Instantaneous Domestic Water Heater - Condensing, 76-200 kBTUh, TE > 90%	209	475	5.51
Instantaneous Domestic Water Heater, > 200 kBTUh, > 85% TE	140	192	2.82
Instantaneous Domestic Water Heater - Condensing, > 200 kBTUh, > 90% TE	141	296	9.68
PG&E Subtotal	**490**	**963**	**18.01**
SCG			
Tankless Water Heater <=200 MBtu/hr (Small / Medium), Tier 1 (>=0.81 UEF)	8	10	0.08
Tankless Water Heater <=200 MBtu/hr (Small / Medium), Tier 2 (>=0.87 UEF)	122	165	5.01
CommercialBlr-DWH-Small(<=200MBtuh)-Tier2(>=87%EF)	1	2	0.03
TanklessWaterHeaters-Large(>200MBtuh)-Tier2(>=90%TE)	23	37	0.95
SCG Subtotal	**154**	**214**	**6.06**
Total	**644**	**1177**	**24.07**

Source:

CEDARS, 2018. Confirmed Claims Dashboards for 2018 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* Count of sites with records of non-zero savings; both positive and negative.

** The 0.05 market effects adder is not included in the net savings values.

Evaluators sought to collect sufficient information to inform savings parameters for the size/UEF tiers featured in Table 4-4. Since a single project might include multiple TWHs among different size/UEF tiers, evaluators designed the analysis to produce results at the record level, not the project level. TWH workpapers and DEER prototype models recommend unit energy savings as a function of many variables defined in the equation above. As a result, evaluators were unable to quantify UES alternatives from the 25-project sample, as the sites spanned 12 different facility classifications and 10 different climate zones.

Nonetheless, evaluators independently quantified parameter results based on the 25-project sample: installation rate, DHW temperature increase, and uniform energy factor. Parameter results were delineated by equipment size or efficiency tier, when relevant. Section 5 examines results for individual impact parameters, along with the resulting gross realization rates.

5 GROSS IMPACT EVALUATION RESULTS

This section compares and contrasts ex-ante and ex-post gross impact results, and model-based parameters that contribute to each result. The intent of this effort is to demonstrate where differences in modeling approach, inputs and assumptions can lead to differences in impact results, and to best explain why those differences exist. This effort also encourages sharing of information derived by the ex-post evaluation that can be used to potentially improve alignment between ex-post and ex-ante gross impact results, and thus lessen the gap between the two approaches on a going forward basis, where warranted.

5.1 REFRIGERATION LED CASE LIGHTING MEASURES

The gross impact evaluation sampling and analysis focused on the Refrigerated Case LED lighting measure group which included nine unique measure codes across the two utilities, as described in the methodology section.

5.1.1 First Year Gross Impact Results

Table 5-1 through Table 5-3 present the first-year gross impacts for the PG&E and SDG&E sample points.

TABLE 5-1: FIRST YEAR GROSS IMPACT RESULTS FOR PG&E LARGE GROCERY CHAIN SAMPLE POINTS

	Ex-Post		Ex-Ante		Results	
Sample Point Identifier	**First Year Gross Impact kW Savings**	**First Year Gross Impact kWh Savings**	**First Year Gross Impact kW Claims**	**First Year Gross Impact kWh Claims**	**First Year Gross Impact kW Realization Rate**	**First Year Gross Impact kWh Realization Rate**
PG&E-1	6.29	29,560	3.85	18,122	1.63	1.63
PG&E-2	0	0	15.09	71,012	0	0
PG&E-3	1.93	9,074	2.73	12,818	0.71	0.71
PG&E-9	0	0	4.14	19,485	0	0
PG&E-10	0.44	2,821	1.03	4,842	0.42	0.58
PG&E-11	3.98	15,459	4.13	19,413	0.96	0.80
PG&E-14	0	0	3.39	15,934	0	0
PG&E-18	0	0	5.81	27,366	0	0
PG&E-20	0.51	2,378	8.39	39,486	0.06	0.06
PG&E-36	3.99	16,869	4.81	22,599	0.83	0.75
PG&E-40	0	0	22.63	106,578	0	0
PG&E-41	2.50	11,729	44.78	210,847	0.06	0.06
PG&E-42	3.55	16,661	4.91	23,064	0.72	0.72
PG&E-47	4.90	20,441	5.60	26,303	0.87	0.78
PG&E-48	3.24	18,371	3.62	17,012	0.89	1.08
PG&E-50	4.96	23,392	5.92	27,797	0.84	0.84
Total	**36.26**	**166,755**	**140.83**	**662,678**	**0.26**	**0.25**
Average	**2.27**	**10,422**	**8.80**	**41,417**	**0.26**	**0.25**

TABLE 5-2: FIRST YEAR GROSS IMPACT RESULTS FOR PG&E GROCERY OTHER SAMPLE POINTS

	Ex-Post		Ex-Ante		Results	
Sample Point Identifier	First Year Gross Impact kW Savings	First Year Gross Impact kWh Savings	First Year Gross Impact kW Claims	First Year Gross Impact kWh Claims	First Year Gross Impact kW Realization Rate	First Year Gross Impact kWh Realization Rate
PG&E-4	1.17	4,102	1.23	4,297	0.95	0.95
PG&E-5	1.17	7,592	0.75	3,536	1.55	2.15
PG&E-6	1.82	7,622	1.55	7,274	1.18	1.05
PG&E-7	0.44	2,072	0.33	1,547	1.34	1.34
PG&E-8	3.95	22,905	2.54	8,908	1.55	2.57
PG&E-12	1.57	7,398	1.58	7,426	1.00	1.00
PG&E-13	6.79	22,839	5.35	25,201	1.27	0.91
PG&E-15	0.11	518	0.11	530	0.98	0.98
PG&E-16	4.56	23,565	3.78	17,802	1.21	1.32
PG&E-17	0.10	624	0.32	1,572	0.31	0.40
PG&E-19	1.60	5,618	1.79	6,250	0.90	0.90
PG&E-21	2.89	21,435	2.12	7,421	1.36	2.89
PG&E-22	5.63	18,251	4.66	21,956	1.21	0.83
PG&E-23	3.70	17,401	2.92	13,737	1.27	1.27
PG&E-24	0.89	4,169	1.87	8,821	0.47	0.47
PG&E-25	0.60	2,107	0.67	2,344	0.90	0.90
PG&E-26	0.86	4,034	1.27	5,970	0.68	0.68
PG&E-27	1.63	7,665	1.47	6,928	1.11	1.11
PG&E-28	2.75	12,321	2.14	10,088	1.28	1.22
PG&E-29	4.08	26,385	2.90	13,648	1.41	1.93
PG&E-30	0.71	3,344	0.83	3,917	0.85	0.85
PG&E-31	2.67	9,792	1.88	8,833	1.42	1.11
PG&E-32	0.75	3,458	0.62	2,917	1.21	1.19
PG&E-33	3.07	12,336	2.10	9,872	1.46	1.25
PG&E-34	2.38	10,750	1.61	7,561	1.48	1.42
PG&E-35	1.45	6,794	1.32	6,235	1.09	1.09
PG&E-37	2.25	8,977	1.55	7,274	1.46	1.23
PG&E-38	0.85	3,981	0.77	3,637	1.10	1.09
PG&E-39	2.98	12,775	2.10	9,872	1.42	1.29
PG&E-43	1.73	5,614	1.21	5,716	1.42	0.98
PG&E-44	0.25	1,082	0.55	2,598	0.46	0.42

TABLE 5-2 (CONT'D): FIRST YEAR GROSS IMPACT RESULTS FOR PG&E GROCERY OTHER SAMPLE POINTS

	Ex-Post		Ex-Ante		Results	
Sample Point Identifier	First Year Gross Impact kW Savings	First Year Gross Impact kWh Savings	First Year Gross Impact kW Claims	First Year Gross Impact kWh Claims	First Year Gross Impact kW Realization Rate	First Year Gross Impact kWh Realization Rate
PG&E-45	1.37	3,765	0.99	4,676	1.38	0.81
PG&E-46	0.31	1,435	0.24	1,105	1.30	1.30
PG&E-49	3.46	15,152	2.32	10,900	1.49	1.39
Total	**70.54**	**317,876**	**57.44**	**260,369**	**1.23**	**1.22**
Average	**2.07**	**9,349**	**1.69**	**7,658**	**1.23**	**1.22**

The overall gross kW and kWh realization rate results for all PG&E sampled points combined are 0.54 and 0.53, respectively. The driver of the low overall realization rate is the realization rates for the large grocery store sites. In particular, one chain of grocery stores claimed savings for the reach-in, display case replacement, which already accounts for the LED lighting savings. Therefore, the saving for these sites was limited to the LED lighting installed in open cases, which significantly reduces the energy and demand savings. The realization rate for the other, smaller grocery stores, and convenience stores is approximately 1. There were only two instances across the PG&E sample where the verified units (length feet) were different than the ex-ante claims and they were minor.

TABLE 5-3: FIRST YEAR GROSS IMPACT RESULTS FOR SDG&E SAMPLE POINTS

	Ex-Post		Ex-Ante		Results	
Sample Point Identifier	First Year Gross Impact kW Savings	First Year Gross Impact kWh Savings	First Year Gross Impact kW Claims	First Year Gross Impact kWh Claims	First Year Gross Impact kW Realization Rate	First Year Gross Impact kWh Realization Rate
SDG&E-1	3.49	21,219	4.72	28,717	0.74	0.74
SDG&E-2	0.21	1,177	0.12	732	1.71	1.61
SDG&E-3	1.66	10,082	3.91	23,766	0.42	0.42
SDG&E-4	0.63	3,748	4.96	30,181	0.13	0.12
SDG&E-5	4.08	22,920	3.91	23,766	1.04	0.96
SDG&E-6	0.14	879	0.09	549	1.60	1.60
SDG&E-7	2.54	15,446	3.26	19,805	0.78	0.78

TABLE 5-3 (CONT'D): FIRST YEAR GROSS IMPACT RESULTS FOR SDG&E SAMPLE POINTS

	Ex-Post		Ex-Ante		Results	
Sample Point Identifier	First Year Gross Impact kW Savings	First Year Gross Impact kWh Savings	First Year Gross Impact kW Claims	First Year Gross Impact kWh Claims	First Year Gross Impact kW Realization Rate	First Year Gross Impact kWh Realization Rate
SDG&E-8	0.27	1,626	0.33	1,981	0.82	0.82
SDG&E-9	0.24	1,415	1.14	6,932	0.21	0.20
SDG&E-10	1.71	10,087	5.70	34,659	0.30	0.29
Total	**14.96**	**88,599**	**28.13**	**171,086**	**0.53**	**0.52**
Average	**1.50**	**8,860**	**2.81**	**17,109**	**0.53**	**0.52**

The SDG&E measure codes assume 1.2 fixtures per door, or six fixtures per five door case, in their calculations. As discussed in more detail below, the evaluators verified slightly less than 1.2 fixtures per door thus driving down the delta watts, and realization rates for most SDG&E sites.

The sampled points with lower realization rates are sites with self-reported existing lamp technology of T8 lamps, resulting in lower delta watts and realization rates. In addition, some of these sites claimed 6ft lamps, but the self-reported measure length was 5ft. This is discussed more below in the measure impacts section.

5.1.2 First Year Measure Impact Results

The total ex-ante claimed and evaluated savings for each of the measure codes claimed by the sample points is summarized in Table 5-4. As is evident from the table, LB09 and LC11 have the highest energy and demand savings claims for PG&E, but have the lowest realization rates for that utility. These low GRRs are due primarily to the fact that these measure codes were prevalent in the large grocery chain strata where savings were disallowed for a large portion of the reach-in cases, due to redundant refrigeration case measure claims.

For SDG&E the GRR is impacted more by the baseline assumptions and number of lamps per door. For 463839 the GRR is low because the ex-ante baseline assumes a 6ft and T12 fixture whereas the evaluation found that many of these sites had 5ft and T8 fixtures.

TABLE 5-4: FIRST YEAR EX-POST GROSS IMPACT RESULTS FOR SAMPLED MEASURE CODES

		Ex-Post		Ex-Ante		Results	
IOU	Measure Code	First Year Gross Impact kW Savings	First Year Gross Impact kWh Savings	First Year Gross Impact kW Claims	First Year Gross Impact kWh Claims	First Year Gross Impact kW Realization Rate	First Year Gross Impact kWh Realization Rate
PG&E	LB03	0.72	2,791	0.77	3,602	0.94	0.77
PG&E	LB05	30.06	137,176	24.70	109,321	1.22	1.25
PG&E	LB07	26.13	125,983	21.11	99,273	1.24	1.27
PG&E	LB09	32.64	142,751	70.28	327,782	0.46	0.44
PG&E	LC05	14.63	63,570	24.57	115,454	0.60	0.55
PG&E	LC09	2.63	12,360	2.21	10,378	1.19	1.19
PG&E	LC11	0	0	54.63	257,238	0	0
SDG&E	463838	0.46	3,147	0.45	2,744	1.01	1.15
SDG&E	463839	14.50	85,452	27.68	168,343	0.52	0.51

Existing Lighting Fixture Wattages

The existing fixture assumptions and resulting fixture wattage used in the ex-ante calculations are summarized in below in Table 5-5. For example, the table shows PG&E measure code LB03 assumes the existing lighting fixture is a 52.25-Watt T8 fixture consisting of one five-foot T8 high output lamps. SDG&E measure code 463838 assumes a similar fixture as LC03.

TABLE 5-5: EX-ANTE EXISTING FIXTURE WATTAGE ASSUMPTIONS

IOU	Measure Code	Existing Lamp Technology	Existing Lamp Length	Existing Lamp Profile	Existing Fixture Wattage
PG&E	LB03	T8	5	1	52.25
PG&E	LB05	T12	6	1	149.76
PG&E	LB07	T8	5	1	52.25
PG&E	LB09	T12	6	1	149.76
PG&E	LC05	T8	5	2	104.50
PG&E	LC09	T8	5	2	104.50
PG&E	LC11	T12	6	2	299.52
SDG&E	463838	T8	5	1	52.25
SDG&E	463839	T12	6	1	149.76

Surveyors asked the site contacts at all sixty onsite points about the existing lighting system prior to replacement with the LED fixtures. In cases when the site contact was able to provide information on the baseline equipment technology (T8 or T12), or when the surveyor found evidence of the baseline equipment technology, that information was used. Of the sixty sites that were visited twenty-one sites reported existing T8 technology, thirty-one reported T12, and eight reported both T8 and T12 fixtures.

Table 5-6 through Table 5-7 report on the existing lighting assumptions used in ex-ante calculations and the final evaluated values for the two utilities.

TABLE 5-6: EXISTING FIXTURE CHARACTERISTICS AND WATTAGES FOR PG&E SAMPLE

	Ex-Ante			Ex-Post Final		
Sample Point Identifier	Existing Lamp Technology	Existing Lamp Length	Existing Fixture Wattage	Existing Lamp Technology	Existing Lamp Length	Existing Fixture Wattage
PG&E-1	T8	5	52.25	T8	5	52.25
PG&E-2	T12	6	149.76	T12	5	124.8
PG&E-3	T8	5	52.25	T8	4	41.8
PG&E-4	T12	6	149.76	T12	6	149.76
PG&E-5	T8	5	52.25	T8	5	52.25
PG&E-6	T12	6	149.76	T12	5	124.8
PG&E-7	T8	5	52.25	T8	5	52.25
PG&E-8	T12	6	149.76	T12	6	149.76
PG&E-9	T12	6	149.76	T12	6	149.76
PG&E-10	T8	5	104.5	T8	5	104.5
PG&E-11	T8	5	104.5	T8	5	52.25
PG&E-12	T8	5	52.25	T8	5	52.25
PG&E-13	T12	6	149.76	T12	6	149.76
PG&E-14	T12	6	149.76	T12	6	149.76
PG&E-15	T8	5	52.25	T8	5	52.25
PG&E-16	T12	6	149.76	T12	6	149.76
PG&E-17	T12	6	149.76	T12	6	149.76
PG&E-18	T12	6	149.76	T12	6	149.76
PG&E-19	T12	6	149.76	T12	6	149.76
PG&E-20	T8	5	104.5	T8	5	52.25
PG&E-21	T12	6	149.76	T12	6	149.76
PG&E-22	T12	6	149.76	T12	6	149.76
PG&E-23	T8	5	52.25	T8	5	52.25
PG&E-24	T8	5	52.25	T8	5	52.25
PG&E-25	T12	6	149.76	T12	6	149.76
PG&E-26	T12	6	149.76	T12	6	149.76
PG&E-27	T12	6	149.76	T12	5	124.8

TABLE 5-6 (CONT'D): EXISTING FIXTURE CHARACTERISTICS AND WATTAGES FOR PG&E SAMPLE

	Ex-Ante			Ex-Post Final		
Sample Point Identifier	**Existing Lamp Technology**	**Existing Lamp Length**	**Existing Fixture Wattage**	**Existing Lamp Technology**	**Existing Lamp Length**	**Existing Fixture Wattage**
PG&E-28	T12	6	149.76	T12	6	149.76
PG&E-29	T12	6	149.76	T12	6	149.76
PG&E-30	T12	6	149.76	T12	6	149.76
PG&E-31	T12	6	149.76	T12	6	149.76
PG&E-32	T8	5	52.25	T8	5	52.25
PG&E-33	T12	6	149.76	T12	6	149.76
PG&E-34	T12	6	149.76	T12	6	149.76
PG&E-35	T12	6	149.76	T12	6	149.76
PG&E-36	T8	5	104.5	T12	5	124.8
PG&E-37	T12	6	149.76	T12	6	149.76
PG&E-38	T12	6	149.76	T12	6	149.76
PG&E-39	T12	6	149.76	T12	6	149.76
PG&E-40	T12	6	299.52	T12	6	250.92
PG&E-41	T12	6	299.52	T12	6	250.92
PG&E-42	T8	5	104.5	T8	5	52.25
PG&E-43	T12	6	149.76	T12	6	149.76
PG&E-44	T12	6	149.76	T8	6	62.7
PG&E-45	T12	6	149.76	T12	6	149.76
PG&E-46	T8	5	52.25	T8	5	52.25
PG&E-47	T8	5	104.5	T8	5	52.25
PG&E-48	T8	5	104.5	T8	5	52.25
PG&E-49	T8	5	52.25	T8	5	52.25
PG&E-50	T8	5	104.5	T8	5	52.25

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TABLE 5-7: EXISTING FIXTURE CHARACTERISTICS AND WATTAGES FOR SDG&E SAMPLE

	Ex-Ante			Ex-Post Final		
Sample Point Identifier	Existing Lamp Technology	Existing Lamp Length	Existing Fixture Wattage	Existing Lamp Technology	Existing Lamp Length	Existing Fixture Wattage
SDG&E-1	T12	6	149.76	T12	5	124.8
SDG&E-2	T8	5	52.25	T8	5	52.25
SDG&E-3	T12	6	149.76	T12	6	149.76
SDG&E-4	T12	6	149.76	T8	5	52.25
SDG&E-5	T12	6	149.76	T12	6	149.76
SDG&E-6	T8	5	52.25	T8	5	52.25
SDG&E-7	T12	6	149.76	T12	5	124.8
SDG&E-8	T12	6	149.76	T12	5	124.8
SDG&E-9	T12	6	149.76	T8	5	52.25
SDG&E-10	T12	6	149.76	T8	6	62.7

Measure Lighting Fixture Wattages

Surveyors verified measure lighting fixture wattages in fifty of the sixty sites. The verified fixture wattages found on-site varied from 4.8W to 30W. When the evaluation team was unable to verify a measure wattage the average of the verified lamp wattage was used, 22.5 Watts. The verified measure wattage is less than the ex-ante assumptions in all applications except for the LC03 code, which assumes a 16.5 watt LED lamp.

TABLE 5-8: VERIFIED MEASURE LAMP WATTAGE

Manufacturer	Model	Count of Measures	Lamp Wattage	Lamp Length
China	ZY-30W1800BINS	5	30	5
CHINA	ZY-22W1800BINS	4	22	6
PHILIPS	TBRS104615600VBNL	4	12	5
China	ZY-22W1500BINS	4	22	5
Zero Zone	4RVMC24D	3	18	5
LED One	FY-T8-1800EC	3	26	5
Kadium	FY-T8-1800EC	3	26	5
Zero Zone	2RVMC24B	2	18	4
PHILLIPS	1BRS104615600VBNL	2	12	5
PHILIPS	IBRS-1046-5600-URNI	2	12	5
PHILLIPS	1BRS-1046-5600-VNL	2	12	5
PHILLIPS	1BRS-10461-5600-VNL	2	12	5

TABLE 5-8 (CONT'D): VERIFIED MEASURE LAMP WATTAGE

Manufacturer	Model	Count of Measures	Lamp Wattage	Lamp Length
SOORCE	3LB-5D-M160-4000K-NP4	1	19	5
Zero Zone	4RVMC24DD	1	18	5
ELECTRALED	ECLS-3N48-PM14E	1	28	5
Zero Zone	4RVMC24RLBD	1	18	5
LED ONE	LOD-C6FT30W	1	30	6
HillPhoenix	9104304A	1	13.2	5
HillPhoenix	P104304A	1	13.2	5
China	ZY-30W1800	1	30	6
HILL PHOENIX	P105998A	1	4.8	5
CHINA	FY-T8-1800EC	1	26	5
ALEDORA	LLTX-FR_YZ-NNK-M	1	20	5
Kadium	FY-T8-1800	1	22	5
Kadium	FY-T8-1500EC	1	22	5
KADIUM	FY-T8-1815 EC	1	26	6
KADIUM	FY-TR-1815 EC	1	22	5
China Made	ZY-30W1800BINS	1	30	5
Unknown	ZY-30W 1800BINS	1	30	6

Annual Hours of Use

Annual hours of use (HOU) used in the ex-ante calculations, the self-report hours, and the logger based hours for sites with completed logger data are reported in Table 5-9 through Table 5-11. Sites with Ex-post logger indicated as NA did not have logger data to support an HOU estimate. For ex-post HOU, we used logger-based estimates where available; otherwise we relied on self-reported HOU. The tables show the self-report hours and logger hours are reasonably comparable for many of the sites with usable logger data. Therefore, we did not apply a correction factor to self-report hours using the ratio of logger HOU to self-report HOU from sites with usable logger data.

TABLE 5-9: HOURS OF USE FOR PG&E LARGE GROCERY CHAIN SAMPLED POINTS

Sample Point Identifier	Ex-Ante	Ex-Post Self-Report	Ex-Post Logger
PG&E-1	4,710	4,710	NA
PG&E-2	4,710	6,570	NA
PG&E-3	4,710	4,710	NA
PG&E-9	4,710	6,570	NA
PG&E-10	4,710	6,570	8,734
PG&E-11	4,710	6,205	5,022
PG&E-14	4,710	6,205	8,691
PG&E-18	4,710	6,205	7,995
PG&E-20	4,710	6,205	NA
PG&E-36	4,710	6,205	NA
PG&E-40	4,710	6,205	NA
PG&E-41	4,710	6,205	6,557
PG&E-42	4,710	5,785	NA
PG&E-47	4,710	6,205	NA
PG&E-48	4,710	6,205	8,444
PG&E-50	4,710	6,205	6,272

TABLE 5-10: HOURS OF USE FOR PG&E OTHER GROCERY SAMPLED POINTS

Sample Point Identifier	Ex-Ante	Ex-Post Self-Report	Ex-Post Logger
PG&E-4	2,740	2,740	NA
PG&E-5	4,710	5,840	8,731
PG&E-6	4,710	5,736	5,635
PG&E-7	4,710	4,710	NA
PG&E-8	2,740	2,190	6,444
PG&E-12	4,710	5,475	NA
PG&E-13	4,710	6,570	4,515
PG&E-15	4,710	4,745	NA
PG&E-16	4,710	7,300	6,941
PG&E-17	3,880	3,525	1,415
PG&E-19	2,740	2,740	NA
PG&E-21	2,740	5,110	8,252
PG&E-22	4,710	4,328	4,308
PG&E-23	4,710	5,877	NA
PG&E-24	4,710	4,710	NA
PG&E-25	2,740	2,740	NA

TABLE 5-10 (CONT'D): HOURS OF USE FOR PG&E OTHER GROCERY SAMPLED POINTS

Sample Point Identifier	Ex-Ante	Ex-Post Self-Report	Ex-Post Logger
PG&E-26	4,710	4,710	NA
PG&E-27	4,710	4,710	NA
PG&E-28	4,710	5,110	6,003
PG&E-29	4,710	6,205	8,686
PG&E-30	4,710	4,710	NA
PG&E-31	4,710	4,849	4,925
PG&E-32	4,710	4,745	NA
PG&E-33	4,710	8,760	5,397
PG&E-34	4,710	5,631	6,093
PG&E-35	4,710	4,710	NA
PG&E-37	4,710	5,293	5,335
PG&E-38	4,710	4,710	NA
PG&E-39	4,710	5,371	5,749
PG&E-43	4,710	4,745	4,363
PG&E-44	4,710	5,631	5,705
PG&E-45	4,710	5,110	3,577
PG&E-46	4,710	4,710	NA
PG&E-49	4,710	5,735	5,912

TABLE 5-11: HOURS OF USE FOR SDG&E SAMPLED POINTS

Sample Point Identifier	Ex-Ante	Ex-Post Self-Report	Ex-Post Logger
SDG&E-1	5390	2920	NA
SDG&E-2	5390	5110	5661
SDG&E-3	5390	6205	NA
SDG&E-4	5390	5214	5080
SDG&E-5	5390	5840	5616
SDG&E-6	5390	8760	NA
SDG&E-7	5390	5058	NA
SDG&E-8	5390	5110	NA
SDG&E-9	5390	5475	5784
SDG&E-10	5390	6205	5908

Installation Rate

The installation rate for PG&E sites was found to be very close to one, with field technicians only reporting a few sites that installed fewer lamps than expected, and this was observed in very few lamps. For SDG&E there was one site where the field technician found fewer fixtures than the ex-ante claim, resulting in an installation rate for that site of 0.45. For SDG&E the unit basis is number of doors with the assumption being that there are 1.2 lamps per door, as discussed above. The evaluation team verified the number of lamps per door and found them to be slightly lower with a lamps per door ratio of 1.13. This also contributed to a lower GRR for SDG&E sites.

5.1.3 Reasons for Discrepancy

First Year Gross Impact Results

The primary drivers to evaluated kWh savings are the evaluated measure wattage, evaluated baseline lighting wattage, and annual hours of use (HOU). The evaluation team verified Installation rates using the measure code units (doors in SDG&E, and linear feet in PG&E) and there were slight differences leading to lower realization rates as discussed above. For PG&E removing the reach-in case LEDs because they were being double counted at the large chain sites reduces the savings significantly and is the largest decrease in savings. The largest increase in PG&E ex-post savings is from increasing the hours of operation based on logger data. Figure 5-1, Figure 5-2, and Figure 5-3 illustrate the impact these changes have on the electric energy savings for the three utilities.

FIGURE 5-1: FIRST YEAR KWH SAVINGS MAGNITUDE REDUCTION WATERFALL BY DISCREPANCY CATEGORY FOR PG&E LARGE GROCERY CHAIN

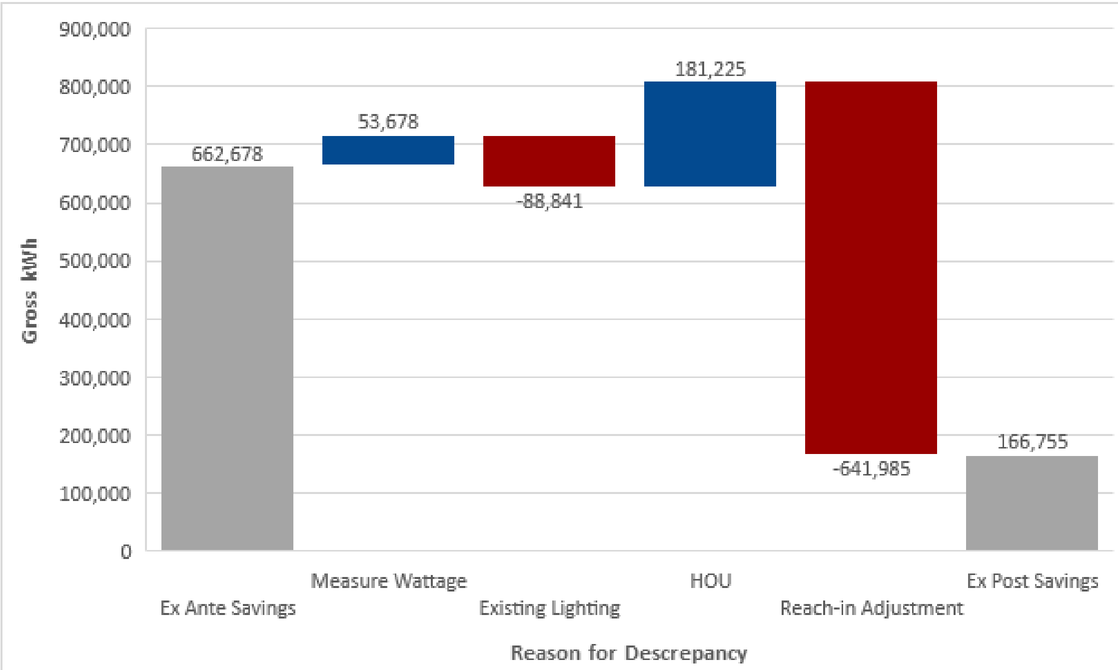


FIGURE 5-2: FIRST YEAR KWH SAVINGS MAGNITUDE REDUCTION WATERFALL BY DISCREPANCY CATEGORY FOR PG&E OTHER GROCERY

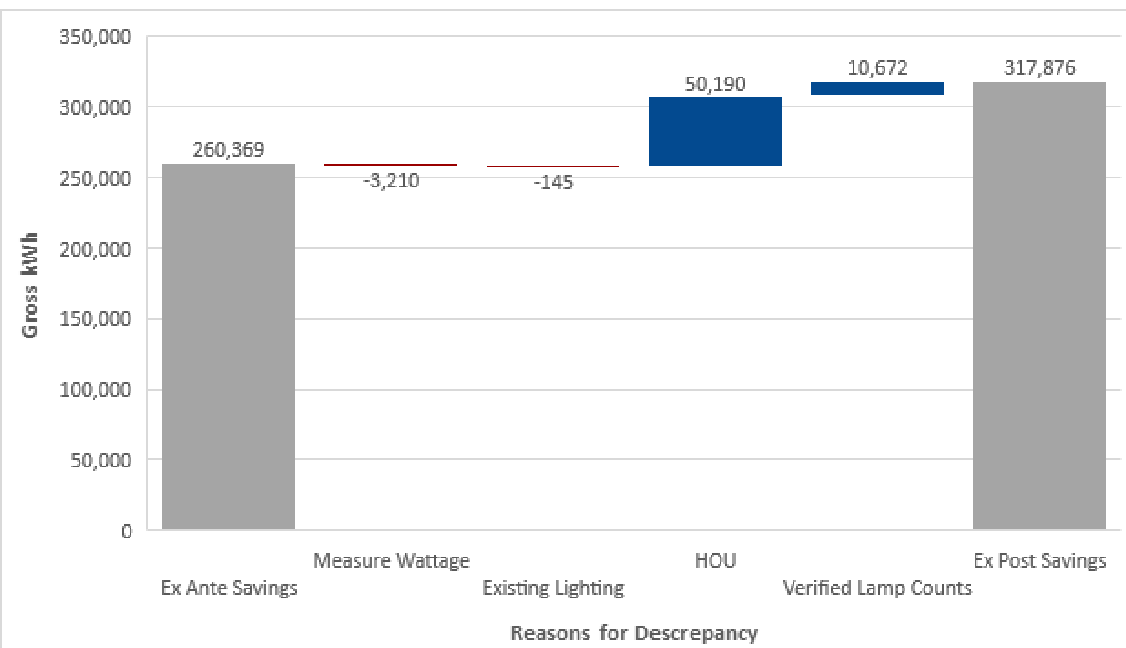
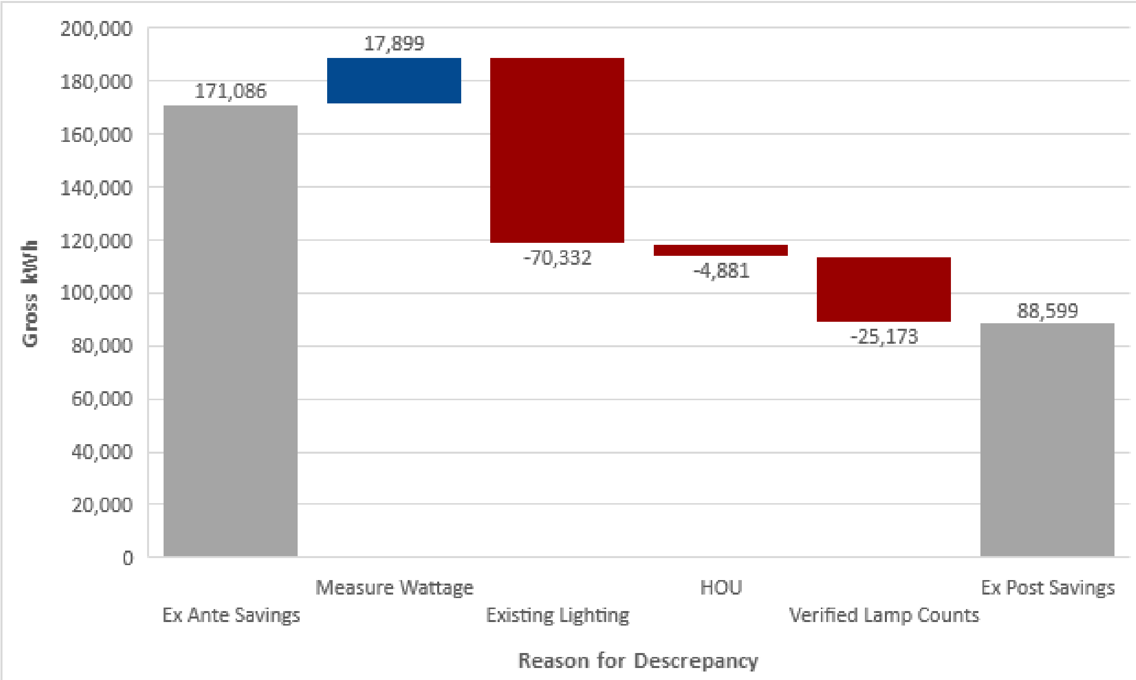


FIGURE 5-3: FIRST YEAR KWH SAVINGS MAGNITUDE REDUCTION WATERFALL BY DISCREPANCY CATEGORY FOR SDG&E



The first year kWh savings for SDG&E are impacted equally by the assumptions related to existing fixture technology and actual number of fixtures per site.

Lifecycle Gross Impact Results

Table 5-12 through Table 5-14 present the lifecycle gross impacts for the PG&E and SDG&E sample points. We multiplied the first-year gross savings by the evaluated EUL of 4 years to calculate lifecycle savings for each measure and project. We assumed the life of the measure is equal to the remaining useful life (RUL) of the host equipment, in this case the refrigeration case itself which has an EUL of 12, using DEER assumptions of 1/3 of the EUL. Therefore, we applied EUL of 4 to the first-year savings to calculate lifecycle savings.

TABLE 5-12: LIFECYCLE EX-POST GROSS IMPACT RESULTS FOR PG&E LARGE GROCERY CHAIN SAMPLE POINTS

	Ex-Post		Ex-Ante		Results	
Sample Point Identifier	**Lifecycle Gross Impact kW Savings**	**Lifecycle Gross Impact kWh Savings**	**Lifecycle Gross Impact kW Claims**	**Lifecycle Gross Impact kWh Claims**	**Lifecycle Gross Impact kW Realization Rate**	**Lifecycle Gross Impact kWh Realization Rate**
PG&E-1	25.17	118,239	61.66	289,952	0.41	0.41
PG&E-2	0	0	241.41	1,136,192	0	0
PG&E-3	7.73	36,295	43.62	205,088	0.18	0.18
PG&E-9	0	0	66.24	311,760	0	0
PG&E-10	1.74	11,284	16.49	77,466	0.11	0.15
PG&E-11	15.92	61,835	66.10	310,608	0.24	0.20
PG&E-14	0	0	54.17	254,950	0	0
PG&E-18	0	0	93.03	437,850	0	0
PG&E-20	2.02	9,512	134.30	631,781	0.02	0.02
PG&E-36	15.95	67,477	76.94	361,584	0.21	0.19
PG&E-40	0	0	362.14	1,705,248	0	0
PG&E-41	9.99	46,917	716.53	3,373,552	0.01	0.01
PG&E-42	14.19	66,644	78.53	369,024	0.18	0.18
PG&E-47	19.59	81,765	89.55	420,848	0.22	0.19
PG&E-48	12.94	73,482	57.92	272,192	0.22	0.27
PG&E-50	19.82	93,570	94.64	444,752	0.21	0.21
Total	**145.06**	**667,020**	**2,253.26**	**10,602,846**	**0.06**	**0.06**
Average	**9.07**	**41,689**	**140.83**	**662,678**	**0.06**	**0.06**

TABLE 5-13: LIFECYCLE EX-POST GROSS IMPACT RESULTS FOR PG&E OTHER SAMPLE POINTS

	Ex-Post		Ex-Ante		Results	
Sample Point Identifier	**Lifecycle Gross Impact kW Savings**	**Lifecycle Gross Impact kWh Savings**	**Lifecycle Gross Impact kW Claims**	**Lifecycle Gross Impact kWh Claims**	**Lifecycle Gross Impact kW Realization Rate**	**Lifecycle Gross Impact kWh Realization Rate**
PG&E-4	4.68	16,408	19.64	68,746	0.24	0.24
PG&E-5	4.67	30,367	12.03	56,576	0.39	0.54
PG&E-6	7.27	30,489	24.73	116,390	0.29	0.26
PG&E-7	1.76	8,288	5.26	24,752	0.34	0.33
PG&E-8	15.81	91,618	40.68	142,522	0.39	0.64
PG&E-12	6.30	29,594	25.27	118,810	0.25	0.25
PG&E-13	27.16	91,357	85.63	403,210	0.32	0.23

TABLE 5-13 (CONT'D): LIFECYCLE EX-POST GROSS IMPACT RESULTS FOR PG&E OTHER SAMPLE POINTS

	Ex-Post		Ex-Ante		Results	
Sample Point Identifier	Lifecycle Gross Impact kW Savings	Lifecycle Gross Impact kWh Savings	Lifecycle Gross Impact kW Claims	Lifecycle Gross Impact kWh Claims	Lifecycle Gross Impact kW Realization Rate	Lifecycle Gross Impact kWh Realization Rate
PG&E-15	0.44	2,072	1.80	8,486	0.24	0.24
PG&E-16	18.25	94,259	60.48	284,832	0.30	0.33
PG&E-17	0.40	2,495	5.15	25,152	0.08	0.10
PG&E-19	6.40	22,471	28.57	99,994	0.22	0.22
PG&E-21	11.55	85,738	33.93	118,742	0.34	0.72
PG&E-22	22.51	73,006	74.59	351,293	0.30	0.21
PG&E-23	14.82	69,604	46.76	219,789	0.32	0.32
PG&E-24	3.55	16,677	29.99	141,142	0.12	0.12
PG&E-25	2.40	8,427	10.71	37,498	0.22	0.22
PG&E-26	3.43	16,137	20.30	95,512	0.17	0.17
PG&E-27	6.53	30,658	23.55	110,848	0.28	0.28
PG&E-28	11.00	49,285	34.27	161,405	0.32	0.31
PG&E-29	16.33	105,541	46.37	218,371	0.35	0.48
PG&E-30	2.85	13,376	13.32	62,674	0.21	0.21
PG&E-31	10.68	39,170	30.03	141,331	0.36	0.28
PG&E-32	3.01	13,831	9.93	46,675	0.30	0.30
PG&E-33	12.28	49,344	33.56	157,958	0.37	0.31
PG&E-34	9.51	43,001	25.71	120,979	0.37	0.36
PG&E-35	5.78	27,174	21.20	99,763	0.27	0.27
PG&E-37	9.01	35,910	24.73	116,390	0.36	0.31
PG&E-38	3.39	15,922	12.36	58,195	0.27	0.27
PG&E-39	11.93	51,099	33.56	157,958	0.36	0.32
PG&E-43	6.92	22,454	19.43	91,450	0.36	0.25
PG&E-44	1.02	4,327	8.83	41,568	0.12	0.10
PG&E-45	5.48	15,059	15.90	74,822	0.34	0.20
PG&E-46	1.22	5,742	3.76	17,680	0.33	0.32
PG&E-49	13.83	60,608	37.06	174,397	0.37	0.35
Total	**282.16**	**1,271,506**	**919.11**	**4,165,910**	**0.31**	**0.31**
Average	**8.30**	**37,397**	**27.03**	**122,527**	**0.31**	**0.31**

The lifecycle savings realization rates are lower than first year realization rates because PG&E assumed a 16 year EUL compared to the 4-year EUL the evaluation applied.

TABLE 5-14: LIFECYCLE EX-POST GROSS IMPACT RESULTS FOR SDG&E SAMPLE POINTS

	Ex-Post		Ex-Ante		Results	
Sample Point Identifier	Lifecycle Gross Impact kW Savings	Lifecycle Gross Impact kWh Savings	Lifecycle Gross Impact kW Claims	Lifecycle Gross Impact kWh Claims	Lifecycle Gross Impact kW Realization Rate	Lifecycle Gross Impact kWh Realization Rate
SDG&E-1	13.95	61,774	75.54	459,476	0.18	0.13
SDG&E-2	0.82	3,425	1.93	11,707	0.43	0.29
SDG&E-3	6.63	29,351	62.52	380,256	0.11	0.08
SDG&E-4	2.51	10,912	79.39	482,890	0.03	0.02
SDG&E-5	16.30	66,724	62.52	380,256	0.26	0.18
SDG&E-6	0.58	2,560	1.44	8,780	0.40	0.29
SDG&E-7	10.16	44,966	52.10	316,880	0.19	0.14
SDG&E-8	1.07	4,735	5.21	31,688	0.21	0.15
SDG&E-9	0.98	4,118	18.23	110,908	0.05	0.04
SDG&E-10	6.83	29,366	91.17	554,540	0.07	0.05
Total	**59.83**	**257,930**	**450.04**	**2,737,381**	**0.13**	**0.09**
Average	**5.98**	**25,793**	**45.00**	**273,738**	**0.13**	**0.09**

The lifecycle savings realization rates are lower than first year realization rates because SDG&E assumed an EUL of 16 years compared to the 4-year EUL the evaluation applied.

5.2 PROCESS PUMPING VFD MEASURES

As discussed in Chapter 3 and 4, gross impact evaluation sampling and analysis was completed for agricultural irrigation pump VFDs; several PG&E claims associated with industrial glycol pumps were excluded from the sample design. The results featured in this section segment the results by PA (PG&E and SCE) and the type of pump (well versus booster pumps). SDG&E claims were also excluded from sampling. Results by pump claim presented in this section represent the as-found condition as determined during on-site inspections for a sample of selected projects (applications). Within the sample of 49 claims (pumps) we determined the following classifications based on inspections; which at times differed when compared with tracking system-based claims:

- Out of the entire PG&E sample of 27 pump claims, on-site inspections revealed that 15 claims were associated with well pumps and 12 claims were associated with booster pumps – resulting in 6 instances where the tracking system-based pump type was reclassified for the purposes of this evaluation and for the reporting of pump-specific results in this section. In 5 out of 6 cases, tracking system-based well pumps were reclassified as booster pumps. For PG&E the tracking system-based horsepower (HP) for four pumps were corrected based on on-site findings, with no net change in HP in the sample of evaluated projects.

- Out of the entire SCE sample of 22 pump claims, on-site inspections revealed that 16 claims were associated with well pumps and 6 claims were associated with booster pumps – resulting in 4 instances where the tracking system-based pump type was reclassified for the purposes of this evaluation and for the reporting of pump-specific results in this section. Tracking system-based claims for2 booster pumps and 2 well pumps were reclassified based on on-site findings. Also, one SCE claim for a 140 hp well pump was found to be composed of two pumps – one 100 hp well pump and one 40 hp booster pump, both equipped with a VFD; in this section those two pumps are treated as a single table line item using a well pump label. For SCE the tracking system-based horsepower for 2 pumps was corrected based on on-site findings – a 50 HP pump, and a 60 HP pump, each with a tracking system-based power rating of 100 HP, resulting in a net reduction in HP of 90 HP.

It is important to note that the results presented in this section reflect the true pump type and horsepower, and that mean gross impact realization rate results by PA and pump type are sample-based weighted averages, with the ex-post savings serving as the weight for each sample point. This differs sharply from mean results and weighting applied in Section 7 (Evaluation Results), where population-level weights are applied and gross impact results presented are at the PA and measure group (strata) level, without differentiation by pump type.

5.2.1 First Year Gross Impact Results

Table 5-15 and Table 5-16 present first year gross impact results for PG&E and SCE well pump on-site sample points, respectively. Table 5-17 and Table 5-18 present first year gross impact results for PG&E and SCE booster pump on-site sample points, respectively.

The ex-ante savings claims are unique by measure code, including differentiation by pump type, as presented in Section 4.2, but savings also vary claim-by-claim as a function of horsepower claimed. Ex-ante claims are based upon thinly-documented workpaper-based approaches involving database analysis of previous custom and new construction agricultural pump VFD projects; the evaluation team was therefore unable to reproduce ex-ante savings estimates, but was generally able to verify proper application of energy savings per unit of horsepower from each relevant workpaper to the tracking system. This was successful in all but one instance in the PG&E sample where a 200 HP booster pump was labeled in the tracking system as a well pump, and the peak demand savings value was mis-entered into the tracking system; the workpaper for well pumps has an 0.117 kW/HP value, while the tracking system-based report was 0.177 kW/HP.

TABLE 5-15: FIRST YEAR EX-POST GROSS IMPACT RESULTS AND DISCREPANCY FACTORS FOR PG&E WELL PUMP SAMPLE POINTS

Gross Impact Results

Sample Point Identifier	Ex-Post First Year Gross Impact Savings (kWh)	Ex-Ante First Year Gross Impact Claim (kWh)	Results First Year Savings Realization Rate	Ex-Post First Year Gross Peak Demand Impact (kW)	Ex-Ante First Year Gross Peak Demand Claim (kW)	Results First Year Peak Demand Realization Rate
PGE Well-1	26,065	19,245	1.35	10.43	9.05	1.15
PGE Well-2	0	6,415	0.00	0.00	3.02	0.00
PGE Well-3	0	38,490	0.00	0.00	18.11	0.00
PGE Well-4	0	38,490	0.00	0.00	18.11	0.00
PGE Well-5	74,260	110,400	0.67	0.00	70.80	0.00
PGE Well-6	14,074	64,150	0.22	0.00	30.18	0.00
PGE Well-7	3,619	102,640	0.04	0.00	48.28	0.00
PGE Well-8	1,273	76,980	0.02	0.00	36.21	0.00
PGE Well-9	68,670	76,980	0.89	39.47	36.21	1.09
PGE Well-10	6,820	51,320	0.13	0.00	24.14	0.00
PGE Well-11	0	33,998	0.00	0.00	18.30	0.00
PGE Well-12	0	64,150	0.00	0.00	30.18	0.00
PGE Well-13	3,014	51,320	0.06	0.00	24.14	0.00
PGE Well-14	48,440	76,980	0.63	7.04	36.21	0.19
PGE Well-15	32,293	64,150	0.50	4.70	30.18	0.16
Total	**278,527**	**875,708**	**0.32**	**62**	**433**	**0.14**

Discrepancy Factors

Sample Point Identifier	Pump Run Hours > 1500	Pump Run Hours < 500	Equiv. Controls Replaced	Pump Speed Typically 90-100%	Farmer Prefers Using District Water	Farmer Also Irrigates with a Different Pump	Farmer Uses Flood Irrigation	Pump HP Greater Than Claim	Pump HP Less Than Claim	Applied Mean Modeled Result from Sample	Pump Peak Coincidence Factor < 50%	Pump is a Well but Claim is a Booster
PGE Well-1	1											
PGE Well-2			1									
PGE Well-3			1									
PGE Well-4			1									
PGE Well-5											1	
PGE Well-6		1		1					1		1	
PGE Well-7		1			1						1	
PGE Well-8		1		1		1					1	
PGE Well-9												
PGE Well-10		1		1		1		1			1	
PGE Well-11							1					1
PGE Well-12							1					
PGE Well-13		1			1						1	
PGE Well-14										1		
PGE Well-15									1	1		
Total	**1**	**5**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**6**	**1**

PG&E ex-post gross first year annual impact results per well pump sample point range from zero to 74,260 kWh, with gross impact realization rates (GRRs) ranging from 0.00 to 1.35, and yielding a sample-based weighted mean GRR of 0.32. Ex-post gross first year peak demand results per point are also presented per sample point, ranging from zero to 39.47 kW, with realization rates ranging from 0.00 to 1.15, and yielding a sample-based weighted mean GRR of 0.14. The table includes a listing of discrepancy factors that collectively influence the savings results in a meaningful way, leading to both relatively high or low ex-post evaluation results, such as hours of operation in excess of 1,500 per year, farmer irrigation practices, pump loading observed, or use of previous pump speed controls. Some highlights to point out include the following:

- Five sample points out of a total sample size of 15 well pumps do not save energy.
  - Replaced pump speed controls on 3 pumps had equivalent functionality to VFD controls, resulting in no savings being realized by the grid. Adjustable frequency drive (AFD) controls were replaced in each instance, with new program sponsored VFD controls. CPUC policy does not allow programs to install like-for-like energy efficiency replacements.
  - Two additional well pumps were being used for flood irrigation. VFDs used for flood irrigation are not eligible for program incentives. Irrigation system pressures maintained when using flood irrigation are low and the program requires pressurized systems such as drip irrigation lines, as outlined in the program application materials.[17] Systems such as these are detrimental to the pump affinity law exponent for a VFD, as discussed in Section 4.2.
- Additionally, another 6 well pumps do not save peak demand; the pumps were not observed to operate at the time of coincident peak, as defined by DEER (see Chapter 4 for details on DEER Peak definition).
- Other factors having a meaningful downward effect on some of the GRR results includes pumps running fewer than 500 hours per year, high pump speeds/loaded pumps, and when multiple pumps serve a given field (especially where well pumps are used as a backup for irrigating fields when district water is available).
  - It is notable that program standards exclude pump eligibility if pump run hours are below 1,000 hours per year. Yet five points in the ex-post sample have annual hours of runtime below 500 hours. Factors that resulted in low pump run hours include pumps being used in backup capacity and orchards with trees that had not yet matured; trees require more water as they mature and require a substantially lower amount of water for the first four years following planting.

[17] https://www.pge.com/pge_global/common/pdfs/save-energy-money/business-solutions-and-rebates/product-rebates/business-rebate-catalog.pdf; page 4

- *It is also notable that pumps that do not operate at substantially reduced speeds and flow should not be eligible for program VFD incentives. We see 3 sample points that typically operate in excess of 89 percent of full speed. The program eligibility requirements should be strengthened to exclude all such pumps from participation. The current language is too open to interpretation and program staff are not currently screening out projects that should be excluded from participation; not only for this reason, but several others noted in this section.*

- One factor having a significant upward effect on GRR results is when pumps run in excess of 1,500 hours per year.
- Models were developed for 8 of the well pumps evaluated (sample point identifiers from Table 5-15 for well pumps 1, 5-10 and 13). The annual energy GRR for just these points is somewhat improved relative to the total sample mean, at 0.36, but not dramatically different.
- For the rest of the pumps in the sample, ex-post savings were derived using a mean savings metric for both energy (kWh/HP) and demand (kW/HP), which were derived from the modeled points noted above. This result was applied to sample point identifiers for well pumps 14 and 15.
  - It is notable that this mean excludes flood irrigation points (well pumps 11 and 12) and AFD control replacement projects (well pumps 2, 3 and 4), which all had no savings, as outlined above.
  - The rationale for excluding those points from the mean result is that these conditions that led to no savings were measurable in all the other sample points, and were not identified during data collection, including well pumps 14 and 15.

Only 4 pumps in the sample have annual energy GRRs that exceed 0.50, but there are a total of 8 projects with annual energy GRRs below 0.20. As noted above, program eligibility requirements and screening should be enhanced to improve this result, and especially to exclude several of the projects that do not save energy, as well as those that save very little energy for the reasons outlined in this discussion.

TABLE 5-16: FIRST YEAR EX-POST GROSS IMPACT RESULTS AND DISCREPANCY FACTORS FOR SCE WELL PUMP SAMPLE POINTS

Gross Impact Results

Sample Point Identifier	Ex-Post First Year Gross Impact Savings (kWh)	Ex-Ante First Year Gross Impact Claim (kWh)	Results First Year Savings Realization Rate	Ex-Post First Year Gross Peak Demand Impact (kW)	Ex-Ante First Year Gross Peak Demand Claim (kW)	Results First Year Peak Demand Realization Rate
SCE Well-1	6,365	9,066	0.70	1.18	4.88	0.24
SCE Well-2	12,490	38,490	0.32	6.85	18.11	0.38
SCE Well-3	0	64,150	0.00	0.00	30.18	0.00
SCE Well-4	43,161	38,490	1.12	25.81	18.11	1.43
SCE Well-5	0	12,830	0.00	0.00	6.04	0.00
SCE Well-6	25,760	7,698	3.35	0.00	3.62	0.00
SCE Well-7	662	35,924	0.02	0.00	16.90	0.00
SCE Well-8	10,108	38,490	0.26	0.00	18.11	0.00
SCE Well-9	0	38,490	0.00	0.00	18.11	0.00
SCE Well-10	4,814	32,075	0.15	0.00	15.09	0.00
SCE Well-11	21,854	32,075	0.68	0.00	15.09	0.00
SCE Well-12	16,317	25,660	0.64	0.00	12.07	0.00
SCE Well-13	1,052	38,490	0.03	8.51	18.11	0.47
SCE Well-14	6,829	12,830	0.53	2.18	6.04	0.36
SCE Well-15	8,194	25,660	0.32	2.62	12.07	0.22
SCE Well-16	5,463	9,066	0.60	1.75	4.88	0.36
Total	**163,069**	**459,484**	**0.35**	**49**	**217**	**0.22**

Discrepancy Factors

Sample Point Identifier	Pump Run Hours > 1500	Pump Run Hours < 500	Pump Speed Typically 90-100%	Pump Speed Relatively Low	Farmer Uses Pump to Fill Reservoir	Pump HP Less Than Claim	Farmer Has PV Which Reduces Grid Impacts	Speed Controls Are Not an Option	Applied Mean Modeled Result from Sample	Pump Peak Coincidence Factor < 50%	Pump is a Well but Claim is a Booster
SCE Well-1										1	1
SCE Well-2			1							1	
SCE Well-3					1						
SCE Well-4											
SCE Well-5					1						
SCE Well-6	1			1						1	
SCE Well-7		1	1							1	
SCE Well-8							1				
SCE Well-9								1			
SCE Well-10			1							1	
SCE Well-11										1	
SCE Well-12										1	
SCE Well-13			1								
SCE Well-14	1								1		
SCE Well-15						1			1		
SCE Well-16									1		1
Total	**2**	**1**	**4**	**1**	**2**	**1**	**1**	**1**	**3**	**7**	**2**

SCE ex-post gross first year annual impact results per well pump sample point range from zero to 43,161 kWh, with gross impact realization rates (GRRs) ranging from 0.00 to 1.12, and yielding a sample-based weighted mean GRR of 0.35. Ex-post gross first year peak demand results per point are also presented per sample point, ranging from zero to 25.81 kW, with realization rates ranging from 0.00 to 1.43, and yielding a sample-based weighted mean GRR of 0.22. Similar to what was presented above, this table includes a listing of discrepancy factors that collectively influence the savings results in a meaningful way, leading to both relatively high or low ex-post evaluation results, such as hours of operation in excess of 1,500 per year, farmer irrigation practices, pump loading observed, or high pump speeds. Important observations include the following:

- Two sample points out of a total sample size of 16 well pumps do not save energy, and evaluators set savings to zero for one additional sample point, as discussed below.
  - Two well pumps are being used to fill a reservoir. VFDs used to fill a reservoir are not eligible for program incentives. Pumping system pressures maintained when filling a reservoir are low and the program requires that pumps/VFDs be used in conjunction with pressurized systems such as drip irrigation lines, as outlined in the program application materials[18]. Systems such as these are detrimental to the pump affinity law exponent for a VFD, as discussed in Section 4.2.
  - For the other pump the VFD add-on to the existing pump was an operation requirement for the farmer in order to prevent pump impeller damage due to sand that was entering the pump housing. Only speed controls are an option to prevent ongoing damage and to conduct operations in an economically viable way. CPUC policy does not allow evaluators to accrue VFD savings in such a case, as no other viable solution exists to remedy this issue; the VFD essentially becomes the baseline practice in this instance.
- Additionally, another 6 well pumps do not save peak demand; the pumps were not observed to operate at the time of coincident peak, as defined by DEER (see Chapter 4 for details on DEER Peak definition).
- Other factors having a meaningful downward effect on some of the GRR results includes pumps running fewer than 500 hours per year, high pump speeds/loaded pumps, and where PV installations mute the grid benefits of a given VFD installation.
  - *It is also notable that pumps that do not operate at substantially reduced speeds and flow should not be eligible for program VFD incentives. We see 4 sample points that typically operate in excess of 89 percent of full speed. The program eligibility requirements should be strengthened to exclude all such pumps from participation. The current language is too open*

[18] 26th Ed SolutionsDirectory2019July_Final R1 8-16-19; page 41

to interpretation and program staff are not currently screening out projects that should be excluded from participation; not only for this reason, but several others noted in this section.

  - It is notable that program standards exclude pump eligibility if pump run hours are below 1,000 hours per year. While only in the sample had annual hours of runtime below 500 hours, another 7 pumps had runtime below the program allowed threshold of 1,000. However, this is not a significant issue with the pumps in the sample, on average having hours of runtime per year in excess of 1,000.

- Two factors having a significant upward effect on GRR results is when pumps run in excess of 1,500 hours per year and when pumps run at a relatively low speed/load.
- Models were developed for 10 of the well pumps evaluated (sample point identifiers from Table 5-16 for well pumps 1-2, 4, 6-8 and 10-13). The annual energy GRR developed using those points alone is improved relative to the total sample mean, at 0.48.
- For the rest of the pumps in the sample the evaluation savings were derived using a mean savings metric for both energy (kWh/HP) and demand (kW/HP), which were derived from the modeled points noted above. This result was applied to well pumps 14-16.
  - It is notable that this mean excludes reservoir filling pump points (wells 3 and 5) and pump impacted by sand (well pump 9), which all had no savings, as outlined above.
  - The rationale for excluding those points from the mean result is that these conditions that led to no savings were measurable in all the other sample points, and were not identified during data collection, including points for well pumps 14-16.

6 pumps in the sample have annual energy GRRs below 0.20. As noted above, program eligibility requirements and screening should be enhanced to improve this result, and especially to exclude several of the projects that do not save energy, as well as those that save very little energy for the reasons outlined in this discussion.

TABLE 5-17: FIRST YEAR EX-POST GROSS IMPACT RESULTS AND DISCREPANCY FACTORS FOR PG&E BOOSTER PUMP SAMPLE POINTS

Gross Impact Results

	Ex-Post	Ex-Ante	Results	Ex-Post	Ex-Ante	Results
Sample Point Identifier	**First Year Gross Impact Savings (kWh)**	**First Year Gross Impact Claim (kWh)**	**First Year Savings Realization Rate**	**First Year Gross Peak Demand Impact (kW)**	**First Year Gross Peak Demand Claim (kW)**	**First Year Peak Demand Realization Rate**
PGE Booster-1	45,274	76,980	0.59	0.00	36.21	0.00
PGE Booster -2	18,535	32,125	0.58	0.99	13.50	0.07
PGE Booster-3	31,394	55,200	0.57	-0.98	35.40	-0.03
PGE Booster-4	67,161	22,665	2.96	6.59	12.20	0.54
PGE Booster-5	67,161	22,665	2.96	6.59	12.20	0.54
PGE Booster-6	-1,088	22,665	-0.05	0.00	12.20	0.00
PGE Booster-7	0	16,999	0.00	0.00	9.15	0.00
PGE Booster-8	0	19,245	0.00	0.00	9.05	0.00
PGE Booster-9	2,997	22,665	0.13	0.00	12.20	0.00
PGE Booster-10	68,601	45,330	1.51	19.60	24.40	0.80
PGE Booster-11	50,560	51,320	0.99	5.58	24.14	0.23
PGE Booster-12	50,560	51,320	0.99	5.58	24.14	0.23
Total	**401,155**	**439,179**	**0.91**	**43.95**	**224.79**	**0.20**

Discrepancy Factors

Sample Point Identifier	**Pump Run Hours > 1500**	**Pump Run Hours < 500**	**Pump Speed Typically 90-100%**	**Farmer Also Irrigates with a Different Pump**	**Pump HP Greater Than Claim**	**Applied Mean Modeled Result from Sample**	**Pump Peak Coincidence Factor < 50%**	**Pump is a Booster but Claim is a Well**
PGE Booster-1				1			1	1
PGE Booster -2	1		1					
PGE Booster-3	1							1
PGE Booster-4	1							
PGE Booster-5	1							
PGE Booster-6		1	1	1	1		1	
PGE Booster-7		1		1				
PGE Booster-8		1		1				1
PGE Booster-9		1	1				1	
PGE Booster-10	1							
PGE Booster-11						1		1
PGE Booster-12						1		1
Total	**5**	**4**	**3**	**4**	**1**	**2**	**3**	**5**

PG&E ex-post gross first year annual impact results per booster pump sample point range from zero to 68,601 kWh, with gross impact realization rates (GRRs) ranging from -0.05 to 2.96, and yielding a sample-based weighted mean GRR of 0.91. Ex-post gross first year peak demand results per point are also presented per sample point, ranging from -0.98 kW to 19.60 kW, with realization rates ranging from -0.03 to 0.80, and yielding a sample-based weighted mean GRR of 0.22. All of the factors leading to relatively high or relatively low results have already been discussed at some length above and will not be repeated here. Some notable exceptions and highlights, however, are discussed below by sample point:

- Two sample points out of a total sample size of 12 booster pumps do not save energy.
  - Pumps associated with sample Identifiers for booster pumps 7 and 8 were not in operation.
  - These pumps serve orchards with young trees and the farmer installed excess pumping capacity for forecasted increases in water demand that will be needed when the trees mature. So for now the pumps sit idle.
  - CPUC policy does not allow evaluators to forecast future operations, but instead to calculate savings based on observed conditions.
- Two pumps in the sample (for booster pumps 4 and 5) have annual energy GRRs of 2.96 due to run hours for each pump exceeding 3,000 hours per year. These pumps serve a common field/crop, sometimes running in parallel when irrigation demand is substantial, and other times running individually.
- One pump in the sample (booster pump 6) has a slightly negative GRR due to the pump running at full speed/load. Fully loaded pumps equipped with a VFD use more energy due to small reduced efficiencies of the VFD. For pumps running at part-load/speed these small VFD efficiency considerations are overcome by the dramatic savings associated with speed reduction and the pump affinity law exponent.
  - *It is again notable that pumps that do not operate at substantially reduced speeds and flow should not be eligible for program VFD incentives. Refer to PG&E and SCE recommendations above under well pump VFD sections.*
  - We also see this same factor affecting peak savings for booster pump 3.
- Models were developed for 8 of the booster pumps evaluated with non-zero savings (sample point identifiers from Table 5-17 for booster pumps 1-6 and 9-10). The annual energy GRR developed using those points alone is somewhat improved relative to the total sample mean, at 1.00, and both results indicate that the program is performing well in achieving desired savings.
- For the rest of the pumps in the sample the evaluation savings were derived using a mean savings metric for both energy (kWh/HP) and demand (kW/HP), which were derived from the modeled points noted above. This result was applied to booster pumps 11 and 12.

- It is notable that this mean excludes non-operational points (booster pumps 7 and 8) which had no savings, as outlined above.
- The rationale for excluding those points from the mean result is that these conditions that led to no savings were measurable in all the other sample points, and were not identified during data collection, including booster pumps11 and 12.

The evaluation results show that on a GRR basis that PG&E booster pumps perform much closer to expectations and claims. However, the evaluation team does not have access to ex-ante calculations and so is not in a position to examine and assess the reasons for good booster results and relatively poor well pump results. However, we urge the workpaper team to obtain access and examine the source of workpaper-based impact estimates, for well pumps in particular, and make efforts to correct any issues as part of the workpaper update process taking place in 2020.

TABLE 5-18: FIRST YEAR EX-POST GROSS IMPACT RESULTS AND DISCREPANCY FACTORS FOR SCE BOOSTER PUMP SAMPLE POINTS

Gross Impact Results

	Ex-Post	Ex-Ante	Results	Ex-Post	Ex-Ante	Results
Sample Point Identifier	**First Year Gross Impact Savings (kWh)**	**First Year Gross Impact Claim (kWh)**	**First Year Savings Realization Rate**	**First Year Gross Peak Demand Impact (kW)**	**First Year Gross Peak Demand Claim (kW)**	**First Year Peak Demand Realization Rate**
SCE Booster-1	28,548	32,075	0.89	0.96	15.09	0.06
SCE Booster-2	24,796	2,267	10.94	3.05	1.22	2.50
SCE Booster-3	-209	11,333	-0.02	-0.04	6.10	-0.01
SCE Booster-4	-1,015	13,599	-0.07	0.00	7.32	0.00
SCE Booster-5	10,637	25,660	0.41	0.81	12.07	0.07
SCE Booster-6	12,764	13,599	0.94	0.97	7.32	0.13
Total	**75,521**	**98,532**	**0.77**	**5.74**	**49.12**	**0.12**

Discrepancy Factors

Sample Point Identifier	Pump Run Hours > 1500	Pump Speed Typically 90-100%	Pump Speed Relatively Low	Pump HP Less Than Claim	Applied Mean Modeled Result from Sample	Pump Peak Coincidence Factor < 50%	Pump is a Booster but Claim is a Well
SCE Booster-1	1					1	1
SCE Booster-2	1		1				
SCE Booster-3	1	1				1	
SCE Booster-4	1	1				1	
SCE Booster-5				1	1		1
SCE Booster-6					1		
Total	**4**	**2**	**1**	**1**	**2**	**3**	**2**

SCE ex-post gross first year annual impact results per booster pump sample point range from -1,015 kWh to 28,548 kWh, with gross impact realization rates (GRRs) ranging from -0.07 to 10.94, and yielding a sample-based weighted mean GRR of 0.77. Ex-post gross first year peak demand results per point are also presented per sample point, ranging from -0.04 kW to 3.05 kW, with realization rates ranging from -0.01 to 2.50, and yielding a sample-based weighted mean GRR of 0.12. All of the factors leading to relatively high or relatively low results have already been discussed at some length above and will not be repeated here. Some notable exceptions and highlights, however, are discussed below by sample point:

- Two pumps in the sample (booster pumps 1 and 6) have annual energy GRRs approaching 1.0 and one additional pump has a realization rate of 10.94 (booster pump 2).
  - Booster pump 1 has annual pump run hours approaching 2,000 hours.
  - Booster pump 2 has annual pump run hours exceeding 8,000 and operates in a relatively unloaded state, both of which drive impacts upwards considerably. This was the only pump in the sample observed to operate at a dramatically low load condition and illustrates the potential of the VFD measure to capture savings under such conditions, and when combined with very high run hours we see much higher impacts than are normally achieved. In fact, you can see this low speed/load effect expressed by the relatively high peak demand realization rate for identifier 2.
  - Booster pump 6 had mean modeled results applied, as discussed further below.
- Two pumps in the sample (booster pumps 3 and 4) have somewhat negative GRRs due to the pump frequently running at full speed/load. Fully loaded pumps equipped with a VFD use more energy due to small reduced efficiencies of the VFD. For pumps running at part-load/speed these small VFD efficiency considerations are overcome by the dramatic savings associated with speed reduction and the pump affinity law exponent.
  - *It is again notable that pumps that do not operate at substantially reduced speeds and flow should not be eligible for program VFD incentives. Refer to PG&E and SCE recommendations above under well pump VFD sections.*
  - We also see this same factor affecting peak savings for booster pump 3.
- Models were developed for 4 of the booster pumps evaluated (booster pumps 1-4). The annual energy GRR developed using those points alone is somewhat improved relative to the total sample mean, at 0.88, and both results indicate that the program is performing well in achieving desired savings.
- For the rest of the pumps in the sample the evaluation savings were derived using a mean savings metric for both energy (kWh/HP) and demand (kW/HP), which were derived from the modeled points noted above. This result was applied to booster pumps 5 and 6.

The evaluation results show that on a GRR basis that SCE booster pumps perform much closer to expectations and claims. However, the evaluation team does not have access to ex-ante calculations and so is not in a position to examine and assess the reasons for good booster results and relatively poor well pump results. However, we urge the workpaper team to obtain access and examine the source of workpaper-based impact estimates, for well pumps in particular, and make efforts to correct any issues as part of the workpaper update process taking place in 2020.

5.2.2 Effective Useful Life Evaluation Results

Table 5-19 and Table 5-20 present effective useful life (EUL) results for the PG&E and SCE well pump sample points, respectively. Table 5-21 and Table 5-22 present effective useful life (EUL) results for the PG&E and SCE booster pump sample points, respectively. These tables compare and contrast ex-post and ex-ante EUL assignments.

In general, ex-post EUL estimates differed sharply from the ex-ante values, both in instances involving new pumps (where ex-post EULs are set equal to 10 years) and instances involving retrofit add-on of VFD controls to an existing pump (often involving the replacement of an existing control technology; where ex-post EULs are set equal to a value substantially lower than 10 years, which differs as a function of pump type and stipulated DEER pump EUL estimates). For these retrofit add-on pumps the EUL is set equal to 1/3 of the EUL of a new agricultural well pump of a given type, consisting of both booster and well pumps and in a configuration equal to either centrifugal, submersible or vertical turbine; refer to Section 4.2.2 for more details on the values applied by the evaluation team.

In all, there are only two ex-ante EUL estimates in the sample that are equal in value to the same values used by the evaluation team, both involving new SCE well pumps with EULs set equal to 10 years. For this reason, little additional discussion will be presented in the remainder of this section concerning differences in EUL assignments. However, we do further note that PG&E assignments are relatively conservative at 3.3 years for each record in the sample, while SCE assignments are much greater in years, consisting of a mix of assignments of 10 and 6.67. It appears that ex-post EUL estimates are greater on average then PG&E assignments and less than SCE assignments. However, both utilities are not properly applying EUL estimates based on new pumps versus existing pump retrofits, nor based on pump type, as outlined in the paragraph above and Section 4.2.2. It is recommended that these utilities more carefully and accurately apply EUL to tracking system measure claims, consistent with CPUC policy.

TABLE 5-19: EX-POST EUL RESULTS FOR PG&E WELL PUMP SAMPLE POINTS

Sample Point Identifier	Ex-Post Effective Useful Life	Ex-Ante Effective Useful Life
PGE Well-1	2.27	3.30
PGE Well-2	2.27	3.30
PGE Well-3	2.27	3.30
PGE Well-4	2.27	3.30
PGE Well-5	10.00	3.30
PGE Well-6	10.00	3.30
PGE Well-7	10.00	3.30
PGE Well-8	2.27	3.30
PGE Well-9	10.00	3.30
PGE Well-10	10.00	3.30
PGE Well-11	10.00	3.30
PGE Well-12	10.00	3.30
PGE Well-13	10.00	3.30
PGE Well-14	10.00	3.30
PGE Well-15	2.27	3.30
Average	**6.91**	**3.30**

TABLE 5-20: EX-POST EUL RESULTS FOR SCE WELL PUMP SAMPLE POINTS

Sample Point Identifier	Ex-Post Effective Useful Life	Ex-Ante Effective Useful Life
SCE Well-1	10.00	10.00
SCE Well-2	2.27	6.67
SCE Well-3	2.27	6.67
SCE Well-4	10.00	10.00
SCE Well-5	10.00	10.00
SCE Well-6	10.00	6.67
SCE Well-7	10.00	6.67
SCE Well-8	10.00	6.67
SCE Well-9	2.27	6.67
SCE Well-10	2.27	6.67
SCE Well-11	2.27	6.67
SCE Well-12	2.27	6.67
SCE Well-13	2.27	6.67
SCE Well-14	2.27	10.00
SCE Well-15	2.17	6.67
SCE Well-16	10.00	6.67
Average	**5.64**	**7.50**

TABLE 5-21: EX-POST EUL RESULTS FOR PG&E BOOSTER PUMP SAMPLE POINTS

Sample Point Identifier	Ex-Post Effective Useful Life	Ex-Ante Effective Useful Life
PGE Booster-1	10.00	3.30
PGE Booster-2	10.00	3.30
PGE Booster-3	10.00	3.30
PGE Booster-4	4.23	3.30
PGE Booster-5	4.23	3.30
PGE Booster-6	10.00	3.30
PGE Booster-7	10.00	3.30
PGE Booster-8	10.00	3.30
PGE Booster-9	10.00	3.30
PGE Booster-10	3.10	3.30
PGE Booster-11	10.00	3.30
PGE Booster-12	10.00	3.30
Average	**8.32**	**3.30**

TABLE 5-22: EX-POST EUL RESULTS FOR SCE BOOSTER PUMP SAMPLE POINTS

Sample Point Identifier	Ex-Post Effective Useful Life	Ex-Ante Effective Useful Life
SCE Booster-1	10.00	6.67
SCE Booster-2	3.10	6.67
SCE Booster-3	3.10	6.67
SCE Booster-4	3.10	10.00
SCE Booster-5	3.10	6.67
SCE Booster-6	3.10	6.67
Average	**4.25**	**7.23**

5.2.3 Lifecycle Gross Impact Results

Table 5-23 and Table 5-24 present lifecycle gross impact results for the PG&E and SCE well pump on-site sample points, respectively. Table 5-25 and Table 5-26 present lifecycle gross impact results for the PG&E and SCE booster pump on-site sample points, respectively.

Lifecycle savings represent first year gross impacts multiplied by the EUL for each project, and mean results presented here for the sample yield lifecycle energy (kWh) realization rates of 0.80 for PG&E well pumps, 0.33 for SCE well pumps, 1.91 for PG&E booster pumps, and 0.61 for SCE booster pumps. Peak demand (kW) lifecycle realization rates are 0.35 for PG&E well pumps, 0.21 for SCE well pumps, 0.31 for

PG&E booster pumps and 0.07 for SCE booster pumps. Adjustments to gross first year savings estimates using EUL estimates leads to increased lifecycle realization rates for PG&E relative to first year realization rates discussed above and decreased SCE realization rates. This is based on EUL differences discussed above in Section 5.2.2. Otherwise, the same discrepancy factors discussed in section 5.2.1 remain in effect.

TABLE 5-23: LIFECYCLE EX-POST GROSS IMPACT RESULTS FOR PG&E WELL PUMP SAMPLE POINTS

	Ex-Post	Ex-Ante	Results	Ex-Post	Ex-Ante	Results
Sample Point Identifier	**Lifecycle Gross Impact Savings (kWh)**	**Lifecycle Gross Impact Claim (kWh)**	**Lifecycle Gross Impact Realization Rate**	**Lifecycle Gross Impact Savings (kW)**	**Lifecycle Gross Peak Demand Claim (kW)**	**Lifecycle Gross Impact Realization Rate**
PGE Well-1	59,080	63,509	0.93	23.64	29.87	0.79
PGE Well-2	0	21,170	0.00	0.00	9.96	0.00
PGE Well-3	0	127,017	0.00	0.00	59.75	0.00
PGE Well-4	0	127,017	0.00	0.00	59.75	0.00
PGE Well-5	742,604	364,320	2.04	0.00	233.64	0.00
PGE Well-6	140,742	211,695	0.66	0.00	99.58	0.00
PGE Well-7	36,189	338,712	0.11	0.00	159.32	0.00
PGE Well-8	2,884	254,034	0.01	0.00	119.49	0.00
PGE Well-9	686,696	254,034	2.70	394.73	119.49	3.30
PGE Well-10	68,202	169,356	0.40	0.00	79.66	0.00
PGE Well-11	0	112,192	0.00	0.00	60.39	0.00
PGE Well-12	0	211,695	0.00	0.00	99.58	0.00
PGE Well-13	30,141	169,356	0.18	0.00	79.66	0.00
PGE Well-14	484,395	254,034	1.91	70.45	119.49	0.59
PGE Well-15	73,198	211,695	0.35	10.65	99.58	0.11
Total	**2,324,133**	**2,889,835**	**0.80**	**499**	**1,429**	**0.35**

TABLE 5-24: LIFECYCLE EX-POST GROSS IMPACT RESULTS FOR SCE WELL PUMP SAMPLE POINTS

	Ex-Post	Ex-Ante	Results	Ex-Post	Ex-Ante	Results
Sample Point Identifier	**Lifecycle Gross Impact Savings (kWh)**	**Lifecycle Gross Impact Claim (kWh)**	**Lifecycle Gross Impact Realization Rate**	**Lifecycle Gross Impact Savings (kW)**	**Lifecycle Gross Peak Demand Claim (kW)**	**Lifecycle Gross Impact Realization Rate**
SCE Well-1	63,652	90,660	0.70	11.80	48.80	0.24
SCE Well-2	28,310	256,728	0.11	15.52	120.76	0.13
SCE Well-3	0	427,881	0.00	0.00	201.27	0.00
SCE Well-4	431,607	384,900	1.12	258.12	181.05	1.43
SCE Well-5	0	128,300	0.00	0.00	60.35	0.00
SCE Well-6	257,603	51,346	5.02	0.00	24.15	0.00
SCE Well-7	6,617	239,613	0.03	0.00	112.71	0.00
SCE Well-8	101,079	256,728	0.39	0.00	120.76	0.00
SCE Well-9	0	256,728	0.00	0.00	120.76	0.00
SCE Well-10	10,913	213,940	0.05	0.00	100.63	0.00
SCE Well-11	49,535	213,940	0.23	0.00	100.63	0.00
SCE Well-12	36,985	171,152	0.22	0.00	80.51	0.00
SCE Well-13	2,385	256,728	0.01	19.29	120.76	0.16
SCE Well-14	15,478	128,300	0.12	4.95	60.35	0.08
SCE Well-15	17,754	171,152	0.10	5.68	80.51	0.07
SCE Well-16	54,629	60,470	0.90	17.47	32.55	0.54
Total	**1,076,547**	**3,308,568**	**0.33**	**333**	**1,567**	**0.21**

TABLE 5-25: LIFECYCLE EX-POST GROSS IMPACT RESULTS FOR PG&E BOOSTER PUMP SAMPLE POINTS

	Ex-Post	Ex-Ante	Results	Ex-Post	Ex-Ante	Results
Sample Point Identifier	Lifecycle Gross Impact Savings (kWh)	Lifecycle Gross Impact Claim (kWh)	Lifecycle Gross Impact Realization Rate	Lifecycle Gross Impact Savings (kW)	Lifecycle Gross Peak Demand Claim (kW)	Lifecycle Gross Impact Realization Rate
PGE Booster-1	452,744	254,034	1.78	0.00	119.49	0.00
PGE Booster-2	185,350	106,013	1.75	9.92	44.55	0.22
PGE Booster-3	313,940	182,160	1.72	-9.81	116.82	-0.08
PGE Booster-4	284,316	74,795	3.80	27.90	40.26	0.69
PGE Booster-5	284,316	74,795	3.80	27.90	40.26	0.69
PGE Booster-6	-10,883	74,795	-0.15	0.00	40.26	0.00
PGE Booster-7	0	56,096	0.00	0.00	30.20	0.00
PGE Booster-8	0	63,509	0.00	0.00	29.87	0.00
PGE Booster-9	29,971	74,795	0.40	0.00	40.26	0.00
PGE Booster-10	212,662	149,589	1.42	60.76	80.52	0.75
PGE Booster-11	505,597	169,356	2.99	55.81	79.66	0.70
PGE Booster-12	505,597	169,356	2.99	55.81	79.66	0.70
Total	**2,763,611**	**1,449,290**	**1.91**	**228**	**742**	**0.31**

TABLE 5-26: LIFECYCLE EX-POST GROSS IMPACT RESULTS FOR SCE BOOSTER PUMP SAMPLE POINTS

	Ex-Post	Ex-Ante	Results	Ex-Post	Ex-Ante	Results
Sample Point Identifier	Lifecycle Gross Impact Savings (kWh)	Lifecycle Gross Impact Claim (kWh)	Lifecycle Gross Impact Realization Rate	Lifecycle Gross Impact Savings (kW)	Lifecycle Gross Peak Demand Claim (kW)	Lifecycle Gross Impact Realization Rate
SCE Booster-1	285,476	213,940	1.33	9.64	100.63	0.10
SCE Booster-2	76,868	15,118	5.08	9.44	8.14	1.16
SCE Booster-3	-646	75,588	-0.01	-0.14	40.69	0.00
SCE Booster-4	-3,147	135,990	-0.02	0.00	73.20	0.00
SCE Booster-5	32,974	171,152	0.19	2.51	80.51	0.03
SCE Booster-6	39,569	90,705	0.44	3.01	48.82	0.06
Total	**431,093**	**702,493**	**0.61**	**24**	**352**	**0.07**

5.2.4 Pump VFD Model-Based Parameters and Results

Although we are unable to directly compare and contrast ex-post and ex-ante models in terms of parameters or sample-based means derived, we are able to assemble model inputs by sample point and unit energy savings estimates that might contribute in some way to workpaper updates that are scheduled for 2020. Table 5-27 and Table 5-28 present model-based parameters and unit energy savings results for well pump sample points, for the PG&E and SCE samples, respectively. Table 5-29 and Table 5-30 present model-based parameters and unit energy savings results for booster pump sample points, for the PG&E and SCE samples, respectively. The tables include pump HP, crop served, age of crops, acres served and pump runtime per year. Also shown are unit energy savings values expressed in a way that parallels ex-ante workpaper values (expressed per horsepower) that are applied to the tracking data. In support of workpaper updates for agricultural pump VFD measures scheduled for 2020, *it is recommended that the utility workpaper team mines this data source and apply findings where feasible.* The potential usefulness of each parameter is as follows:

- The monthly irrigation requirements in the California Central Valley are well-established by UC Davis and other stakeholders for various crops. Here we see the frequency with which various crops appear in the sample, which have unique irrigation requirements and might inform parameter like annual water applied in workpaper models and perhaps predominant irrigation methods.
- Likewise, orchard age is a key indicator of crop irrigation requirements and by knowing the age distribution of orchards, more accurate estimates of crop annual irrigation requirements can be derived.
- Acres served per horsepower might be an important indicator of expected pump runtime. Pumps running more hours save more energy, provided they run a good portion of the time at speeds 80 percent or lower.
- Pump runtime findings can inform pump runtime assumptions applied within the workpaper.
- The energy metrics are an indication of how far off the sample is from the values predominantly applied in the tracking system, but also how varied results were within the sample.

TABLE 5-27: EX-POST MODEL-BASED PARAMETERS AND RESULTS FOR PG&E WELL PUMP SAMPLE POINTS

Sample Point Identifier	Pump Power (HP)	Crops Served	Crop Age (Years)	Acres Served	Pump Runtime per Year (Hours)	First Year Per-Unit Gross Energy Savings (kWh/HP)	First Year Per-Unit Gross Peak Demand Impact (kW/HP)
PGE Well-1	75	Almonds	3	78	1,829	348	0.14
PGE Well-2	25	Walnuts	15	13	NA	0	0.00
PGE Well-3	150	Walnuts	15	120	NA	0	0.00
PGE Well-4	150	Walnuts	15	122	NA	0	0.00
PGE Well-5	400	Row Crops	NA	240	1,487	186	0.00
PGE Well-6	200	Almonds	2	320	248	70	0.00
PGE Well-7	400	Almonds	2	320	69	9	0.00
PGE Well-8	300	Almonds	12	280	431	4	0.00
PGE Well-9	300	Almonds	3	216	1,246	229	0.13
PGE Well-10	250	Walnuts/	2	200	333	27	0.00
PGE Well-11	150	Pasture	NA	400	NA	0	0.00
PGE Well-12	250	Pasture	NA	400	NA	0	0.00
PGE Well-13	200	Almonds	2	300	138	15	0.00
PGE Well-14	300	Almonds	10	116	NA	161	0.02
PGE Well-15	200	Almonds	3	299	NA	161	0.02
Weighted	**NA**		**6**	**252**	**670**	**83**	**0.02**
Predominant Ex-ante Metrics						**257**	**0.12**

* Weighted average uses pump horsepower as a weight.

TABLE 5-28: EX-POST MODEL-BASED PARAMETERS AND RESULTS FOR SCE WELL PUMP SAMPLE POINTS

Sample Point Identifier	Ex-Post Pump Power (HP)	Crops Served	Crop Age (Years)	Acres Served	Pump Runtime per Year (Hours)	First Year Per-Unit Gross Energy Savings (kWh/HP)	First Year Per-Unit Gross Peak Demand Impact (kW/HP)
SCE Well-1	40	Kiwis/ Plums/	2 / 3 / 65	17 / 10 /	926	159	0.03
SCE Well-2	150	Almonds	2	95	536	83	0.05
SCE Well-3	250	Almonds	14	180	2,272	0	0.00
SCE Well-4	150	Cotton/ Corn/	NA	80 / 80 /	1,436	288	0.17
SCE Well-5	50	Kiwis/ Peaches/	5 / 30 / 5	100 / 5 /	1,162	0	0.00
SCE Well-6	30	Pistachios	1	20	1,665	859	0.00
SCE Well-7	100	Mandarins	1	38	250	7	0.00
SCE Well-8	150	Alfalfa/ Wheat/	NA	500 / 1500	NA	67	0.00
SCE Well-9	150	Wheat/ Corn	NA	300 / 300	NA	0	0.00
SCE Well-10	125	Pistachios	15	107	889	39	0.00
SCE Well-11	125	Pistachios	15	107	983	175	0.00
SCE Well-12	100	Pistachios	15	86	977	163	0.00
SCE Well-13	150	Almonds	8	43	741	7	0.06
SCE Well-14	50	Almonds	12	23	NA	137	0.04
SCE Well-15	60	Peaches and	4	49	NA	137	0.04
SCE Well-16	40	Almonds	0	70	NA	137	0.04
Weighted	**NA**		**11**	**1,039**	**1,163**	**95**	**0.03**
Predominant Ex-ante Metrics						**257**	**0.12**

* Weighted average uses pump horsepower as a weight.

TABLE 5-29: EX-POST MODEL-BASED PARAMETERS AND RESULTS FOR PG&E BOOSTER PUMP SAMPLE POINTS

Sample Point Identifier	Pump Power (HP)	Crops Served	Crop Age (Years)	Acres Served	Pump Runtime per Year (Hours)	First Year Per-Unit Gross Energy Savings (kWh/HP)	First Year Per-Unit Gross Peak Demand Impact (kW/HP)
PGE Booster-1	300	Almonds	2	320	704	151	0.00
PGE Booster-2	125	Row Crops	NA	235	1,752	148	0.01
PGE Booster-3	200	Row Crops	NA	375	1,603	157	0.00
PGE Booster-4	100	Grapes	12	334	3,024	672	0.07
PGE Booster-5	100	Grapes	12	334	3,024	672	0.07
PGE Booster-6	150	Walnuts/ Plums	2	100	355	-7	0.00
PGE Booster-7	75	Walnuts/ Plums	2	50	0	0	0.00
PGE Booster-8	75	Walnuts/ Plums	2	50	0	0	0.00
PGE Booster-9	100	Almonds	2	300	431	30	0.00
PGE Booster-10	100	Walnuts	5	4,190	2,571	686	0.20
PGE Booster-11	200	Walnuts/ Almonds	4	60	474	253	0.03
PGE Booster-12	200	Walnuts/ Almonds	4	320	1,912	253	0.03
Weighted Average*	**NA**		**4**	**472**	**1,267**	**233**	**0.03**
Predominant Ex-ante Metrics						**227**	**0.12**

* Weighted average uses pump horsepower as a weight.

TABLE 5-30: EX-POST MODEL-BASED PARAMETERS AND RESULTS FOR SCE BOOSTER PUMP SAMPLE POINTS

Sample Point Identifier	Pump Power (HP)	Crops Served	Crop Age (Years)	Acres Served	Pump Runtime per Year (Hours)	First Year Per-Unit Gross Energy Savings (kWh/HP)	First Year Per-Unit Gross Peak Demand Impact (kW/HP)
SCE Booster-1	125	Almonds/ Pistachios	3	400	1,922	228	0.01
SCE Booster-2	10	Pistachios	15	NA	8,097	2,480	0.30
SCE Booster-3	50	Almonds	5	151	1,978	-4	0.00
SCE Booster-4	60	Almonds	2	151	1,581	-17	0.00
SCE Booster-5	50	Almonds	5	150	3,040	213	0.02
SCE Booster-6	60	Almonds	2	125	1,683	213	0.02
Weighted Average*	**NA**		**4**	**237**	**2,163**	**213**	**0.02**
Predominant Ex-ante Metrics						**227**	**0.12**

* Weighted average uses pump horsepower as a weight.

5.3 AGRICULTURAL IRRIGATION MEASURES

Below we discuss the detailed approach for estimating each individual impact parameter, including the installation rate, reduction in pumping discharge pressure and coincidence factor. Site-specific results and program-level GRRs follow. The section concludes with an examination of the key contributors to the GRRs.

Installation Rate

The installation rate is defined as the ratio of affected acreage served by the installed equipment, as verified by the evaluators, versus the affected acreage reported to the program administrator. The installation rate is estimated for each site based on data gathered during the engineering interview and on-site visit (where applicable). As part of the interviews and on-site visits, an objective of the evaluator was to identify and assess the quantity and operability of all equipment installed as well as the acreage of plot served by the irrigation system.

For the PY2018 cycle, evaluators assessed 17 participating sites and determined **an installation rate of 100.0 percent**, and all site inspections corroborated the installation rate findings initially gathered over the phone.[19]

The key measure count identified during the interviews and visits is the acreage served by the rebated irrigation system currently installed and in working condition. Evaluators used a combination of interview questions, inspection, and review of project invoices to confirm the acreage served. The installation rate is calculated directly from this measurement. Additionally, when possible, the evaluator collected data on the length of rebated drip tape.

$$IR = \frac{A_V}{A_R}$$

Where:

IR = Installation Rate

A_V = Affected area (acres) verified by evaluators

A_R = Affected area (acres) reported in program tracking system

[19] As discussed below, the evaluators determined that nine sampled projects were ineligible because they were growing deciduous crops These sites are nonetheless included in the installation rate, as the rebated equipment was properly installed and functioning.

For the 17 drip irrigation projects assessed, the evaluators determined an installation rate of 100.0 percent, as all participating farms installed the drip irrigation system on the fully reported acreage. All installed drip systems were confirmed as properly functioning (i.e., no installed drip systems were failed, removed, or in storage). Table 5-31 breaks down the installation rate by the categories defined previously.

TABLE 5-31: DISPOSITION OF ESPI MICRO-NOZZLE AND DRIP IRRIGATION VERIFICATION

Measure	Sites	Received Rate	Failure Rate	Storage Rate	Removal Rate	Installation Rate
Drip Irrigation	17	100%	0.0%	0.0%	0.0%	100.0%

Pumping Discharge Pressure

A key variable affecting the sprinkler replacement savings is the reduction in discharge pressure experienced by the irrigation pump. Evaluators gathered information on this parameter using engineering interviews regarding pre- and post-intervention discharge pressures. Farmers typically monitor these values closely, to ensure no overwatering occurs, which can lead to crop disease. Evaluators noted their pre/post discharge pressure estimates during phone interviews and site visits. Evaluators sought to estimate the post-project value via gauge reading when possible, but due to the timing of the study, not all affected irrigation pumps were operating at the time of the site visits.

The evaluators calculated the weighted average discharge pressure reduction for eligible sites to **be 22.1 psi**. As a point of comparison, prior PG&E workpapers (PGECOAGR111 Revisions 3 and earlier) reflected an assumed discharge pressure reduction of 20 psi; however, the current workpaper (Revision 6) does not explicitly specify the discharge pressure reduction reflected in ex-ante savings.

Coincidence Factor

Evaluators requested interval utility data for all 24 farms in the participant population to calculate site-specific ex-post peak demand savings. Aggregate analysis of the interval data showed a weighted average coincidence factor of 0.38. This value compares closely to results from prior evaluation cycles of this measure—for example, PY2015 evaluation resulted in an average CF of 0.37.

Site-Specific Results

Table 5-32 illustrates results for the 17 projects sampled for evaluation. Program-level GRRs and analysis of key contributors are presented in subsequent sections.

TABLE 5-32: SITE-SPECIFIC AGRICULTURAL DRIP IRRIGATION EVALUATION RESULTS

Evaluation ID	PA	Stratum	Ex-Ante First-Year Savings (kWh)	Ex-Post First-Year Savings (kWh)	kWh GRR	Ex-Ante First-Year Savings (kW)	Ex-Post First-Year Savings (kW)	kW GRR
AG2001	PGE	3	35,625	20,684	0.58	28.28	26.46	0.94
AG2002	PGE	3	35,625	2,706	0.08	28.28	0.20	0.01
AG2003	PGE	3	41,325	3,139	0.08	32.80	0.85	0.03
AG2004	PGE	4	16,910	1,285	0.08	13.42	0.18	0.01
AG2005	PGE	3	53,642	6,956	0.13	42.57	2.01	0.05
AG2012	PGE	2	146,775	39,656	0.27	116.49	119.20	1.02
AG2013	PGE	3	45,600	11,219	0.25	36.19	3.37	0.09
AG2015	PGE	2	95,000	0	0.00	75.40	0.00	0.00
AG2016	PGE	3	61,750	0	0.00	49.01	0.00	0.00
AG2017	PGE	2	94,050	0	0.00	74.65	0.00	0.00
AG2018	PGE	3	74,452	0	0.00	59.09	0.00	0.00
AG2019	PGE	1	327,275	0	0.00	259.75	0.00	0.00
AG2020	PGE	3	76,000	0	0.00	60.32	0.00	0.00
AG2021	PGE	3	34,537	0	0.00	27.41	0.00	0.00
AG2022	PGE	1	331,883	8,396	0.03	263.41	0.51	0.00
AG2023	PGE	3	32,775	0	0.00	26.01	0.00	0.00
AG2024	PGE	3	37,164	0	0.00	29.50	0.00	0.00
Total			**1,540,387**	**107,827**	**0.07**	**1,223**	**147**	**0.12**

Gross First Year Realization Rates

The evaluation team estimated gross realization rates (GRRs) by examining the ratio of the aggregate evaluated gross savings to the aggregated ex-ante gross savings.

Table 5-33 below presents the population-level first year gross kWh and kW realization rates for the drip irrigation measure along with the aggregate ex-ante and ex-post first year kWh and kW savings. The corresponding relative precisions are also presented. The first year kWh GRR is 7 percent with a corresponding relative precision of 39 percent at the 90 percent confidence interval and the kW GRR is 12 percent with a corresponding relative precision of 51 percent at the 90 percent confidence interval. The reasons behind the low GRRs and unexpectedly poor precisions are examined further in this section.

TABLE 5-33: PGE FIRST YEAR GROSS KWH AND KW REALIZATION RATES FOR SPRINKLER-TO-DRIP MEASURE

	First Year Gross kWh Savings				First Year Gross kW Savings			
PA	Ex-Ante Savings	Ex-Post Savings	GRR	RP	Ex-Ante Savings	Ex-Post Savings	GRR	RP
PGE	2,030,521	139,547	7%	39%	1,612	198	12%	51%

In the PY2018 data collection and sampling plan, evaluators targeted results within ±15 percent relative precision at the 90 percent confidence interval. Despite the 17-project sample accounting for 73 percent of PY2018 ex-ante kWh savings, evaluation results demonstrated a relative precision of ±39 percent (kWh) and ±51 percent (kW) due to extremely low kWh and kW GRRs. Relative precision is proportional to the inverse of the GRR, meaning the lower the GRR value, the poorer the relative precision. Alternatively, evaluation results show *absolute* precisions of 3 percent (kWh) and 6 percent (kW).[20]

The ex-post impacts and ex-ante claims are products of several unique parameters that are generated in the impact algorithm. The underlying ex-ante assumptions differ from ex-post findings for those parameters, resulting in ex-post impact differences. Below is a brief discussion of some of those underlying differences and how they affected the overall realization rates.

- Nine projects were determined to be ineligible[21] for program participation and therefore resulted in zero savings, driving the GRR down by 59 percent.
  - All nine ineligible projects involved irrigation upgrades within tree groves classified as deciduous/orchard crops. Revision 6 of the PGECOAGR111 workpaper, which applied during PY2018, specified only field/vegetable crops and explicitly stated that deciduous crops are no longer eligible due to changes in industry standard practice.
- Evaluators determined a weighted average pump discharge pressure reduction of 22 psi. This difference reduced the kWh GRR by 17 percent.
- Evaluators determined varying estimates of annual operating hours from telephone and on-site interviews in addition to utility bill analysis. The variation in operating hours was significant among the 17 evaluated projects and prevented the evaluators from recommending a revision to

[20] Absolute precision is calculated similarly to relative precision, except that it is not proportional to the inverse of GRR. In evaluation context, absolute precision is sometimes reported when GRRs deviate significantly from 100 percent.

[21] As the program is currently inactive, eligibility requirements cannot be cited via web link of the program application. However, per program workpapers and the program measure offering catalog, evaluators determined that the crop type eligibility requirements were not met for these nine projects due to deciduous crops (nut or fruit trees).

workpaper-recommended operating hours. We estimate that differences in operation decreased the kWh GRR by 15 percent.

The key discrepancies and their relative contribution to the overall program-level kWh GRR are illustrated in Table 5-34.

TABLE 5-34: KEY DISCREPANCY CATEGORIES AND CONTRIBUTIONS TO OVERALL KWH GRR – SPRINKLER-TO-DRIP

Discrepancy Category	# Instances	Impact on GRR
Ineligible measure	9	-59%
Difference in irrigation hours of operation	7	-15%
Difference in pump discharge pressure reduction	2	-17%
Reported savings greater than annual billed usage	2	-2%
Total	**20**	**-93%**

Gross Lifecycle Realization Rates

Table 5-35 presents the population-level gross lifecycle kWh and kW realization rates for the evaluated sprinkler-to-drip irrigation measure, along with the aggregate ex-ante and ex-post lifecycle kWh and kW savings. The corresponding relative precisions are also presented.

While interviewing participating farmers on the age and condition of preexisting systems, evaluators found that the preexisting irrigation systems were replaced for various reasons—e.g., crop switches, reconfiguration of the farmed acreage, water savings—but never due to equipment failure or end-of-life. Evaluators collected data on the age of replaced systems but could not conduct a representative effective useful life (EUL) analysis for the sprinkler-to-drip measure. Evaluators instead referenced the workpaper's recommended EUL of 20 years, and the first-year and lifecycle GRRs are therefore identical.

TABLE 5-35: PGE LIFECYCLE GROSS KWH AND KW REALIZATION RATES FOR SPRINKLER-TO-DRIP MEASURE

	Lifecycle Gross kWh Savings				Lifecycle Gross kW Savings			
PA	Ex-Ante	Ex-Post	GRR	RP	Ex-Ante	Ex-Post	GRR	RP
PGE	40,610,410	2,790,946	7%	39%	32,232	3,958	12%	51%

5.4 TANKLESS WATER HEATERS

Below we discuss the detailed approach for estimating each individual impact parameter, including the installation rate, DHW temperature increase and uniform energy factor. Site-specific results and program-level GRRs follow. The section concludes with an examination of the key contributors to the GRRs.

As a result of the TWH measure's midstream, distributor-facing design, evaluators struggled to recruit site visit participants due to insufficient tracked end-user contact data and a lack of end-user awareness that they had participated in an efficiency program altogether. Nonetheless, evaluators worked with PAs to obtain the best available end-user data and focus recruitment on the facilities with credible contact information. Ultimately, the evaluators completed just 25 of the target 36 site visits. As the TWH measure remains on the uncertain list in PY2019, evaluators may have the opportunity to supplement these findings with additional data points in the next cycle.

Installation Rate

For the TWH measure, installation rate is defined as the ratio of evaluator-verified TWH size in kBtu/h to the TWH size as reported to the program administrator. Evaluators quantified installation rate for each of the 25 assessed sites based on data gathered during on-site visits. Field engineers confirmed the installation and inspected the nameplate of each rebated TWH to confirm equipment size, make/model, and rated efficiency.

Evaluators assessed installations at 25 participating facilities and determined **a TWH installation rate of 90.7 percent.** The 9 percent reduction in installed kBtu/h was driven by observed differences at five of the 25 projects:

- Three of the 25 projects were deemed zero-savers: one project occurred at a facility that has since gone out of business, one project occurred at a facility that uses electricity for water heating, and one project occurred at a service address that had no evidence of recent TWH installation.
- Two of the 25 facilities had TWH systems installed in 2018, but the installed size slightly differed from the tracked TWH capacity.

Based on the reasons above, the 90.9 percent ISR is disaggregated in Table 5-36.

TABLE 5-36: DISPOSITION OF TANKLESS WATER HEATER VERIFICATION

Measure	Sites	Received Rate	Failure Rate	Storage Rate	Removal or Closure Rate	Installation Rate
Tankless Water Heater	25	92.2%	0.0%	0.0%	1.5%	90.7%

DHW Temperature Increase

A key variable affecting TWH unit energy savings is the increase in DHW temperature between the water heater's inlet and outlet piping. The measure's supporting workpapers assume that the rebated TWHs do not operate in a closed-loop system—the TWHs draw municipal water and instantaneously heat the stream to a desired DHW setpoint temperature. Wastewater does not recirculate to the TWH but is subsequently discarded via sewer.

From the evaluators' examination of supporting DEER prototype models, the workpaper-recommended UES values reflect an assumed DHW temperature increase of 60°F to 84°F depending on the climate zone's average municipal water temperature. The DEER models reflect a DHW setpoint of 135°F for all facility classifications except University Dormitory and Hotel Guest Room (110°F).

Evaluators sought to independently calculate the average DHW inlet and outlet temperatures and corresponding temperature increase through spot measurements for all rebated TWH systems among the 25-site sample. Field measurements, weighted by TWH size, show an **average DHW outlet temperature of 132.2°F**, slightly lower than the 135°F reflected in DEER models (no dormitories or hotel guest room facilities were selected in the evaluation sample). As illustrated in Table 5-37 below, evaluators observed minimal difference in DHW outlet temperature between large and small TWHs.

Analysis of TWH inlet temperatures showed higher water temperatures than reflected within DEER models. For eight projects, evaluators found that the DHW loops were closed—DHW was recirculated back to the TWH, thereby lowering the heating load and subsequent savings. Closed-loop systems were more prevalent for small TWHs as illustrated in Table 5-37. Overall, evaluators determined a **weighted average inlet DHW temperature of 75.7°F**.

Comparing average outlet and inlet DHW temperatures, evaluators determined a **weighted average DHW temperature increase of 56.5°F**. Table 5-37 examines differences in average DHW temperatures by TWH size. Please note that DHW temperature measurements could not be taken at three zero-saver sites.

TABLE 5-37: MEASURED DHW TEMPERATURES BY TANKLESS WATER HEATER SIZE

TWH Size Classification	Sites	Weighted Average DHW Inlet Temperature (°F)	Weighted Average DHW Outlet Temperature (°F)	Weighted Average DHW Temperature Increase (°F)
Large (≥ 200 kBtu/h)	9	71.9	132.5	60.5
Small (< 200 kBtu/h)	13	90.3	131.2	40.9
Total	**22**	**75.7**	**132.2**	**56.5**

Uniform Energy Factor

Another variable affecting TWH savings is the rated efficiency of the installed system. As shown in Table 5-38 program administrators classify rebated TWHs into two efficiency tiers. Tier 1 reflects efficiency thresholds greater than 80 percent thermal efficiency or 0.81 UEF (SCG) or 85 percent thermal efficiency (PG&E). Tier 2 reflects efficiency thresholds greater than 90 percent thermal efficiency or 0.87 UEF (SCG) or 90 percent thermal efficiency (PG&E).

Evaluators assessed all measure records in the sample of 25 projects to quantify evaluated UEFs among the size and efficiency tiers considered by program administrators. During each site visit, field engineers determined the system's rated efficiency (in thermal efficiency, EF, or UEF units) from nameplate inspection. Efficiencies were subsequently converted into UEF format for comparison among tiers. Results of the UEF analysis are provided in Table 5-38. Please note that three zero-saver projects did not allow UEF confirmation.

TABLE 5-38: MEASURED DHW TEMPERATURES BY TANKLESS WATER HEATER SIZE

TWH Size and UEF Tier Classification	Sites	Weighted Average UEF
Large (≥ 200 kBtu/h) – Tier 1	2	0.843
Large (≥ 200 kBtu/h) – Tier 2	7	0.938
Small (< 200 kBtu/h) – Tier 1	0	No Data
Small (< 200 kBtu/h) – Tier 2	13	0.951
Total	**22**	**0.936**

The evaluation sample contained nearly all Tier 2 TWH installations, save for two projects involving large Tier 1 TWHs. As a result, UEF values for Tier 1 small systems could not be provided. Evaluators calculated **weighted average UEFs of 0.94 for large Tier 2 TWHs and 0.95 for small Tier 2 TWHs**.

Site-Specific Results

Table 5-39 illustrates key characteristics and results of the 25 projects sampled for evaluation. Program-level GRRs and analysis of key contributors are presented in subsequent sections.

TABLE 5-39: SITE-SPECIFIC TANKLESS WATER HEATER EVALUATION RESULTS

Evaluation ID	PA	Stratum	Total Size Installed (kBtu/h)	Ex-Ante First-Year Savings (therm)	Ex-Post First-Year Savings (therm)	GRR
WH2005	PGE	1	31,989	23,800	0	0.00
WH2008	PGE	1	5,950	37,741	48,587	1.29
WH2021	PGE	2	796	9,679	4,145	0.43
WH2022	PGE	2	2,400	15,684	3,535	0.23
WH2041	PGE	3	1,502	4,401	3,586	0.81
WH2143	PGE	3	1,500	4,605	4,427	0.96
WH2052	PGE	4	120	582	728	1.25
WH2053	PGE	4	399	1,381	529	0.38
WH2165	PGE	4	199	637	72	0.11
WH2175	PGE	4	700	1,505	435	0.29
WH2193	PGE	4	200	572	685	1.20
WH2208	PGE	4	400	1,375	1,707	1.24
WH2223	PGE	4	399	1,381	195	0.14
WH2142	PGE	4	399	1,300	0	0.00
WH2225	PGE	4	400	1,103	0	0.00
WH2058	SCG	1	1,999	11,314	714	0.06
WH2059	SCG	1	3,798	21,497	10,325	0.48
WH2088	SCG	3	750	4,245	1,291	0.30
WH2092	SCG	3	750	4,245	1,975	0.47
WH2116	SCG	3	400	2,263	668	0.30
WH2257	SCG	3	400	2,263	1,634	0.72
WH2263	SCG	4	200	1,131	104	0.09
WH2273	SCG	4	199	1,126	968	0.86
WH2283	SCG	4	199	1,126	861	0.76
WH2289	SCG	4	200	1,131	456	0.40
Total			**56,247**	**156,088**	**82,727**	**0.53**

Gross First Year Realization Rates

The evaluation team estimated gross realization rates (GRRs) by examining the ratio of the aggregate evaluated gross savings to the aggregated ex-ante gross savings.

Table 5-40 below presents the population-level first year gross therm realization rates for the tankless water heater measure along with the aggregate ex-ante and ex-post first year therm savings. The corresponding relative precisions are also presented. The first year therm GRR is 53 percent with a corresponding relative precision of 34 percent at the 90 percent confidence interval. The reasons behind the GRR and precision are examined further in this section.

TABLE 5-40: FIRST YEAR GROSS THERM REALIZATION RATE BY PROGRAM ADMINISTRATOR FOR TANKLESS WATER HEATER MEASURE

	First Year Gross Therm Savings			
PA	**Ex-Ante Savings**	**Ex-Post Savings**	**GRR**	**RP at 90% Confidence**
PGE	1,452,289	815,643	56%	±40%
SCG	460,352	195,304	42%	±24%
Total	**1,912,641**	**1,021,951**	**53%**	**±34%**

In the PY2018 data collection and sampling plan, evaluators targeted results within ±15 percent relative precision at the 90 percent confidence interval. Evaluators experienced challenges in recruiting customers for participation in the study. The measure's midstream, distributor-facing design resulted in end-users generally unaware that they participated in a utility rebate program. Additionally, the tracking data from both program administrators lacked basic customer contact information for approximately 80 percent of the PY2018 population. For these reasons, evaluators visited 25 participating facilities, 11 fewer than the original sample target of 36 projects. The reduced sample size, high variation among site-specific results, and relatively low GRRs each contributed to poorer relative precisions than the target ±15 percent.

Overall, evaluation results show that TWH projects realize 53 percent of reported savings. The evaluation team identified the following key contributors to the 47 percent reduction in evaluated savings:

- As discussed previously in the context of installation rate, evaluators identified three zero-saver projects due to business closure, incorrect DHW fuel, or non-install. Two additional sites installed systems slightly lower in size than reported by the program. These differences reduced the GRR by 23 percent.
- Differences in DHW temperature increase, as detailed earlier in this section, reduced the GRR by 37 percent. The eight instances of closed-loop DHW systems significantly reduced the temperature increase and subsequent savings.

- Differences in TWH uniform energy factor, as detailed earlier in this section, increased the GRR by 27 percent. Evaluators found that systems generally exceeded the minimum efficiency thresholds set forth by TWH workpapers.
- Evaluators identified inconsistencies between workpaper-recommended UES and those assumed within tracked savings calculations. In some cases, the project was classified as "commercial" but should have been classified more specifically (e.g., "hotel," "office"). Differences between tracked and DEER-recommended UES led to an 8 percent reduction in GRR.

A comprehensive analysis of discrepancy reasons, frequencies, and relative contributions to program-level therm GRR is illustrated in Table 5-41.

TABLE 5-41: DISCREPANCY CATEGORIES AND CONTRIBUTIONS TO OVERALL THERM GRR – TANKLESS WATER HEATER MEASURE

	Negative		Positive	
Discrepancy Category	**Frequency**	**RR Impact**	**RR Impact**	**Frequency**
Difference in temperature rise	21	-37%	0%	1
Difference in water heater efficiency	3	-1%	27%	19
Difference in installed quantity	2	-5%	0%	6
Difference in water heater type	2	-4%	0%	0
Difference in building type	6	-2%	4%	1
Tracking UES does not match workpaper	11	-10%	0%	0
Residual differences or interactivity	16	-7%	6%	6
Facility closure	1	-1%	0%	0
Ineligible due to incorrect fuel	1	-16%	0%	0
Measure never installed	1	-1%	0%	0
Total	**64**	**-84%**	**38%**	**33**

Gross Lifecycle Realization Rates

Table 5-42 presents the population-level gross lifecycle therm realization rates for the evaluated tankless water heater measure, along with the aggregate ex-ante and ex-post lifecycle therm savings. The corresponding relative precisions are also presented.

While interviewing participating customers on the age and condition of preexisting water heaters, evaluators found that the preexisting systems were generally functioning. Of the 25-project sample (ignoring three zero-savers), evaluators identified one instance of new construction and one instance of equipment failure. Otherwise, preexisting water heater age varied considerably between five and 20+ years. The variability in equipment ages, in addition to only one instance of equipment failure, led the evaluators to reference the workpaper's recommended EUL of 20 years, and the first-year and lifecycle GRRs and RPs are therefore identical.

TABLE 5-42: LIFECYCLE GROSS THERM REALIZATION RATE BY PROGRAM ADMINISTRATOR FOR TANKLESS WATER HEATER MEASURE

	Lifecycle Gross Therm Savings			
PA	Ex-Ante Savings	Ex-Post Savings	GRR	RP at 90% Confidence
PGE	29,045,777	16,312,865	56%	±40%
SCG	9,207,047	3,906,088	42%	±24%
Total	**38,252,824**	**20,439,013**	**53%**	**±34%**

6 NET-TO-GROSS ANALYSIS

6.1 BACKGROUND

The net impact methodology involves a two-step process:

- First, a net-of-free-ridership ratio is estimated for each project evaluated through analysis of surveys and/or professional in-depth interviews.
- Second, a net-of-free ridership estimate is developed for the population by extrapolating from the sample to the entire population sample frame.[22]

Over the last several evaluation cycles, Net-to-Gross (NTG) analysis for Nonresidential programs has used a standardized Self-Report Approach (SRA)[23] that is based on the results of self-report telephone surveys with program participants and has been used with minor modifications since the 2006-2008 evaluation cycle. This 2018 evaluation continues use of this standard SRA framework with two types of updates, developed through a collaborative process by team members from both the Group A and Group D evaluations:

1. **An alternative scoring structure to replace the current PAI-1 score.** This is designed to address problems identified in previous evaluation cycles.
2. **Expansion of the framework to address Midstream programs**. The expanded framework incorporates a Vendor score and combines it with the Participating Customer score if certain conditions are met.

The Nonresidential NTG methodology that has been used since the 2006-2008 evaluation cycle was developed to address the unique needs of nonresidential customer projects developed through energy efficiency programs offered by the four California IOUs and third-party implementers. This method relies exclusively on the standardized Self-Report Approach (SRA) to estimate project and domain-level net-to-gross ratios (NTGRs), since other available approaches and research designs are generally not feasible. The SRA in this evaluation is implemented in accordance with the relevant EM&V guidelines including the California Energy Efficiency Evaluation Protocols (April 2006).

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[22] Please note that the 0.05 market effects adder is not included in the NTGR. The NTGR is defined as one minus free ridership. The market effects adder is, however, included in the final ex-post net savings values presented in Chapter 1 and 7 and Appendices AA and AB.

[23] This SRA framework was originally developed by the statewide Nonresidential NTG working group during 2008.

This SRA methodology provides a standard framework, including decision rules, for integrating findings from both quantitative and qualitative information in the calculation of the NTGR in a systematic and consistent manner. The method uses a 0 to 10 scoring system for key questions used to estimate the NTGR, rather than using fixed categories that are assigned weights. Respondents are asked to jointly consider and rate the importance of the many likely events or factors that may have influenced their energy efficiency decision-making for the project in question, rather than focusing narrowly on only their rating of the program's importance. This question structure more accurately reflects the complex nature of real-world decision making and helps to ensure that all non-program influences are considered when assessing the unique contribution of the program to the energy efficiency project's implementation.

6.2 NTG QUESTIONS AND SCORING ALGORITHM

6.2.1 Approach Used in Previous Evaluations

Under this SRA methodology, the NTGR has been calculated as an average of three scores. Each of these scores represents the highest response or the average of several responses given to one or more questions about the decision to install a program measure.

- **Score PAI-1** that reflects the influence of the most important of various program and non-program elements in the customer's decision to select the specific program measure at this time. Program influence through vendor recommendations is also incorporated in this score. PAI-1 is based on the highest program element score divided by the sum of the maximum of the program and non-program element scores. Note that in the 2017 evaluation, the PAI-1 score was excluded from the NTG ratio. This change was made based on specific recommendations from the 2013-2015 Program Performance Assessment[24] and on concerns raised during the 2017 evaluation with respect to the PAI-1 analysis.
- **Score PAI-2** that captures the perceived importance of the program (whether incentive, recommendation, audit, or other program intervention) relative to non-program factors in the decision to implement the specific measure that was eventually adopted or installed. This score is determined by asking respondents to assign importance values to both the program and most important non-program influences so that the two values total 10. The program influence score is reduced by half if respondents say they had already made their decision to install the specific program qualifying measure before they learned their project was eligible for program rebates.

[24] https://pda.energydataweb.com/api/view/1975/2013-2015%20Program%20Performance%20Assessment%20Of%20The%20Nonresidential%20Downstream%20Programs%20-%20Final.pdf

- **Score PAI-3** that captures the likelihood of various actions the customer might have taken at the time or project decision making, and in the future, if the program had not been available (the counterfactual). This score also accounts for deferred free ridership by incorporating the likelihood that the customer would have installed program-qualifying measures at a later date if the program had not been available.

When there are missing data or 'don't knows' to critical elements of each score, one of two options is used. The most common approach, in cases where it is one of several other elements that are considered in the algorithm, is to simply exclude the missing element from consideration.

With the exception of the 2017 evaluation, the resulting self-reported NTGR in most cases has been simply the average of all three scores, divided by 10. The one exception to this is when the respondent indicates a 10 in 10 probability of installing the same equipment at the same time in the absence of the program, in which case the NTGR is based on the average of the PAI-2 and PAI-3 scores only.

6.2.2 Issues with Current PAI-1 Score

The problems identified in the 2017 Small Commercial evaluation and underlying analysis are discussed below. These problems led to a change in methodology for the 2018 evaluation to replace the PAI-1 score with a new score specification.

Issue 1: Lack of variation in PAI-1 scores. Overall, the evaluation team found the average PAI-1 score to be 4.9, with over 80 percent of the individual scores within 0.5 of that mean (i.e., between 4.4 and 5.4). This is likely due to respondents rating at least one program and one non-program factor very high. The team found that respondents rated at least one program factor a 9 or 10 nearly three-fourths of the time (72 percent), and at least one non-program factor a 9 or 10 over three-fourths of the time (80 percent). Furthermore, two-thirds of the time (66 percent), the respondent's highest rated program and non-program factors were rated equally. Respondents are likely to score at least one program and one non-program influence very highly, leading most PAI-1 scores to cluster near 4.9 (pulling NTGRs towards 0.5).

Issue 2: Similarity in concept between PAI-1 and PAI-2 scores. The PAI-1 and PAI-2 scores are based on a similar concept of program influence and are based on self-reported influence scores for individual program and non-program elements. In addition, to provide for greater consistency in responses during the survey, the introduction to the N41/N42 questions which PAI-2 is based on consisted of a read-through of the highest-scored program and non-program elements from the previous question (which is used to calculate PAI-1). While both scores are intended to represent different ways of characterizing program influence, there is a high degree of similarity between them. Including both scores in the NTGR calculation amounts to assigning a two-thirds weight to similar program influence metrics and reduces the importance of the PAI-3 "no program" score in the overall calculation.

Issue 3: Weak correspondence between the PAI-1 score and the "no program" behaviors cited by participants. Perhaps the most telling indication of program influence is the self-reported action that participants say they would have taken had the program not existed. Respondents were asked what they would have been most likely to do if the program had not been available. Two common responses were "done nothing and keep existing equipment as is", and "done the same thing I would have done as I did through the program". One would expect relatively high PAI scores for the "done nothing" and relatively low PAI scores for the "done the same thing" responses. As shown in the table below, the PAI-2 and PAI-3 scores did meet this expectation, but the PAI-1 scores were contrary to expectations.

TABLE 6-1: COMPARISON OF PAI-1 SCORES WITH NO-PROGRAM BEHAVIORS

Stated Action in Absence of the Program	PAI-1	PAI-2	PAI-3
Done nothing, keep existing equipment as is	4.89	7.19	6.42
Done the same thing I would have done as I did through the program	4.79	5.34	1.48

*Results from https://pda.energydataweb.com/api/view/2162/2017_SmMedComESPI_ImpactEval_w_Appendices.pdf

6.2.3 Alternative to Current PAI-1 Structure

The evaluation team examined several alternative specifications to replace the PAI_1 score and then calculated the resulting NTGR using each alternative by averaging it with the PAI_2 and PAI_3 scores.[25] The Evaluation team's preferred alternative approach uses the participant phone survey question N6 value and assigns a PAI score based on the following responses to this question Note that this approach is also referred to as PAI-1 alternative 3 = Assign value based on No Program actions (survey question N6):[26]

Question N6 - Now I would like you to think one last time about what action you would have taken if the program had not been available. Which of the following alternatives would you have been most likely to do?

- If N6 = 2,4 then NTGR = 1
  - 2 Install standard efficiency equipment or whatever required by code
  - 4 Done nothing (keep existing equipment as is)
- If N6=5 then NTGR = 0
  - 5 Done the same thing I would have done as I did through the program

[25] See Appendix D for a memo detailing the updates considered to the NTG framework. This memo includes a detailed description of the alternative score specifications considered, including PAI-1 alternative 3.

[26] The numbers immediately below each bullet point indicate specific response categories to question N6.

- If N6=1, then NTGR = 1.00 minus the % share they would have installed
  - 1 Install/Delamped fewer units
- If N6=3, then NTGR =0.75
  - 3 Installed equipment more efficient than code but less efficient than what you installed through the program
- IF N6=6, NTGR=missing (This is a repair and the efficiency of the action ultimately taken is unknown, therefore this response is excluded from the analysis.)
  - 6 Repair/rewind or overhaul the existing equipment
- If N6=77, the response is reviewed and a judgment made regarding the likely NTGR level, frequently a 0 or 1
  - 77 Something else (specify what _____________)

The overall NTGR using this approach is the average of PAI-2, PAI-3, and PAI-N6. This alternative NTGR specification has been used in this evaluation to calculate the NTGR at the project-level, except for those projects that merit use of the Midstream approach discussed below.

6.2.4 Protocol for Refrigeration Case LED Lighting

The protocol for the Refrigeration Case LED Lighting measure differs slighting from the standard approach listed above because this measure only provides savings when the lighting retrofit was accelerated and the case was not replaced at the same time. As mentioned earlier, savings is zero because LED case lighting is industry standard practice. Therefore, savings only occurs during the accelerated period, which in this case would be equal to the remaining useful life of the existing case.

The standard NTG approach discussed above focuses on how the program has influenced the customer to install more efficient equipment. But for Refrigeration Case LED Lighting, we need to examine how the program has influenced the customer to accelerate the lighting retrofit. Therefore, for this measure, we make the following modifications to the NTG approach to focus on timing.

Revised PAI-2 Score:

The PAI-2 score currently uses question N41:

> N41: If you were given 10 points to award in total, how many points would you give to the importance of the program and how many points would you give to these other non-program factors?

In order to capture the effects of timing, we use question N41P which is modified to include the effects of timing:

> Next, I would like for you to consider the importance of the PROGRAM in your decision to install your equipment ***at the time you did*** rather than waiting to install new equipment sometime in the future, regardless of the actual efficiency of the equipment you selected. Please rate the importance of the program on this timing decision as opposed to other non-program factors that may have influenced your decision.
>
> NP41 - If you were given 10 points to award in total, how many points would you give to the importance of the program and how many points would you give to these other non-program factors in your decision to install your equipment ***at the time you did*** rather than waiting to install new equipment sometime in the future?

Revised PAI-3 Score:

The PAI-3 score currently uses question N5:

> N5 - Using a likelihood scale from 0 to 10, where 0 is not at all likely and 10 is extremely likely, if THE PROGRAM had NOT BEEN AVAILABLE, what is the likelihood that you would have installed exactly the same program-qualifying energy efficient equipment that you did for this project regardless of when you would have installed it?

In order to capture the effects of timing, we use question N5B which is modified to include the effects of timing:

> N5B- Using the same scale as before, if the program had not been available, what is the likelihood that you would have done this project ***at the same time as you did***?

Revised N6 Score:

Because LED lighting is considered ISP, if the customer responded to N6 (shown above) that they would have installed whatever is required by code or something more efficient than code, then they would have installed LEDs and would be a free rider. Therefore, we modify the scoring using N6 as follows:

- If N6 = 2 or 3 then NTGR = 0
  - 2 Install standard efficiency equipment or whatever required by code
  - 3 Installed equipment more efficient than code but less efficient than what you installed through the program

Also, if the customer responded to N6 saying that they would have repaired their equipment, we take this to mean they would not have retrofitted the lighting at that time and give them credit for an accelerated replacement and set the NTGR to 1 as follows:

- IF N6=6, NTGR=1
  - 6 Repair/rewind or overhaul the existing equipment

Once the revised scores are developed for PAI-2, PAI-3 and N6, we follow the rest of the standard protocol for developing the NTGR.

6.3 NTG APPROACH FOR MIDSTREAM PROGRAMS

The current Nonresidential NTG framework is designed mainly for Downstream programs, which are focused on delivering incentives directly to end-use customers. Some programs are positioned higher up in the supply chain, so that they work through vendors (e.g., distributors, contractors, and design professionals) to deliver incentives to customers. Such programs are classified as Midstream.

The current Downstream-centric framework relies primarily on findings from end-use customer surveys for determining NTGRs, which is appropriate, given the customer-focused program delivery approach. The method does allow for vendor input into the NTGR but only in cases where the customer rates the vendor higher than any other program or non-program element in their decision-making. The vendor is interviewed, and their input is incorporated into the final NTG ratio.

The Midstream approach as described applies to programs delivered through vendors that meaningfully change how they stock, promote and price program-qualified energy efficient equipment as a result of their participation in the program. There are multiple Midstream program delivery approaches, some for which the program intervention(s) is “invisible” to the end-use customer, and others where the end-use customer is fully aware of the program intervention(s). The design of the program, and the availability of customer data determines the specific NTG approach to be used:

- Programs that work through vendors, where customer contact data is collected, and where it is believed the end-user is either unaware or aware of the program (Midstream A).
- Programs that work entirely with vendors, customer contact data is not collected, and where it is believed the end-user may not be aware of the program (Midstream B).

6.3.1 Midstream NTG Protocol

To assess impacts from Midstream A programs, evaluators need to survey end-use customers and their associated equipment vendors. As with Downstream programs, customers are queried regarding the importance of various program and non-program factors that influenced their decision, the relative importance of the program, and the likely actions they would have taken absent the program. In addition, for Midstream A and Midstream B programs, evaluators need to determine if the Vendor changed their practices in a way that ultimately influenced the customer's buying decision. Assessing the influence of the program on vendors involves conducting in-depth interviews with participating vendors and asking them how the program influenced their stocking, pricing and promotion practices, and alternatively, how they would behave in the absence of the program.

NTGR Estimation Methodology

For Midstream A programs where customer contact data is collected, surveys are conducted of both participating customers and participating vendors. Customer and Vendor-based estimates of program influence are developed and combined into a single NTGR metric. For Midstream B programs that work exclusively with vendors and customer information is not collected, telephone or web surveys with end-use customers are not feasible. Another approach is in-store intercept surveys that allow for direct questioning of customers at the point-of-sale. However, if in-store or telephone/web surveys are not feasible, then the NTGR must rely solely on the results of the Vendor survey and associated NTGR algorithm.

For the **Customer** component, the standard NTG framework is used, participating customer surveys are conducted, and the customer-based NTGR is calculated.

Vendor Component

The **Vendor** component of this Midstream methodology uses three indicators of free ridership, the Program Importance Score, the Relative Program Influence Score (similar to PAI-2), and the No-Program Score (similar to PAI-3).

The **Program Importance** score is based on the Vendor's rating of the importance of the program as a whole (considering various program factors) in their decision to recommend the program-qualifying measure to distributors/customers.

The **Relative Program Influence** Score is based on the Vendor's rating of the Program's relative importance (versus non-program factors in influencing their decision to recommend the program-qualifying measure to distributors/customers.

The **No-Program** Score is based on the Vendor's response to a counterfactual question regarding their likelihood to recommend the program-qualifying measure if the program had not been available.

The Vendor-based NTGR is simply the average of these three scores divided by 10. Once this has been computed, the project-level NTGR is determined from a combination of findings from the participating customer (if available) and participating vendor surveys. The triangulation approach, combining customer and vendor input, is used.[27] The algorithm uses the customer's input to guide the assessment, with input by the vendor if certain conditions are met.

6.4 NTG RESULTS

Table 6-2 presents the ex-post NTGR scores by sample strata that were developed for the evaluated sampling domains using the above methodology. Also presented are the ex-ante NTG values as well as the average PAI2, PAI3 and PAI N6 scores for each segment. These data are weighted by ex-post lifecycle savings.

TABLE 6-2: EX-ANTE AND EX-POST NET-TO-GROSS RATIOS AND NTG SCORES BY MEASURE TYPE AND SAMPLING DOMAIN

		Responses	Applica-tions	NTGR			PAI Score			Vendor NTGR Scores		
Measure	PA/Delivery Approach	n	#	Ex-Ante	Ex-Post	Relative Precision	PAI 2	PAI 3	PAI N6	Score 1	Score 2	Score 3
Process Pumping VFDs	*PG&E Weighted Average*	*43*	*73*	*0.60*	*0.39*	*23%*	*3.5*	*3.2*	*4.9*	*N/A*	*N/A*	*N/A*
	SCE Weighted Average	*17*	*25*	*0.60*	*0.48*	*24%*	*6.2*	*3.2*	*5.7*	*N/A*	*N/A*	*N/A*
	Overall Weighted Average	**60**	**98**	**0.60**	**0.39**	**20%**	**3.7**	**3.2**	**5.0**	N/A	N/A	N/A
Refrig. Case LEDs	**Overall Weighted Average**	**22**	**88**	**0.60**	**0.63**	**17%**	**5.5**	**6.8**	**6.6**	N/A	N/A	N/A
Agricultural Irrigation	**Overall Weighted Average**	---	--	**0.60**	N/A	--	--	--	--	N/A	N/A	N/A
Tankless Water Heating	**Overall Weighted Average**	**6**	**6**	**0.58**	**0.55**	**23%**	N/A	N/A	N/A	**8.3**	**5.7**	**2.4**

* Please note that the 0.05 market effects adder is not included in the NTGR.

[27] The detailed version of this algorithm is provided in Appendix D.

Table 6-3 illustrates how these values can be used in the future for DEER if a single statewide number were to be used for a measure. Ideally, results would be applied consistently statewide and vary by program delivery mechanism. Results are shown below by delivery approach when the data could support an estimate at that level.

TABLE 6-3: RECOMMENDED STATEWIDE DEER NTG VALUES BASED ON EVALUATED RESULTS

Measure Type	Overall	Deemed Downstream	Deemed Midstream
Process Pumping VFDs	0.39	0.39	---
Refrigeration Case LED Lighting	0.63	0.63	---
Tankless Water Heating	0.55	---	0.55

6.4.1 Process Pumping VFD Measure Group

- Statewide NTGR results
  - The Statewide weighted average NTG ratio for Process Pumping VFDs is 0.39, representing a medium-low program influence level. This ex-post NTG ratio is well below the ex-ante value of 0.60. It is derived from separate NTG analyses for PG&E and SCE as discussed below.
- PG&E Process Pumping VFD Measures
  - Separate sampling strata were created for PG&E Process Pump VFD applications, Booster pumps and Well pumps. For Booster pumps, 16 interviews representing 29 applications were completed, while for Wells, 27 interviews covering 49 applications were completed. Separate NTG ratios were calculated for each category, with the Booster NTGR averaging 0.47 while the Well NTGR value was 0.36. However, the difference in NTGRs between these categories was not statistically significant, so the results have been combined into a single PG&E Weighted Average NTG ratio of 0.39.
  - This value is much lower than the assumed ex-ante value of 0.60 and indicates low program influence for these applications. Individual PAI score averages were below 5 in all cases, reinforcing the program's weak influence for this measure.
- SCE Process Pumping VFD Measures
  - Similarly, two sampling strata were created for SCE Process Pumping VFD measures, one for Downstream applications and one for Midstream applications. A total of 17 interviews were completed (25 applications) across these two delivery approaches, however, only two of the 17 interviews were completed for the Midstream category. This was insufficient to support a separate statistically-valid NTG determination for Midstream, so the results have been pooled into a single category, SCE Process Pumping VFDs.

- The SCE weighted average NTG ratio is 0.48 which demonstrates a medium level of program influence and is well short of the 0.60 ex-ante NTGR. It is interesting to note that SCE's average PAI scores showed considerable variation with PAI-2 and PAI-N6 values that were greater than or equal to 5.7, while PAI-3 averaged only 3.2.

6.4.2 Refrigeration Case LED Lighting Measure Group

For the Refrigeration Case LED Lighting measure, a total of four separate sampling strata were created across the state. Three of the four were for PG&E, and were tied to program categories, i.e., the Energy Smart Grocer program, the Hospitality program and the LGP program group. The fourth stratum was for SDG&E. All four of these categories were associated with a Downstream delivery approach. A total of 21 NTG surveys, representing 56 applications, was completed across all four strata. However, the sample sizes were not sufficient to support separate estimates by strata. Therefore, the survey results have been pooled to generate a single Statewide weighted average NTGR value.

The Statewide weighted average NTG ratio is 0.63 which falls just above of the ex-ante value of 0.60. This ex-post value is similar to the evaluated NTGR value in the 2017 evaluation of 0.58. Average PAI scores were fairly similar, with values for PAI-2 of 5.5, PAI-3 of 6.8 and PAI-N6 of 6.6. Collectively, these demonstrate a moderate level of program influence for the Refrigeration Case LED measure.

6.4.3 Agricultural Irrigation Measure Group

For the Agricultural Irrigation measure, there was a single sampling stratum for PG&E. As discussed in Section 3, a total of 11 NTG surveys, representing 11 applications, was completed. However, 8 of these 11 projects with completed interviews were found ineligible by the Gross team (as explained in Section 5) and were removed from the NTG sample. This left only three projects, which was insufficient to support the NTG analysis. Because of this, we decided to pass through the ex-ante NTGR of 0.60 rather than to base it on a sample size of only two participants.

It is interesting to note that the NTGR analysis on all 11 participants yielded a weighted average NTGR of 0.46.[28] Although we do not believe it is valid to use this value because of the large number of ineligible projects in this sample, the result does indicate that directionally, the NTGR is much lower than the ex-ante value of 0.60. This is an improvement over the NTGR finding of 0.28 in the 2017 Small Commercial evaluation, but well short of the ex-ante NTGR.

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[28] Weighted calculations are based on the ex-ante savings values.

6.4.4 Tankless Water Heating Measure Group

The Tankless Water Heating measure offered by PG&E and SCG is delivered exclusively through a Midstream approach. The program falls into the Midstream B category discussed earlier, works exclusively through vendors, and does not collect any participating customer or contractor information. Therefore, telephone surveys with end-use customers are not feasible.

Given this, the NTGR has been based solely on the results of surveys completed with 6 distributors that participate in the program, and the associated Vendor NTG algorithm described previously. The completed surveys represented 93 percent of units and 83 percent of Btu/h. Results have been weighted by each utility's share of statewide Tankless Water heating savings. The Statewide weighted average NTG ratio is 0.55 which is slightly less than the ex-ante value of 0.58. It is notable that the weighted average scores show wide variation and range from a low value of 2.4 for Score 3 to a high value of 8.3 for Score 1.

7 EVALUATION RESULTS

This section of the report presents the gross and net realization rates the evaluation team developed for the 2018 Small and Medium Commercial Sector ESPI measures discussed throughout the report. These results are presented for both first year and lifecycle electric and gas savings, were applicable.

7.1 GROSS FIRST YEAR REALIZATION RATES

The evaluation team estimated gross realization rates (GRR) by examining the ratio of the aggregate evaluated gross savings to the aggregated ex-ante gross savings for each "segment" (utility/measure/strata). The evaluation team utilized the following algorithm to develop each unique segment-specific GRR:

$$Gross\_Realization\_Rate_s = \frac{\sum_{i=1}^{n} Gross\_Ex\_Post\_Impact_{i,s}}{\sum_{i=1}^{n} Gross\_Ex\_Ante\_Impact_{i,s}}$$

Where:

$Gross\_Ex\_Post\_Impact_{i,s}$ = the gross ex-post impact estimate for $site_i$, for all sites in the sample for $segment_s$.

$Gross\_Ex\_Ante\_Impact_{i,s}$ = the gross ex-ante impact estimate $site_i$, for all sites in the sample for $segment_s$.

At the conclusion of the above "segment-level" calculations, the resulting GRR was applied back to the population of projects that fall into a given segment, and multiplied with each ex-ante impact entry in the tracking system to completely populate ex-post savings for every measure in support of measure group final results. Measure group GRR results are based on the summed ratio of ex-post impacts divided by ex-ante impacts. Table 7-1 and Table 7-2 below present the population level first year gross gas and electric realization rates, respectively, for evaluated measures along with the aggregate ex-ante and ex-post first year savings. The corresponding relative precision at the 90 percent confidence interval is also presented.[29]

[29] Relative precision is calculated as the confidence interval divided by the mean. A smaller relative precision value indicates a more precise mean result. Relative precision presented in this report is at the 90 percent confidence level.

TABLE 7-1: POPULATION FIRST YEAR GROSS THERM REALIZATION RATES FOR EVALUATED GAS MEASURES

ESPI Measure Group	First Year Gross Therm Savings			
	Ex-Ante Savings	Ex-Post Savings	GRR	RP
Tankless Water Heaters	1,912,641	1,006,630	0.53	34%

TABLE 7-2: POPULATION FIRST YEAR GROSS MWH AND MW REALIZATION RATES FOR EVALUATED ELECTRIC MEASURES

ESPI Measure Group	First Year Gross MWh Savings				First Year Gross MW Savings			
	Ex-Ante Savings	Ex-Post Savings	GRR	RP	Ex-Ante Savings	Ex-Post Savings	GRR	RP
Refrigeration Case LED Lighting	4,035	3,095	0.77	5%	0.85	0.66	0.78	4%
Process Pumping VFD Measures	18,375	9,998	0.54	31%	8.86	1.49	0.17	26%
Agricultural Irrigation	2,031	142	0.07	39%	1.61	0.19	0.12	51%

7.2 GROSS LIFECYCLE REALIZATION RATES

Table 7-3 and Table 7-4 present the population level gross lifecycle gas and electric realization rates for the evaluated ESPI measures along with the aggregate ex-ante and ex-post lifecycle savings. The corresponding relative precision at the 90 percent confidence interval is also presented.

TABLE 7-3: POPULATION LIFECYCLE GROSS THERM REALIZATION RATES FOR EVALUATED GAS MEASURES

ESPI Measure Group	Lifecycle Gross Therm Savings			
	Ex-Ante Savings	Ex-Post Savings	GRR	RP
Tankless Water Heaters	38,252,824	20,132,595	0.53	34%

TABLE 7-4: POPULATION LIFECYCLE GROSS MWH AND MW REALIZATION RATES FOR EVALUATED ELECTRIC MEASURES

ESPI Measure Group	Lifecycle Gross MWh Savings				Lifecycle Gross MW Savings			
	Ex-Ante Savings	Ex-Post Savings	GRR	RP	Ex-Ante Savings	Ex-Post Savings	GRR	RP
Refrigeration Case LED Lighting	64,562	12,381	0.19	5%	13.57	2.65	0.20	4%
Process Pumping VFD Measures	68,745	70,475	1.03	34%	33.02	9.26	0.28	35%
Agricultural Irrigation	40,610	2,843	0.07	39%	32.23	3.87	0.12	51%

7.3 NET FIRST YEAR REALIZATION RATES

The evaluation team estimated the net ex-post impacts by multiplying the measure-specific NTGR by the ex-post gross savings for the entire population for a given measure. The resulting net realization rates (NRR) represent the ratio of aggregated evaluated net savings to the aggregated ex-ante net savings for a given measure. The evaluation team utilized the following formula to develop measure group-specific NRRs:

$$Net\_Realization\_Rate_m = \frac{\sum_{i=1}^{N}(NTGR_m + ME) * \ Gross\_Ex\_Post\_Impact_{i,m}}{\sum_{i=1}^{N} Net\_Ex\_Ante\_Impact_{i,m}}$$

Where:

$NTGR_m$ = the net-to-gross ratio for $measure_m$

ME = the 0.05 market effects adder

$Gross\_Ex\_Post\_Impact_{i,m}$ = the gross ex-post impact estimate for $site_i$, for all sites in the population with $measure_m$

$Net\_Ex\_Ante\_Impact_{i,m}$ = the net ex-ante impact estimate for $site_i$, for all sites in the population with $measure_m$. Note that this value includes the 0.05 market effects adder.

Table 7-5 and Table 7-6 below present the population level first year gas and electric net realization rates for the evaluated ESPI measures along with the aggregate ex-ante and ex-post first year net savings. The net realization rate is impacted by the difference in ex-ante and ex-post gross savings along with the differences between the ex-ante and ex-post NTG ratios.

TABLE 7-5: POPULATION FIRST YEAR NET THERM REALIZATION RATES FOR EVALUATED GAS MEASURES

ESPI Measure Group	First Year Net Therm Savings*			
	Ex-Ante Savings	Ex-Post Savings	NRR	RP
Tankless Water Heaters	1,203,677	602,305	0.50	41%

* Please note that the net savings values include the 0.05 market effects adder.

TABLE 7-6: POPULATION FIRST YEAR NET MWH AND MW REALIZATION RATES FOR EVALUATED ELECTRIC MEASURES

ESPI Measure Group	First Year Net MWh Savings*				First Year Net MW Savings*			
	Ex-Ante Savings	Ex-Post Savings	NRR	RP	Ex-Ante Savings	Ex-Post Savings	NRR	RP
Refrigeration Case LED Lighting	2,628	2,105	0.80	18%	0.55	0.45	0.81	17%
Process Pumping VFD Measures	11,945	4,655	0.39	37%	5.76	0.69	0.12	33%
Agricultural Irrigation	1,320	92	0.07	39%	1.05	0.13	0.12	51%

* Please note that the net savings values include the 0.05 market effects adder.

7.4 NET LIFECYCLE REALIZATION RATES

Table 7-7 and Table 7-8 present the population lifecycle gas and electric net realization rates for the evaluated ESPI measures along with the aggregate ex-ante and ex-post lifecycle net savings. The corresponding relative precision at the 90 percent confidence interval is also presented.

TABLE 7-7: POPULATION LIFECYCLE NET THERM REALIZATION RATES FOR EVALUATED GAS MEASURES

ESPI Measure Group	Lifecycle Net Therm Savings*			
	Ex-Ante Savings	Ex-Post Savings	NRR	RP
Tankless Water Heaters	24,073,536	12,046,096	0.50	41%

* Please note that the net savings values include the 0.05 market effects adder.

TABLE 7-8: POPULATION LIFECYCLE NET MWH AND MW REALIZATION RATES FOR EVALUATED ELECTRIC MEASURES

ESPI Measure Group	Lifecycle Net MWh Savings*				Lifecycle Net MW Savings*			
	Ex-Ante Savings	Ex-Post Savings	NRR	RP	Ex-Ante Savings	Ex-Post Savings	NRR	RP
Refrigeration Case LED Lighting	42,048	8,420	0.20	18%	8.83	1.79	0.20	17%
Process Pumping VFD Measures	44,698	31,588	0.71	39%	21.47	4.14	0.19	41%
Agricultural Irrigation	26,397	1,848	0.07	39%	20.95	2.51	0.12	51%

* Please note that the net savings values include the 0.05 market effects adder.

8 CONCLUSIONS AND RECOMMENDATIONS

This section of the report provides conclusions and recommendations related to the findings that were developed from this evaluation.

8.1 REFRIGERATION LED CASE LIGHTING MEASURES

Conclusion (Section 5) RL1 [PG&E]: A large participating grocery store chain also received rebates for new refrigeration cases in addition to the lighting rebate. The savings PG&E claimed for the installation of the new cases also included savings for the efficient lighting that comes standard with new cases. By separately claiming savings for the refrigeration case lighting measure in addition to the new case, savings associated with the new efficient lighting in the case are double-counted. Therefore, savings for the lighting measure resulted in zero incremental savings for this participant's reach in cases, resulting in significantly lower overall gross savings.

> **Recommendations RL1 [PG&E]: The program's application review and verification process should ensure that project savings are not being double counted for any participants receiving incentives in any given program or across any set of programs**, in addition to other traditional roles for these program processes.

Conclusion RL2 [Section 5]: Ex-post hours of operation generally support the assumed HOU used in the workpapers and deemed savings for the refrigerated case LED measures. The exception is for sites verified with 24/7 operation through both self-report and logger data.

> **Recommendations RL2 [SDG&E]: Utilities should continue using the HOU currently being used in the ex-ante calculations.** One possible exception is to develop a measure code for buildings that are open 24/7.

Conclusion RL3 [Section 5]: SDG&E and PG&E applied an EUL of 16 years to the measures. Evaluators concluded the remaining useful life of the refrigerated case, or 1/3 of the case's 12 year EUL, is more appropriate to use when calculating lifecycle savings because when the case is replaced, the LED's rebated through the program will be removed from service.

> **Recommendations RL3 [PG&E, SDG&E]: The IOUs should revise the EUL they use for lifecycle savings.** Instead of claiming these measures as replace on burnout with a 16 year EUL, the Evaluation Team recommends they be considered accelerated replacement with an EUL equal to the remaining useful life of the refrigerated case itself, or 4 years.

Conclusion RL4 [Section 6]: In general, Refrigerated LED Case Lighting measures exhibited medium program influence levels. The statewide weighted average NTG ratio is 0.63, which is similar to that found in the 2017 evaluation, and fairly close to the ex-ante value of 0.60.

> **Recommendation RL4 [SCE, SDG&E]: As Refrigerated LED Case Lighting measures continue to be incented by SCE and SDG&E, free ridership should be monitored on an ongoing basis.** As the market matures for this technology and free ridership levels rise, programs should revisit incentive eligibility.

8.2 PROCESS PUMPING VFD MEASURES

Conclusion PPVFD1 [Section 5]: The workpaper-based estimates of savings currently draw results from a database of legacy custom and new construction projects involving pump VFDs. As such, there are no stipulated values reported in the workpapers for operating hours, pump load distribution, assumed baseline condition, motor efficiency, VFD efficiency, pump OPE and the assumed affinity law exponent – from which to contrast evaluation-based parameters that were derived or assumed.

> **Recommendation PPVFD1a [PG&E, SCE and SDG&E]: However, the evaluation did nonetheless report out on metric-based per-unit results that should prove useful to workpaper updates, as well as several of the parameters noted above.** Workpaper updates for agricultural pump VFD measures that are scheduled for 2020 should take into consideration the broad results of this evaluation and any trends observed in order to best improve the accuracy of future workpaper estimates.

> **Recommendation PPVFD1b [PG&E, SCE and SDG&E]: The program's application and review process should be expanded to increase the range of irrigation pump performance information captured in the ex-ante tracking databases.** The PAs should consider including fields within the project application forms for proposed pump runtime, the acreage to be served by the pump, the crop being served, irrigation end-point type (drip, sprinkler, flood), OPE, etc., and make use of those data to fine tune ex-ante savings values in order to more accurately represent the pumping conditions/water requirements. It might be possible, for example, to support crop-specific savings estimates and to better customize expected pump loads based on water requirement by crop, pump capacity and acreage.

> **Recommendation PPVFD1c [PG&E, SCE and SDG&E]: The PAs should consider using an enhanced measure savings algorithm that provides for some reasonable level of customization for relevant input parameters.** Based on observations during this evaluation, we believe that irrigation pumps are better suited as a quasi-prescriptive (partially-deemed) measure rather than

a fully deemed measure. The diversity among sample points and results suggests that irrigated fields and the VFDs that serve them are unique to each farm, but nonetheless trends may be leveraged that can lead to more accurate savings claims; to that effect, using crop-specific irrigation requirements, for example, could be used to more accurately characterize the measure savings. Continuing to use a database of legacy ex-ante pump VFD results, as currently planned for the 2020 workpaper revisions, will likely continue to misrepresent realized program savings.

Conclusion PPVFD2 [Section 5]: By far the most valuable data source supporting ex-post gross impact accuracy was the AMI data that the utilities provided to the evaluation team. The evaluation team was able to create AMI summaries that presented pump loads as a function of kW bins – and to report out on both the frequency of observed loads in each bin (a reasonable proxy for hours of operation), as well as operating load statistics within each bin, including the average, median, minimum and maximum kW values. This illuminated pump loading for the majority of sample points, especially for the post-installation period under VFD operation, and served as a key set of inputs used for both modeling and model calibration. Often the program pumps were served by dedicated AMI meters, providing the equivalent of long-term interval metering data, and capturing all aspects of pump operation in terms of seasonality of crop irrigation and the hourly distribution of loads.

Recommendation PPVFD2a [PG&E, SCE and SDG&E]: The PAs should leverage AMI data for the purposes of deriving workpaper-based impact estimates. Similar to the approach outlined above, using dedicated AMI meters and post-installation pump loads with VFDs in place, and given tracking system-based knowledge of pump horsepower, mean profiles could be derived by pump type and crop type, and normalized on a per-horsepower basis. This would provide a robust data source regarding pump part-load operating conditions, and might support a more accurate estimation approach to apply relative to the intended 2020 database approach discussed above. For VFDs the true pump part-load condition is THE key parameter informing VFD impact results.

Recommendation PPVFD2b [PG&E, SCE and SDG&E]: The PAs should make use of AMI data to screen projects for eligibility based on pump run time being greater than the required 1,000 hours.

Conclusion PPVFD3 [Section 6]: Although the evaluation did not contest the utility-derived standard practice baseline, nor conduct additional research surrounding standard practice for VFDs in pumping systems, there are certainly irrigation applications where there is a high likelihood that a VFD would have been installed in the absence of the program, given many non-energy benefits of VFD operations. The evaluation team concludes, for example, that non-energy benefits include:

- Telemetry – being able to monitor and control pump operations remotely
- Soft-start – utilities need these pumps to be on soft-start mode to avoid spikes in the distribution lines
- Maintain constant pressure setpoints at the distribution valves/manifolds -- adding VFDs will help the pump to save energy by doing just enough work needed to meet the pressure setpoints, as valves are opened and closed in order to serve an array of irrigation sets across a given crop or set of crops
- VFDs can save on equipment maintenance and extend the life of both pumps and motor equipment
- Pumps on TOU rates use VFDs to set low/no operations during peak hours

  Recommendation PPVFD3 [PG&E, SCE and SDG&E]: In lieu of these conclusions the workpaper baseline condition should be revisited in advance of completion of 2020 workpaper updates for the agricultural pump VFD measure. The utilities recently completed a standard practice baseline assessment for irrigation pump VFDs and concluded that throttle valve controls are standard practice for new pumps and new pumping systems. However, evaluation team review of the report casts reasonable doubt on this conclusion. Importantly, we believe that the data collection effort did not appropriately segment the questionnaire on pump type and pump size, and analyses performed lumped booster and well pumps together, but standard practice is likely quite different for well pumps and booster pumps (as some of the study intermediate results show) and size of pump (due to soft start and other considerations). Additional data collection may be warranted. Furthermore, aspects of the analytic approach applied should be revisited – for example, when respondents indicated "likely to install VFD" the analysis assigned a probability of VFD installation of 63 percent. Is this an appropriate probability to assign to a likely VFD installation?

Conclusion PPVFD4 [Section 5]: Pumps in the sample frequently failed to comply with various program eligibility requirements. These requirements are generally in place to ensure each VFD installation will produce a desirable minimum level of program savings and/or produce savings at all.

- **Conclusion PPVFD4a [PG&E, SCE]: Across both the PG&E and SCE samples, 10 out of 49 claims evaluated (pumps) were found to run for less than 500 hours, even though the program requires that pumps operate 1,000 hours per year or more.** First year annual gross impact realization rates for these projects were relatively low, yielding an unweighted mean of 0.06. In fact, some of the pumps were not operable during the most recent past year, yielding a realization rate of zero due to low run hours. One such reason involved new booster pumps installed for future use, in anticipation of greater crop water requirements once trees matured. Orchard irrigation requirements increase dramatically as trees mature. CPUC evaluation policy, however, is to evaluate the as-found condition, and forecasting of future conditions is not allowed.

- **Conclusion PPVFD4b [Section 5]: For two additional claims the VFD-equipped well pump operates exclusively to fill a reservoir, thus failing to meet that eligibility requirement.** Gross impact realization rates for these projects were set to zero.
- **Conclusion PPVFD4c [Section 5]: Two additional claims in the sample serve flood irrigation and therefore are not eligible.** Gross impact realization rates for these projects were set to zero; flood irrigation systems fail to comply with program eligibility requirements that irrigation systems be pressurized, including program standards that specifically reference the lack of eligibility for flood irrigation equipment.
- **Conclusion PPVFD4d [Section 5]: Three claims in the sample involved the replacement of controls that are equivalent in functionality to VFD controls.** Gross impact realization rates for these projects were set to zero; CPUC policy does not allow programs to install like-for-like energy efficiency replacements, as no savings are realized by the grid.

  Recommendation PPVFD4 [PG&E, SCE]: The program's application and review process should be enhanced to better screen projects against eligibility requirements and exclusions, and verification should be performed to ensure that installations claimed are both valid and accurately represent the associated irrigation system. One additional related observation from the on-site sample is that pump VFD claims were not always properly labeled in each measure description; again this indicates the need for improvements in verification AND tracking. Well pumps were labeled as booster pumps and booster pumps as well pumps. Pump horsepower was also mischaracterized for some pumps in the sample. These tracking system errors also result in errors in associated ex-ante claims; given the true nature of each pump.

Conclusion PPVFD5 [Section 5]: It is also notable that pumps that do not operate at substantially reduced speeds and flow should not be eligible for program VFD incentives. We see twelve sample points that typically operate in excess of 89 percent of full speed. The current program standards language is too open to interpretation and program staff are not currently screening out projects that should be excluded from participation; not only for this reason, but several others noted in this section.

Recommendation PPVFD5 [PG&E, SCE, SDG&E]: The program eligibility requirements should be strengthened to exclude all such pumps from participation.

Conclusion PPVFD6 [Section 5]: Across both the PG&E and SCE samples (49 pumps), there were only two pumps where evaluation-based EUL assignments matched those applied by the utilities in the tracking system. The utilities are failing to properly set EUL values to 1/3 of the EUL of an appropriate pump description from DEER for retrofit add-on projects (where the RUL of the pump informs the EUL of the VFD measure, based on host equipment policy). Ex-post EUL estimates demonstrate some level of confusion on the part of the utilities surrounding proper reporting of EUL and proper use of DEER database sources.

> **Recommendation PPVFD6 [PG&E, SCE]: The PAs should apply greater due diligence in populating tracking system-based EULs and better classify participating projects as new pump installations versus retrofit add-on installations.** Furthermore, there is room for improvement in using and applying DEER resources proficiently.

Conclusion PPVFD7 [Section 6]: The Process Pumping VFD measure's average ex-post NTG ratio of 0.39 suggests a medium-low level of program influence and corresponding medium-high level of free ridership. This value is based on utility-specific NTG ratios of 0.39 for PG&E and 0.48 for SCE. This result is associated with project-level NTGR findings that vary widely, ranging from a low value of 0.03 to a high value of 0.95, when considering results from both utilities.

> **Recommendation PPVFD7 [PG&E, SCE, SDG&E]: Given the medium-low program influence level, the programs should monitor free ridership on an ongoing basis.** Based on these findings, the programs should adjust the program design, targeting and delivery approach as needed to maximize program influence and minimize free ridership.

8.3 AGRICULTURAL IRRIGATION

Conclusion AG1 [Section 5]: N**ine of the 17 sampled projects in this evaluation were ineligible for program participation.** Each of these nine farms grow deciduous crops (shredding leaves annually), such as almonds and walnuts, that were not allowed by the program in 2018. These ineligible projects resulted in zero savings and significantly reduced program savings.

> **Recommendation AG1 [PG&E]: The program's application and review process should be enhanced to screen projects against all eligibility criteria, and selected auditing or verification should be performed to ensure that only valid installations are claimed.** Enhanced screening will serve to reign-in claims that are found by evaluators to not save energy, and thereby improve the cost-effectiveness of the programs.

Conclusion AG2 [Section 5]: IOU models for estimating savings were found to lack key parameters that are critical for accurately characterizing irrigation needs and resulting savings. These gaps generally led to a reduction in evaluated savings relative to IOU reported savings. Nearly each of the 17 evaluated agricultural irrigation projects were a unique combination of the following parameters which were not considered in IOU's reported savings calculation: pre-project crop type, pre-project irrigation method, and post-project crop type. Each of these parameters can significantly affect irrigation requirements and subsequent savings from drip irrigation installations.

> **Recommendation AG2 [PG&E]: Future workpaper revisions, ex-ante models, and impact claims should incorporate recent evaluation data and results.** This information should be used for revising parameter-level assumptions, correcting errors and omissions, and otherwise improving the accuracy of ex-ante claims. This will ensure better alignment between ex-ante claims and ex-post savings results.

8.4 TANKLESS WATER HEATERS

Conclusion TWH1 [Section 5]: The tankless water heater measure's distributor-facing design results in inconsistent or missing tracking data. The midstream design involves rebates paid to distributors, who in turn work with contractors to install high-efficiency systems among commercial customers. For approximately 85 percent of projects in the PY2018 population, evaluators had insufficient customer contact data to verify water heater installation or evaluate savings. For projects with sufficient customer contact data, recruitment for evaluation was challenging, as the customers were often unaware that they had participated in an efficiency program. The measure's midstream design and subsequent data gaps caused the evaluators to fall short of the target evaluation sample count of 36 projects.

> **Recommendation TWH1 [PG&E, SCG]: For any measures delivered midstream through distributor rebates, or for any other offering where the IOUs are providing support and incentives through the state's energy efficiency programs, such as the tankless water heater measure, program administrators should require participating distributors and partnering contractors to collaboratively collect and submit basic information for each customer ultimately receiving the equipment or other support.** Such information should include: facility name; facility classification; facility address; name(s), phone number(s), and email address(es) of customer representatives familiar with the project; and contractor name, phone number, and email address. This basic information is critical for the utilities, the CPUC, and its contractors to verify installations and maintain the integrity of ratepayer incentive dollars.

Conclusion TWH2 [Section 5]: Three of the 25 evaluated projects were determined to result in zero savings due to non-install or ineligibility. One project occurred at a facility that has since gone out of business, one project occurred at a facility that uses electricity for water heating, and one project occurred at a service address that had no evidence of recent TWH installation. These projects resulted in zero savings and significantly reduced program savings. Evaluators believe that the measure's midstream design complicated the programs' ability to screen the ineligible projects.

> **Recommendation TWH2 [PG&E, SCG]: For any measures delivered midstream through distributor rebates, such as the tankless water heater measure, the programs must require participating distributors and partnering contractors to submit more comprehensive installation documentation** (e.g., invoices, commissioning reports) and photographs to prove measure installation, quantity, size, fuel source, and efficiency. Such documentation would allow the programs to conduct thorough eligibility screening and internal audits of a selection of tracked installations to confirm tracking data accuracy.

Conclusion TWH3a [Section 5]: 11 of the 25 evaluated projects applied incorrect reported per-unit savings values or misclassified the type of facility where the measure was installed. For these projects, the tracked unit energy savings values differed from those recommended by workpapers applicable in PY 2018. Additionally, due to the measure's midstream delivery, some installations were broadly classified as "commercial," as the systems' ultimate destinations were unknown by the distributors. This broad commercial classification led to further differences as compared with facility-specific UES values recommended by applicable workpapers.

Conclusion TWH3b [Section 6]: In the course of our net-to-gross analysis, we noticed inconsistent application of ex-ante NTGR as compared with workpaper recommendations. Active workpapers for the TWH measure in PY2018 recommended an NTGR of 0.60. However, evaluators found that 19 percent of PY2018 tracking records reflected an NTGR of 0.60, 80 percent an NTGR of 0.65, and 1 percent an NTGR of 0.90.

> **Recommendation TWH3 [PG&E, SCG]: Deemed measures in the small-medium commercial sector should conform with workpapers active at the time of installation.** Claimed savings should reflect the product of workpaper-recommended unit energy savings (UES) with the total installed quantity or size for the most appropriate facility type. Additionally, applied NTGRs should consistently reflect the NTGRs specified by workpapers active at the time of project application.

Conclusion TWH4 [Section 5]: We found differences in tankless water heater efficiency and temperature increase as compared with workpaper assumptions. Through measurement and verification of rebated TWHs, we found that systems raise the hot water temperature by 57°F on average, as compared with workpaper-assumed temperature increases ranging from 60°F to 84°F depending on climate zone and facility type. Differences in temperature increase led to an overall reduction in GRR by 37 percent. On the other hand, we found that TWHs generally operate more efficiently than assumed in workpapers, which led to an increase in the GRR by 27 percent.

> **Recommendation TWH4 [PG&E and SCG]: Future workpaper revisions, ex-ante models and impact claims should incorporate recent evaluation data and results.** This information should be used for revising parameter-level assumptions such as TWH temperature increase and efficiency to improve the accuracy of ex-ante claims. Such revisions will ensure better alignment between ex-ante claims and ex-post savings results.

Conclusion TWH5 [Section 6]: TWH measures incurred slightly higher levels of free-ridership (NTGR = 0.55) as compared with the default NTGR assumption of 0.58. Interviews with participating distributors revealed a wide range of program influence on their decisions to stock and market high-efficiency units.

> **Recommendation TWH5 [PG&E and SCG]: The DEER team should take this evaluation result under consideration, given the unique nature of mid-stream delivery, for the purposes of future workpaper NTGR revisions.** Caution is warranted, however in doing so, given that this result is based on a limited number of vendor interview responses.

APPENDIX AA STANDARDIZED HIGH LEVEL SAVINGS

Gross Lifecycle Savings (MWh)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PASS THROUGH	384,650	384,650	1.00	100.0%	
PGE	PGE - AG IRRIGATION	40,610	2,843	0.07	0.0%	0.07
PGE	PGE - PROCESS PUMPING VFD	54,677	64,875	1.19	2.1%	1.19
PGE	PGE - REFRIGERATION CASE LED LIGHTING	57,007	11,402	0.20	0.0%	0.20
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	120	120	1.00	0.0%	1.00
PGE	**Total**	**537,065**	**463,890**	**0.86**	**71.8%**	**0.52**
SCE	PASS THROUGH	81,679	81,679	1.00	100.0%	
SCE	SCE - PROCESS PUMPING VFD	13,932	5,464	0.39	0.0%	0.39
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0	0			
SCE	**Total**	**95,612**	**87,143**	**0.91**	**85.4%**	**0.39**
SCG	PASS THROUGH	2,699	2,699	1.00	100.0%	
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0			
SCG	**Total**	**2,699**	**2,699**	**1.00**	**100.0%**	
SDGE	PASS THROUGH	12,554	12,554	1.00	100.0%	
SDGE	SDGE - PROCESS PUMPING VFD	136	136	1.00	100.0%	
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	7,555	978	0.13	0.0%	0.13
SDGE	**Total**	**20,245**	**13,668**	**0.68**	**62.7%**	**0.13**
MCE	PASS THROUGH	1,415	1,415	1.00	100.0%	
MCE	**Total**	**1,415**	**1,415**	**1.00**	**100.0%**	
	Statewide	***657,035***	***568,816***	***0.87***	***73.7%***	***0.49***

Net Lifecycle Savings (MWh)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
PGE	PASS THROUGH	255,270	255,270	1.00	100.0%	0.66	0.66		
PGE	PGE - AG IRRIGATION	26,397	1,848	0.07	100.0%	0.65	0.65		
PGE	PGE - PROCESS PUMPING VFD	35,540	28,578	0.80	2.1%	0.65	0.44	0.65	0.44
PGE	PGE - REFRIGERATION CASE LED LIGHTING	37,054	7,458	0.20	0.0%	0.65	0.65	0.65	0.65
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	78	72	0.92	0.0%	0.65	0.60	0.65	0.60
PGE	**Total**	**354,339**	**293,225**	**0.83**	**79.7%**	**0.66**	**0.63**	**0.65**	**0.47**
SCE	PASS THROUGH	53,682	53,682	1.00	100.0%	0.66	0.66		
SCE	SCE - PROCESS PUMPING VFD	9,056	2,909	0.32	1.6%	0.65	0.53	0.65	0.53
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0	0						
SCE	**Total**	**62,738**	**56,591**	**0.90**	**85.8%**	**0.66**	**0.65**	**0.65**	**0.53**
SCG	PASS THROUGH	1,845	1,845	1.00	100.0%	0.68	0.68		
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0						
SCG	**Total**	**1,845**	**1,845**	**1.00**	**100.0%**	**0.68**	**0.68**		
SDGE	PASS THROUGH	8,509	8,509	1.00	100.0%	0.68	0.68		
SDGE	SDGE - PROCESS PUMPING VFD	102	102	1.00	100.0%	0.75	0.75		
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	4,994	962	0.19	0.0%	0.66	0.98	0.66	0.98
SDGE	**Total**	**13,605**	**9,573**	**0.70**	**63.3%**	**0.67**	**0.70**	**0.66**	**0.98**
MCE	PASS THROUGH	1,213	1,213	1.00	100.0%	0.86	0.86		
MCE	**Total**	**1,213**	**1,213**	**1.00**	**100.0%**	**0.86**	**0.86**		
	Statewide	***433,741***	***362,448***	***0.84***	***80.2%***	***0.66***	***0.64***	***0.65***	***0.48***

*All Net Savings and NTG values presented above include the 0.05 Market Effects Adder.

Gross Lifecycle Savings (MW)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PASS THROUGH	67.5	67.5	1.00	100.0%	
PGE	PGE - AG IRRIGATION	32.2	3.9	0.12	0.0%	0.12
PGE	PGE - PROCESS PUMPING VFD	26.1	7.9	0.30	0.0%	0.30
PGE	PGE - REFRIGERATION CASE LED LIGHTING	12.3	2.5	0.20	0.0%	0.20
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0.1	0.1	1.00	0.0%	1.00
PGE	**Total**	**138.2**	**81.8**	**0.59**	**48.8%**	**0.20**
SCE	PASS THROUGH	9.7	9.7	1.00	100.0%	
SCE	SCE - PROCESS PUMPING VFD	6.8	1.3	0.19	0.0%	0.19
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0.0	0.0			
SCE	**Total**	**16.5**	**11.0**	**0.66**	**58.8%**	**0.19**
SCG	PASS THROUGH	0.1	0.1	1.00	100.0%	
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0.0	0.0			
SCG	**Total**	**0.1**	**0.1**	**1.00**	**100.0%**	
SDGE	PASS THROUGH	1.2	1.2	1.00	100.0%	
SDGE	SDGE - PROCESS PUMPING VFD	0.1	0.1	1.00	100.0%	
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	1.2	0.2	0.13	0.0%	0.13
SDGE	**Total**	**2.5**	**1.4**	**0.56**	**49.8%**	**0.13**
MCE	PASS THROUGH	0.3	0.3	1.00	100.0%	
MCE	**Total**	**0.3**	**0.3**	**1.00**	**100.0%**	
	Statewide	***157.6***	***94.6***	***0.60***	***50.0%***	***0.20***

Net Lifecycle Savings (MW)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
PGE	PASS THROUGH	44.3	44.3	1.00	100.0%	0.66	0.66		
PGE	PGE - AG IRRIGATION	21.0	2.5	0.12	100.0%	0.65	0.65		
PGE	PGE - PROCESS PUMPING VFD	17.0	3.4	0.20	0.0%	0.65	0.42	0.65	0.42
PGE	PGE - REFRIGERATION CASE LED LIGHTING	8.0	1.6	0.20	0.0%	0.65	0.65	0.65	0.65
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0.0	0.0	0.92	0.0%	0.65	0.60	0.65	0.60
PGE	**Total**	**90.3**	**51.8**	**0.57**	**72.3%**	**0.65**	**0.63**	**0.65**	**0.48**
SCE	PASS THROUGH	6.4	6.4	1.00	100.0%	0.66	0.66		
SCE	SCE - PROCESS PUMPING VFD	4.4	0.7	0.16	1.8%	0.65	0.57	0.65	0.57
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0.0	0.0						
SCE	**Total**	**10.8**	**7.1**	**0.66**	**59.9%**	**0.66**	**0.65**	**0.65**	**0.57**
SCG	PASS THROUGH	0.0	0.0	1.00	100.0%	0.75	0.75		
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0.0	0.0						
SCG	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.75**	**0.75**		
SDGE	PASS THROUGH	0.8	0.8	1.00	100.0%	0.68	0.68		
SDGE	SDGE - PROCESS PUMPING VFD	0.1	0.1	1.00	100.0%	0.75	0.75		
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0.8	0.2	0.20	0.0%	0.66	0.98	0.66	0.98
SDGE	**Total**	**1.7**	**1.0**	**0.60**	**50.8%**	**0.67**	**0.72**	**0.66**	**0.98**
MCE	PASS THROUGH	0.3	0.3	1.00	100.0%	0.86	0.86		
MCE	**Total**	**0.3**	**0.3**	**1.00**	**100.0%**	**0.86**	**0.86**		
	Statewide	***103.1***	***60.3***	***0.58***	***70.7%***	***0.65***	***0.64***	***0.65***	***0.50***

*All Net Savings and NTG values presented above include the 0.05 Market Effects Adder.

Gross Lifecycle Savings (MTherms)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PASS THROUGH	48,525	48,525	1.00	100.0%	
PGE	PGE - AG IRRIGATION	0	0			
PGE	PGE - PROCESS PUMPING VFD	0	0			
PGE	PGE - REFRIGERATION CASE LED LIGHTING	-760	-760	1.00	0.0%	1.00
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	29,046	16,266	0.56	0.0%	0.56
PGE	**Total**	**76,810**	**64,030**	**0.83**	**63.2%**	**0.55**
SCE	PASS THROUGH	-15	-15	1.00	100.0%	
SCE	SCE - PROCESS PUMPING VFD	0	0			
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0	0			
SCE	**Total**	**-15**	**-15**	**1.00**	**100.0%**	
SCG	PASS THROUGH	54,366	54,366	1.00	100.0%	
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	9,207	3,867	0.42	0.0%	0.42
SCG	**Total**	**63,573**	**58,233**	**0.92**	**85.5%**	**0.42**
SDGE	PASS THROUGH	2,102	2,102	1.00	100.0%	
SDGE	SDGE - PROCESS PUMPING VFD	0	0			
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0	0			
SDGE	**Total**	**2,102**	**2,102**	**1.00**	**100.0%**	
MCE	PASS THROUGH	1	1	1.00	100.0%	
MCE	**Total**	**1**	**1**	**1.00**	**100.0%**	
	Statewide	***142,472***	***124,351***	***0.87***	***73.7%***	***0.52***

Net Lifecycle Savings (MTherms)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
PGE	PASS THROUGH	31,561	31,561	1.00	100.0%	0.65	0.65		
PGE	PGE - AG IRRIGATION	0	0						
PGE	PGE - PROCESS PUMPING VFD	0	0						
PGE	PGE - REFRIGERATION CASE LED LIGHTING	-494	-459	0.93	0.0%	0.65	0.60	0.65	0.60
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	18,011	9,732	0.54	0.0%	0.62	0.60	0.62	0.60
PGE	**Total**	**49,078**	**40,835**	**0.83**	**64.3%**	**0.64**	**0.64**	**0.62**	**0.60**
SCE	PASS THROUGH	-9	-9	1.00	100.0%	0.65	0.65		
SCE	SCE - PROCESS PUMPING VFD	0	0						
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0	0						
SCE	**Total**	**-9**	**-9**	**1.00**	**100.0%**	**0.65**	**0.65**		
SCG	PASS THROUGH	37,080	37,080	1.00	100.0%	0.68	0.68		
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	6,063	2,314	0.38	0.0%	0.66	0.60	0.66	0.60
SCG	**Total**	**43,143**	**39,393**	**0.91**	**85.9%**	**0.68**	**0.68**	**0.66**	**0.60**
SDGE	PASS THROUGH	1,363	1,363	1.00	100.0%	0.65	0.65		
SDGE	SDGE - PROCESS PUMPING VFD	0	0						
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0	0						
SDGE	**Total**	**1,363**	**1,363**	**1.00**	**100.0%**	**0.65**	**0.65**		
MCE	PASS THROUGH	1	1	1.00	100.0%	1.72	1.72		
MCE	**Total**	**1**	**1**	**1.00**	**100.0%**	**1.72**	**1.72**		
	Statewide	***93,575***	***81,583***	***0.87***	***74.8%***	***0.66***	***0.66***	***0.63***	***0.60***

*All Net Savings and NTG values presented above include the 0.05 Market Effects Adder.

Gross First Year Savings (MWh)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PASS THROUGH	36,007	36,007	1.00	100.0%	
PGE	PGE - AG IRRIGATION	2,031	142	0.07	0.0%	0.07
PGE	PGE - PROCESS PUMPING VFD	16,448	9,055	0.55	1.4%	0.54
PGE	PGE - REFRIGERATION CASE LED LIGHTING	3,563	2,851	0.80	0.0%	0.80
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	6	6	1.00	0.0%	1.00
PGE	**Total**	**58,055**	**48,061**	**0.83**	**62.4%**	**0.54**
SCE	PASS THROUGH	15,664	15,664	1.00	100.0%	
SCE	SCE - PROCESS PUMPING VFD	1,913	929	0.49	0.0%	0.49
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0	0			
SCE	**Total**	**17,577**	**16,593**	**0.94**	**89.1%**	**0.49**
SCG	PASS THROUGH	475	475	1.00	100.0%	
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0			
SCG	**Total**	**475**	**475**	**1.00**	**100.0%**	
SDGE	PASS THROUGH	2,530	2,530	1.00	100.0%	
SDGE	SDGE - PROCESS PUMPING VFD	14	14	1.00	100.0%	
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	472	245	0.52	0.0%	0.52
SDGE	**Total**	**3,016**	**2,788**	**0.92**	**84.3%**	**0.52**
MCE	PASS THROUGH	119	119	1.00	100.0%	
MCE	**Total**	**119**	**119**	**1.00**	**100.0%**	
	Statewide	***79,242***	***68,036***	***0.86***	***69.5%***	***0.54***

Net First Year Savings (MWh)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
PGE	PASS THROUGH	23,815	23,815	1.00	100.0%	0.66	0.66		
PGE	PGE - AG IRRIGATION	1,320	92	0.07	100.0%	0.65	0.65		
PGE	PGE - PROCESS PUMPING VFD	10,692	4,149	0.39	1.4%	0.65	0.46	0.65	0.45
PGE	PGE - REFRIGERATION CASE LED LIGHTING	2,316	1,865	0.81	0.0%	0.65	0.65	0.65	0.65
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	4	4	0.92	0.0%	0.65	0.60	0.65	0.60
PGE	**Total**	**38,146**	**29,924**	**0.78**	**66.3%**	**0.66**	**0.62**	**0.65**	**0.50**
SCE	PASS THROUGH	10,231	10,231	1.00	100.0%	0.65	0.65		
SCE	SCE - PROCESS PUMPING VFD	1,244	496	0.40	1.8%	0.65	0.53	0.65	0.53
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0	0						
SCE	**Total**	**11,475**	**10,727**	**0.93**	**89.4%**	**0.65**	**0.65**	**0.65**	**0.53**
SCG	PASS THROUGH	320	320	1.00	100.0%	0.67	0.67		
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0						
SCG	**Total**	**320**	**320**	**1.00**	**100.0%**	**0.67**	**0.67**		
SDGE	PASS THROUGH	1,675	1,675	1.00	100.0%	0.66	0.66		
SDGE	SDGE - PROCESS PUMPING VFD	10	10	1.00	100.0%	0.75	0.75		
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	312	240	0.77	0.0%	0.66	0.98	0.66	0.98
SDGE	**Total**	**1,997**	**1,926**	**0.96**	**84.4%**	**0.66**	**0.69**	**0.66**	**0.98**
MCE	PASS THROUGH	102	102	1.00	100.0%	0.86	0.86		
MCE	**Total**	**102**	**102**	**1.00**	**100.0%**	**0.86**	**0.86**		
	Statewide	***52,040***	***42,999***	***0.83***	***72.3%***	***0.66***	***0.63***	***0.65***	***0.51***

*All Net Savings and NTG values presented above include the 0.05 Market Effects Adder.

Gross First Year Savings (MW)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PASS THROUGH	7.1	7.1	1.00	100.0%	
PGE	PGE - AG IRRIGATION	1.6	0.2	0.12	0.0%	0.12
PGE	PGE - PROCESS PUMPING VFD	7.9	1.3	0.16	0.0%	0.16
PGE	PGE - REFRIGERATION CASE LED LIGHTING	0.8	0.6	0.81	0.0%	0.81
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0.0	0.0	1.00	0.0%	1.00
PGE	**Total**	**17.5**	**9.3**	**0.53**	**40.9%**	**0.20**
SCE	PASS THROUGH	1.5	1.5	1.00	100.0%	
SCE	SCE - PROCESS PUMPING VFD	0.9	0.2	0.21	0.0%	0.21
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0.0	0.0			
SCE	**Total**	**2.4**	**1.7**	**0.70**	**61.7%**	**0.21**
SCG	PASS THROUGH	0.0	0.0	1.00	100.0%	
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0.0	0.0			
SCG	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
SDGE	PASS THROUGH	0.2	0.2	1.00	100.0%	
SDGE	SDGE - PROCESS PUMPING VFD	0.0	0.0	1.00	100.0%	
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0.1	0.0	0.53	0.0%	0.53
SDGE	**Total**	**0.3**	**0.3**	**0.88**	**74.2%**	**0.53**
MCE	PASS THROUGH	0.0	0.0	1.00	100.0%	
MCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
	Statewide	***20.2***	***11.2***	***0.56***	***44.0%***	***0.21***

Net First Year Savings (MW)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
PGE	PASS THROUGH	4.7	4.7	1.00	100.0%	0.65	0.65		
PGE	PGE - AG IRRIGATION	1.0	0.1	0.12	100.0%	0.65	0.65		
PGE	PGE - PROCESS PUMPING VFD	5.1	0.6	0.11	0.0%	0.65	0.44	0.65	0.44
PGE	PGE - REFRIGERATION CASE LED LIGHTING	0.5	0.4	0.81	0.0%	0.65	0.65	0.65	0.65
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0.0	0.0	0.92	0.0%	0.65	0.60	0.65	0.60
PGE	**Total**	**11.4**	**5.8**	**0.51**	**50.3%**	**0.65**	**0.63**	**0.65**	**0.51**
SCE	PASS THROUGH	1.0	1.0	1.00	100.0%	0.66	0.66		
SCE	SCE - PROCESS PUMPING VFD	0.6	0.1	0.19	2.0%	0.65	0.57	0.65	0.57
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0.0	0.0						
SCE	**Total**	**1.6**	**1.1**	**0.69**	**62.6%**	**0.65**	**0.65**	**0.65**	**0.57**
SCG	PASS THROUGH	0.0	0.0	1.00	100.0%	0.75	0.75		
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0.0	0.0						
SCG	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.75**	**0.75**		
SDGE	PASS THROUGH	0.1	0.1	1.00	100.0%	0.67	0.67		
SDGE	SDGE - PROCESS PUMPING VFD	0.0	0.0	1.00	100.0%	0.75	0.75		
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0.1	0.0	0.79	0.0%	0.66	0.98	0.66	0.98
SDGE	**Total**	**0.2**	**0.2**	**0.95**	**74.4%**	**0.67**	**0.72**	**0.66**	**0.98**
MCE	PASS THROUGH	0.0	0.0	1.00	100.0%	0.86	0.86		
MCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.86**	**0.86**		
	Statewide	***13.2***	***7.1***	***0.54***	***52.3%***	***0.65***	***0.63***	***0.65***	***0.53***

*All Net Savings and NTG values presented above include the 0.05 Market Effects Adder.

Gross First Year Savings (MTherms)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PASS THROUGH	5,344	5,344	1.00	100.0%	
PGE	PGE - AG IRRIGATION	0	0			
PGE	PGE - PROCESS PUMPING VFD	0	0			
PGE	PGE - REFRIGERATION CASE LED LIGHTING	-48	-48	1.00	0.0%	1.00
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	1,452	813	0.56	0.0%	0.56
PGE	**Total**	**6,749**	**6,110**	**0.91**	**79.2%**	**0.55**
SCE	PASS THROUGH	-3	-3	1.00	100.0%	
SCE	SCE - PROCESS PUMPING VFD	0	0			
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0	0			
SCE	**Total**	**-3**	**-3**	**1.00**	**100.0%**	
SCG	PASS THROUGH	6,696	6,696	1.00	100.0%	
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	460	193	0.42	0.0%	0.42
SCG	**Total**	**7,156**	**6,889**	**0.96**	**93.6%**	**0.42**
SDGE	PASS THROUGH	189	189	1.00	100.0%	
SDGE	SDGE - PROCESS PUMPING VFD	0	0			
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0	0			
SDGE	**Total**	**189**	**189**	**1.00**	**100.0%**	
MCE	PASS THROUGH	1	1	1.00	100.0%	
MCE	**Total**	**1**	**1**	**1.00**	**100.0%**	
	Statewide	***14,091***	***13,185***	***0.94***	***86.8%***	***0.51***

Net First Year Savings (MTherms)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
PGE	PASS THROUGH	3,486	3,486	1.00	100.0%	0.65	0.65		
PGE	PGE - AG IRRIGATION	0	0						
PGE	PGE - PROCESS PUMPING VFD	0	0						
PGE	PGE - REFRIGERATION CASE LED LIGHTING	-31	-29	0.93	0.0%	0.65	0.60	0.65	0.60
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	901	487	0.54	0.0%	0.62	0.60	0.62	0.60
PGE	**Total**	**4,356**	**3,944**	**0.91**	**80.0%**	**0.65**	**0.65**	**0.62**	**0.60**
SCE	PASS THROUGH	-2	-2	1.00	100.0%	0.65	0.65		
SCE	SCE - PROCESS PUMPING VFD	0	0						
SCE	SCE - REFRIGERATION CASE LED LIGHTING	0	0						
SCE	**Total**	**-2**	**-2**	**1.00**	**100.0%**	**0.65**	**0.65**		
SCG	PASS THROUGH	4,651	4,651	1.00	100.0%	0.69	0.69		
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	303	116	0.38	0.0%	0.66	0.60	0.66	0.60
SCG	**Total**	**4,955**	**4,767**	**0.96**	**93.9%**	**0.69**	**0.69**	**0.66**	**0.60**
SDGE	PASS THROUGH	122	122	1.00	100.0%	0.65	0.65		
SDGE	SDGE - PROCESS PUMPING VFD	0	0						
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0	0						
SDGE	**Total**	**122**	**122**	**1.00**	**100.0%**	**0.65**	**0.65**		
MCE	PASS THROUGH	1	1	1.00	100.0%	0.93	0.93		
MCE	**Total**	**1**	**1**	**1.00**	**100.0%**	**0.93**	**0.93**		
	Statewide	***9,432***	***8,832***	***0.94***	***87.6%***	***0.67***	***0.67***	***0.63***	***0.60***

*All Net Savings and NTG values presented above include the 0.05 Market Effects Adder.

APPENDIX AB STANDARDIZED PER UNIT SAVINGS

Per Unit (Quantity) Gross Energy Savings (kWh)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
PGE	PGE - AG IRRIGATION	0	0.0%	0.0%	20.0	665.0	33.3	33.3
PGE	PGE - PROCESS PUMPING VFD	0	0.0%	0.0%	7.9	983.7	136.2	136.2
PGE	PGE - REFRIGERATION CASE LED LIGHTING	0	0.0%	0.0%	4.0	216.5	54.1	54.1
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	0.3	0.0	0.0
PGE	PASS THROUGH	1	0.3%		16.3	401.8	37.6	37.6
PGE	PGE - PROCESS PUMPING VFD	1	0.0%		5.0	166,881.5	33,376.3	33,376.3
SCE	SCE - PROCESS PUMPING VFD	0	0.0%	0.0%	6.7	709.1	120.6	120.6
SCE	PASS THROUGH	1	0.0%		3.9	2,767.5	530.7	530.7
SCE	SCE - REFRIGERATION CASE LED LIGHTING	1	0.0%		4.0	0.0	0.0	0.0
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	0.0	0.0	0.0
SCG	PASS THROUGH	1	0.4%		6.5	0.6	0.1	0.1
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0	0.0%	0.0%	4.0	1,680.6	420.1	420.1
SDGE	PASS THROUGH	1	0.0%		4.5	365.2	73.6	73.6
SDGE	SDGE - PROCESS PUMPING VFD	1	0.0%		10.0	2,266.5	226.6	226.6
MCE	PASS THROUGH	1	0.0%		8.2	5,970.5	502.5	502.5

Per Unit (Quantity) Gross Energy Savings (Therms)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
PGE	PGE - AG IRRIGATION	0	0.0%	0.0%	20.0	0.0	0.0	0.0
PGE	PGE - PROCESS PUMPING VFD	0	0.0%	0.0%	7.9	0.0	0.0	0.0
PGE	PGE - REFRIGERATION CASE LED LIGHTING	0	0.0%	0.0%	4.0	-14.4	-0.9	-3.6
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	38.0	1.9	1.9
PGE	PASS THROUGH	1	0.3%		16.3	50.7	5.6	5.6
PGE	PGE - PROCESS PUMPING VFD	1	0.0%		5.0	0.0	0.0	0.0
SCE	SCE - PROCESS PUMPING VFD	0	0.0%	0.0%	6.7	0.0	0.0	0.0
SCE	PASS THROUGH	1	0.0%		3.9	-0.5	-0.1	-0.1
SCE	SCE - REFRIGERATION CASE LED LIGHTING	1	0.0%		4.0	0.0	0.0	0.0
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	37.0	1.8	1.8
SCG	PASS THROUGH	1	0.4%		6.5	11.3	1.4	1.4
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0	0.0%	0.0%	4.0	0.0	0.0	0.0
SDGE	PASS THROUGH	1	0.0%		4.5	61.2	5.5	5.5
SDGE	SDGE - PROCESS PUMPING VFD	1	0.0%		10.0	0.0	0.0	0.0
MCE	PASS THROUGH	1	0.0%		8.2	2.9	3.2	3.2

Per Unit (Quantity) Net Energy Savings (kWh)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
PGE	PGE - PROCESS PUMPING VFD	0	0.0%	0.0%	7.9	430.4	61.8	61.8
PGE	PGE - REFRIGERATION CASE LED LIGHTING	0	0.0%	0.0%	4.0	141.6	35.4	35.4
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	0.2	0.0	0.0
PGE	PASS THROUGH	1	0.3%		16.3	266.6	24.9	24.8
PGE	PGE - AG IRRIGATION	1	0.0%		20.0	432.3	21.6	21.6
PGE	PGE - PROCESS PUMPING VFD	1	0.0%		8.6	5,752.4	1,150.5	1,150.5
SCE	SCE - PROCESS PUMPING VFD	0	0.0%	0.0%	6.7	375.4	63.3	63.3
SCE	PASS THROUGH	1	0.0%		3.9	1,818.9	346.6	346.6
SCE	SCE - PROCESS PUMPING VFD	1	0.0%		4.0	484.3	120.4	120.4
SCE	SCE - REFRIGERATION CASE LED LIGHTING	1	0.0%		4.0	0.0	0.0	0.0
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	0.0	0.0	0.0
SCG	PASS THROUGH	1	0.4%		6.5	0.4	0.1	0.1
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0	0.0%	0.0%	4.0	1,652.6	413.1	413.1
SDGE	PASS THROUGH	1	0.0%		4.5	247.6	48.7	48.7
SDGE	SDGE - PROCESS PUMPING VFD	1	0.0%		10.0	1,699.9	170.0	170.0
MCE	PASS THROUGH	1	0.0%		8.2	5,120.0	432.1	432.1

Per Unit (Quantity) Net Energy Savings (Therms)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
PGE	PGE - PROCESS PUMPING VFD	0	0.0%	0.0%	7.9	0.0	0.0	0.0
PGE	PGE - REFRIGERATION CASE LED LIGHTING	0	0.0%	0.0%	4.0	-8.7	-0.5	-2.2
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	22.7	1.1	1.1
PGE	PASS THROUGH	1	0.3%		16.3	33.0	3.6	3.6
PGE	PGE - AG IRRIGATION	1	0.0%		20.0	0.0	0.0	0.0
PGE	PGE - PROCESS PUMPING VFD	1	0.0%		8.6	0.0	0.0	0.0
SCE	SCE - PROCESS PUMPING VFD	0	0.0%	0.0%	6.7	0.0	0.0	0.0
SCE	PASS THROUGH	1	0.0%		3.9	-0.3	-0.1	-0.1
SCE	SCE - PROCESS PUMPING VFD	1	0.0%		4.0	0.0	0.0	0.0
SCE	SCE - REFRIGERATION CASE LED LIGHTING	1	0.0%		4.0	0.0	0.0	0.0
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	22.1	1.1	1.1
SCG	PASS THROUGH	1	0.4%		6.5	7.7	1.0	1.0
SDGE	SDGE - REFRIGERATION CASE LED LIGHTING	0	0.0%	0.0%	4.0	0.0	0.0	0.0
SDGE	PASS THROUGH	1	0.0%		4.5	39.7	3.6	3.6
SDGE	SDGE - PROCESS PUMPING VFD	1	0.0%		10.0	0.0	0.0	0.0
MCE	PASS THROUGH	1	0.0%		8.2	5.0	3.0	3.0

APPENDIX AC RESPONSE TO RECOMMENDATIONS

EM&V Impact Study Recommendations
Study Title: 2018 Small and Medium Sector ESPI Impact Evaluation
Study Manager: CPUC

ID	PA	Section	Conclusion	Recommendation	Disposition (Accepted, Rejected, or Other)	Disposition Notes (e.g. Description of specific program change or Reason for rejection or Under further review)
Refrigeration Case LED Lighting Measures						
RL1	PG&E	Section 5	By separately claiming savings for the refrigeration case lighting measure in addition to the new case, savings associated with the new efficient lighting in the case are double-counted	The program's application review and verification process should ensure that project savings are not being double counted for any participants receiving incentives in any given program or across any set of programs.		
RL2	SDG&E	Section 5	Ex-post hours of operation generally support the assumed HOU used in the workpapers and deemed savings for the refrigerated case LED measures.	Utilities should continue using the HOU currently being used in the ex-ante calculations. One possible exception is to develop a measure code for buildings that are open 24/7.		
RL3	PG&E, SDG&E	Section 5	Evaluators concluded the remaining useful life of the refrigerated case, or 1/3 of the case's 12 year EUL.	The Evaluation Team recommends this measure be considered accelerated replacement with an EUL equal to the remaining useful life of the refrigerated case itself, or 4 years.		
RL4	SDG&E, SCE	Section 6	In general, Refrigerated LED Case Lighting measures exhibited medium program influence levels.	As Refrigerated LED Case Lighting measures continue to be incented by SCE and SDG&E, free ridership should be monitored on an ongoing basis.		

EM&V Impact Study Recommendations
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ID	PA	Section	Conclusion	Recommendation	Disposition (Accepted, Rejected, or Other)	Disposition Notes (e.g. Description of specific program change or Reason for rejection or Under further review)
Process Pumping VFD Measures						
PPVFD1a	PG&E, SCE, SDG&E	Section 5	The workpaper-based estimates of savings currently draw results from a database of legacy custom and new construction projects involving pump VFDs.	Workpaper updates for agricultural pump VFD measures that are scheduled for 2020 should take into consideration the broad results of this evaluation and any trends observed in order to best improve the accuracy of future workpaper estimates.		
PPVFD1b	PG&E, SCE, SDG&E	Section 5	The workpaper-based estimates of savings currently draw results from a database of legacy custom and new construction projects involving pump VFDs.	The program's application and review process should be expanded to increase the range of irrigation pump performance information captured in the ex-ante tracking databases.		
PPVFD1c	PG&E, SCE, SDG&E	Section 5	The workpaper-based estimates of savings currently draw results from a database of legacy custom and new construction projects involving pump VFDs.	The PAs should consider using an enhanced measure savings algorithm that provides for some reasonable level of customization for relevant input parameters.		
PPVFD2a	PG&E, SCE and SDG&E	Section 5	By far the most valuable data source supporting ex-post gross impact accuracy was the AMI data that the utilities provided to the evaluation team.	The PAs should leverage AMI data for the purposes of deriving workpaper-based impact estimates.		

EM&V Impact Study Recommendations
Study Title: 2018 Small and Medium Sector ESPI Impact Evaluation
Study Manager: CPUC

ID	PA	Section	Conclusion	Recommendation	Disposition (Accepted, Rejected, or Other)	Disposition Notes (e.g. Description of specific program change or Reason for rejection or Under further review)
PPVFD2b	PG&E, SCE and SDG&E	Section 5	By far the most valuable data source supporting ex-post gross impact accuracy was the AMI data that the utilities provided to the evaluation team.	The PAs should make use of AMI data to screen projects for eligibility based on pump run time being greater than the required 1,000 hours.		
PPVFD3	PG&E, SCE, SDG&E	Section 5	Although the evaluation did not contest the utility-derived standard practice baseline, nor conduct additional research surrounding standard practice for VFDs in pumping systems, there are certainly irrigation applications where there is a high likelihood that a VFD would have been installed in the absence of the program, given many non-energy benefits of VFD operations.	The workpaper baseline condition should be revisited in advance of completion of 2020 workpaper updates for the agricultural pump VFD measure.		
PPVFD4	PG&E, SCE	Section 5	Pumps in the sample frequently failed to comply with various program eligibility requirements. These requirements are generally in place to ensure each VFD installation will produce a desirable minimum level of program savings and/or produce savings at all.	The program's application and review process should be enhanced to better screen projects against eligibility requirements and exclusions, and verification should be performed to ensure that installations claimed are both valid and accurately represent the associated irrigation system.		
PPVFD5	PG&E, SCE, SDG&E	Section 5	Pumps that do not operate at substantially reduced speeds and flow should not be eligible for program VFD incentives.	The program eligibility requirements should be strengthened to exclude all such pumps from participation.		

EM&V Impact Study Recommendations
Study Title: 2018 Small and Medium Sector ESPI Impact Evaluation
Study Manager: CPUC

ID	PA	Section	Conclusion	Recommendation	Disposition (Accepted, Rejected, or Other)	Disposition Notes (e.g. Description of specific program change or Reason for rejection or Under further review)
PPVFD6	PG&E, SCE	Section 5	Across both the PG&E and SCE samples (49 pumps), there were only two pumps where evaluation-based EUL assignments matched those applied by the utilities in the tracking system.	The PAs should apply greater due diligence in populating tracking system-based EULs and better classify participating projects as new pump installations versus retrofit add-on installations.		
PPVFD7	PG&E, SCE, SDG&E	Section 5	The Process Pumping VFD measure's average ex-post NTG ratio of 0.41 suggests a medium-low level of program influence and corresponding medium-high level of free ridership.	Given the medium-low program influence level, the programs should monitor free ridership on an ongoing basis.		

EM&V Impact Study Recommendations
Study Title: 2018 Small and Medium Sector ESPI Impact Evaluation
Study Manager: CPUC

ID	PA	Section	Conclusion	Recommendation	Disposition (Accepted, Rejected, or Other)	Disposition Notes (e.g. Description of specific program change or Reason for rejection or Under further review)
Agricultural Irrigation Measures						
AG1	PG&E	Section 5	Nine of the 17 sampled projects in this evaluation were ineligible for program participation because each of these nine farms grow deciduous crops.	The program's application and review process should be enhanced to screen projects against all eligibility criteria, and selected auditing or verification should be performed to ensure that only valid installations are claimed.		
AG2	PG&E	Section 5	IOU models for estimating savings were found to lack key parameters that are critical for accurately characterizing irrigation needs and resulting savings.	Future workpaper revisions, ex-ante models, and impact claims should incorporate recent evaluation data and results.		

EM&V Impact Study Recommendations
Study Title: 2018 Small and Medium Sector ESPI Impact Evaluation
Study Manager: CPUC

ID	PA	Section	Conclusion	Recommendation	Disposition (Accepted, Rejected, or Other)	Disposition Notes (e.g. Description of specific program change or Reason for rejection or Under further review)
Tankless Water Heaters						
TWH1	PG&E, SCG	Section 5	The tankless water heater measure's distributor-facing design results in inconsistent or missing tracking data.	For any offering where the IOUs are providing support and incentives through the state's energy efficiency programs, such as the tankless water heater measure, program administrators should require participating distributors and partnering contractors to collaboratively collect and submit basic information for each customer ultimately receiving the equipment or other support.		
TWH2	PG&E, SCG	Section 5	Three of the 25 evaluated projects were determined to result in zero savings due to non-install or ineligibility.	For any measures delivered midstream through distributor rebates, such as the tankless water heater measure, the programs must require participating distributors and partnering contractors to submit more comprehensive installation documentation (e.g., invoices, commissioning reports) and photographs to prove measure installation, quantity, size, fuel source, and efficiency.		

EM&V Impact Study Recommendations
Study Title: 2018 Small and Medium Sector ESPI Impact Evaluation
Study Manager: CPUC

ID	PA	Section	Conclusion	Recommendation	Disposition (Accepted, Rejected, or Other)	Disposition Notes (e.g. Description of specific program change or Reason for rejection or Under further review)
TWH3a	PG&E, SCG	Section 5	11 of the 25 evaluated projects applied incorrect reported per-unit savings values or misclassified the type of facility where the measure was installed.	Deemed measures in the small-medium commercial sector should conform with workpapers active at the time of installation, and claimed savings should reflect the product of workpaper-recommended unit energy savings (UES) with the total installed quantity or size for the most appropriate facility type.		
TWH3b	PG&E, SCG	Section 5	Active workpapers for the TWH measure in PY2018 recommended an NTGR of 0.60. However, evaluators found that 19% of PY2018 tracking records reflected an NTGR of 0.60, 80% an NTGR of 0.65, and 1% an NTGR of 0.90.	Deemed measures in the small-medium commercial sector should conform with workpapers active at the time of installation, and applied NTGRs should consistently reflect the NTGRs specified by workpapers active at the time of project application.		
TWH4	PG&E, SCG	Section 5	We found differences in tankless water heater efficiency and temperature increase as compared with workpaper assumptions.	Future workpaper revisions, ex-ante models and impact claims should incorporate recent evaluation data and results.		

APPENDIX A SMALL COMMERCIAL SECTOR TELEPHONE SURVEY INSTRUMENTS

- Participant Telephone Survey Instrument
- Vendor Telephone Survey Instrument

PARTICIPANT TELEPHONE SURVEY INSTRUMENT

Participant Survey for CPUC **PY2018 Small Commercial Evaluation**		
	INTRODUCTION AND FINDING CORRECT RESPONDENT	
OUTCOME1	This is %n calling on behalf of the CPUC, from Pacific Market Research. THIS IS NOT A SALES CALL NOR A SERVICE CALL. May I please speak with ...<%CONTACT> ...<%OLDCONTACT> ... <%BUSINESS> ... the person at your organization that is most knowledgeable about your participation in <%UTILITY>'s <%PROGRAM> program. !___[IF NEEDED]...This is a fact-finding survey only, authorized by the California Public Utilities Commission.	
1	Yes (go to next screen)	Continue
2	Make appointment	Make appt and record time
3	Busy/engaged	Record Response and T&T
4	No Answer	Record Response and T&T
6	Refused	Record Response and T&T
6	Disconnected	Record Response and T&T
7	Answering Machine - no message	Record Response and T&T
8	Duplicate	Record Response and T&T
9	DRNA	Record Response and T&T
10	Disability	Record Response and T&T
11-12	Language Barriers	Record Response and T&T
13	Answering Machine - left message	Record Response and T&T
14	NO SCREEN - Participant	Record Response and T&T
15	Hang up	Record Response and T&T
16	Residence	Record Response and T&T
17	Fax	Record Response and T&T
18	Quota full	Record Response and T&T
19	Wrong Address	Record Response and T&T
20	Home office	Record Response and T&T
21	Max attempts	Record Response and T&T
24	General callback	Record Response and T&T
25	Name/Number changed	Record Response and T&T

Thank & Terminate PBLOCK NO_ONE	Thank you for your time. For this study, we need to speak to someone about your organization's installation of energy efficient equipment that your organization installed through <%UTILITY>'s <%PROGRAM> program.	END
Q1B	[IF YOU ARE TRANSFERRED TO ANOTHER PERSON OTHER THAN THE BEST CONTACT] Who would be the person most familiar about your organization's participation in <%UTILITY>'S <%PROGRAM> program? [ENTER NEW CONTACT NAME AND MOVE ON]	
	[IF NEEDED] This is not a sales call.	
	[IF NEEDED] This is a fact-finding survey only, and responses will not be connected with your firm in any way. The California Public Utilities Commission wants to better understand how businesses think about and manage their energy consumption.	
77	There is no one here who can help you	T&T
1	Continue Q1B until you find appropriate contact person, record as &NEW CONTACT NAME	Intro3:s
Intro3:S	[IF BEST CONTACT IS AVAILABLE] Hello, my name is _____________%n_____________ and I am calling on behalf of the California Public Utilities Commission from Pacific Market Research. THIS IS NOT A SALES CALL. We are interested in speaking with the person most knowledgeable about your organization's participation in ... <%UTILITY>'s <%PROGRAM> program during 2018......I was told that would be you. ...Your organization participated in <%UTILITY>'s <%PROGRAM> by installing energy saving equipment in 2018. You should have received an email recently that explained the evaluation process and provided a letter from the CPUC validating this study.	
	Through this program, your organization installed.... <%CUSTOM_MEASURE> on <CUST_INSTALL_DATE>...<CUST_PAID_DATE>... <%UNITS_1> ... <%MEASURE_1> on <MEASURE_1_DATE> <%UNITS_2> ... <%MEASURE_2> on <MEASURE_2_DATE> <%UNITS_3> ... <%MEASURE_3> on <MEASURE_3_DATE> Are you the best person to speak to about your organization's participation in this program?	
1	Yes	Person:s
2	No, there is someone else	Intro3:s
3	No and I don't know who to refer you to	Appoint
5	Property management company handles this	PMNAME
99	Don’t know/refused	T&T

Ext	Is there a phone extension or phone number you recommend we use when we call back?	
77	Record Extension or Phone Number, &PHONE	Thank&Terminate
88	Refused	Thank&Terminate
99	Don't know	Thank&Terminate
PMNAME	May I have the name and contact information of your property management company?	
1	Yes - RECORD	Record Response and T&T
2	No	Thank&Terminate
88	Refused	Thank&Terminate
99	Don't Know	Thank&Terminate
Appoint	[IF RECOMMENDED CONTACT IS NOT CURRENTLY AVAILABLE] When would be a good day and time for us to call back?	
77	Record day of the week, time of day and date to call back, as &APPOINT	Record Response and T&T
88	Refused	Intro3(99)
99	Don't know	Intro3(99)
	If Person(3)	
Intro3(99)	Thank you for your time. We need to speak with the person at your organization that is most familiar with this facility's energy using equipment. Those are all of the questions I have for you today.	Abandoned User30
PBLOCK Hi	Who would be the person at this location who is most knowledgeable about this facility's energy using equipment? [Enter New Contact Name and move on.]	
77	Record Name, as &CONTACT	May_I
88	Refused	Thank&Terminate
99	Don't know	Intro3(99)
May_I	May I speak with him/her?	
77	Yes	Intro3:s
88	No (not available right now@, set cb)	Abandoned Appointment

PERSON:s	According to our records, your organization participated in <%UTILITY>'s <%PROGRAM> program by installing energy saving equipment around ... <%DEEM_PAID_DATE1> <%CUST_PAID_DATE> Through this program, your organization installed.... <%CUSTOM_MEASURE> on <CUST_INSTALL_DATE>...<CUST_PAID_DATE>... <%UNITS_1> ... <%MEASURE_1> on <MEASURE_1_DATE> <%UNITS_2> ... <%MEASURE_2> on <MEASURE_2_DATE> <%UNITS_3> ... <%MEASURE_3> on <MEASURE_3_DATE> Are you the person most knowledgeable about your organization's participation in ...<%UTILITY>'s <%PROGRAM> Program?	
1	Yes	Continue
2	Yes, need to make appointment	Appoint
4	No, but I will give you a name	Thank&Terminate
99	No one knows about the energy using equipment	Thank&Terminate
	If you need to provide validation for this survey, provide the following contact name and number: Mona Dzvova, California Public Utilities Commission, Energy Division, (415) 703-1231, and the following website: **www.cpuc.ca.gov/eevalidation**	
DISPLAY	Before we start, I would like to inform you that for quality control purposes, this call may be monitored by my supervisor. Today we're conducting a very important study on the energy needs and perceptions of organizations like yours. We are interested in how organizations like yours think about and manage their energy consumption. Your input will allow the California Public Utilities Commission to build and maintain better energy savings programs for customers like you. And we would like to remind you, your responses will not be connected with your organization in any way.	

	SCREENER	
VERIFY	For verification purposes only, may I please have your name?	
77	Get name	Scrn_Addr
88	Refused	Scrn_Addr
99	Don't know	Scrn_Addr
DISPLAY	For the sake of expediency, I will refer to ....<%UTILITY>'s <%PROGRAM> ...program as the PROGRAM.	
Scrn_Addr	First, I'd like to ask you a few questions about your organization and facility. Our records show your organization is located at %ADDRESS in %CITY. Is that correct?	
	[CONTINUE IF ADDRESS REPORTED BY RESPONDENT IS SIMILAR ENOUGH]	
1	Yes	Bus_Name
2	No	CORRECT
88	Refused	COMMENT
99	Don't Know	COMMENT
COMMENT	We were attempting to reach <%UTILITY>'s customer at <%ADDRESS> and since you cannot confirm this address, those are all the questions that we have for you today, on behalf of the California Public Utilities Commission, thank you for your time.	
CORRECT	May I have your correct address?	
%CORRECT	Corrected Address	COMPARE
COMPARE	Are these addresses similar or totally different? Computer Address - %ADDRESS Corrected Address - &CORRECT	
1	Similar	Bus_Name
2	Totally Different	COMMENT2
COMMENT2	We were attempting to reach the <%UTILITY> customer at <%ADDRESS> in <%CITY> and since that does not match your address, then we must have mis-dialed the telephone number. Those are all the questions that we have for you today, on behalf of the California Public Utilities Commission. Thank you for your time and cooperation.	Thank and Terminate
BUS_NAME	Our records show your organization's name as: <%BUSINESS> <%CONTACT> <%OLDCONTACT>. Is that correct?	
1	Yes	INCENT
2	No	Bus_Correct
88	Refused	COMMENT
99	Don't Know	COMMENT

BUS_CORRECT	What is the correct name for your organization?	
&BUS_CORRECT	Corrected Business	INCENT
INCENT	What percentage of the cost of your rebated equipment was covered by the program?	
77	RECORD RESPONSE	A1gg
101	REFUSED	FM050
102	DON'T KNOW	A1gg
	IF INCENT <> 100 then ask; Else skip to FM050	
A1gg	What incentive amount did your organization receive from the program towards your energy efficient equipment installation?	
77	RECORD VERBATIM	FM050
88	Refused	FM050
99999	Don't know	FM050
FM050	What is the main business ACTIVITY at this facility? [DO NOT READ] (SINGLE RESPONSE)	V1
1	Offices (non-medical)	V1
2	Restaurant/Food Service	V1
3	Food Store (grocery/liquor/convenience)	V1
4	Agricultural (farms, greenhouses)	V1
5	Retail Stores	V1
6	Warehouse	V1
7	Health Care	V1
8	Education	V1
9	Lodging (hotel/rooms)	V1
10	Public Assembly (church, fitness, theatre, library, museum, convention)	V1
11	Services (hair, nail, massage, spa, gas, repair)	V1
12	Industrial (food processing plant, manufacturing)	V1
13	Laundry (Coin Operated, Commercial Laundry Facility, Dry Cleaner)	V1
14	Condo Assoc./Apartment Mgr (Garden Style, Mobile Home Park, High-rise, Townhouse)	V1
15	Public Service (fire/police/postal/military)	V1
77	OPEN\Record Other Service Shop	V1
88	Refused	V1
99	Don’t know	V1

	ROLE OF CONTRACTORS	
V1	Did you use a contractor/vendor to install any of the energy efficient measures that were purchased through the program?	
1	Yes	V2
2	No	AP9
88	Refused	AP9
99	Don't Know	AP9
	If V1 = 1 then ask; else skip to AP9	
V2	How did you come into contact with the contractor/vendor?	
1	They contacted you	V2b
2	You contacted them	V3
3	You had worked with them before	V2a
77	OTHER - Record	V3
88	Refused	V3
99	Don't Know	V3
	Ask if V2 = 3; else skip to V2b	
V2a	In relation to this project, did the vendor/contractor approach you about your energy efficient equipment retrofit/installation?	
1	Yes	V2ab
2	No	V3
88	Refused	V3
99	Don't Know	V3
	Ask if V2a=1 AND <PROGRAM>= IDEEA365 **else skip to V2b**	
V2ab	Did the VENDOR recommend purchasing high efficiency equipment instead of standard efficiency equipment?	
1	Yes	V2b
2	No	V2b
88	Refused	V2b
99	Don't Know	V2b
	Ask if V2 = 1 or V2a = 1; else skip to V3	
V2b	On a scale of 0 - 10, with 0 being NOT AT ALL LIKELY and 10 is VERY LIKELY, how likely is it that your organization would have installed this new equipment had the contractor/vendor not contacted you?	
1	0-10 response	V3
88	Refused	V3
99	Don't Know	V3

V3	Did the contractor/vendor tell you about or recommend the program?	
1	Yes	V3A
2	No	AP9
88	Refused	AP9
99	Don't Know	AP9
	Ask if V3=1 AND <PROGRAM>= IDEEA365 **else skip to V4**	
V3a.	Did you install what your VENDOR recommended?	
1	Yes	V4
2	No	V4
88	Refused	V4
99	Don't Know	V4
	Ask if V3 = 1; else skip to AP9	
V4	Prior to coming into contact with the contractor/vendor, did your organization have plans to replace/install this equipment?	
1	Yes	V4a
2	No	V4a
88	Refused	V4a
99	Don't Know	V4a
V4a	Using the same scale of 0 - 10 as before, how likely is it that your organization would have installed the new energy efficient equipment had the contractor/vendor not recommended it?	
1	0-10 response	V4b
88	Refused	V4b
99	Don't Know	V4b
V4b	Using the same scale, how likely is it that your organization would have installed the energy efficient equipment with the same level of efficiency if the contractor/vendor had not recommended to do so?	
1	0-10 response	V40
88	Refused	V40
99	Don't Know	V40
V40	On a scale of 0 - 10, with 0 being not at all important and 10 being very important, how important was the input from the contractor you worked with in deciding which specific equipment to install?	
1	0-10 response	AP9
88	Refused	AP9
99	Don't Know	AP9

	PROGRAM AWARENESS	
	Next, I'd like to ask you about various energy efficiency programs and what influenced your program participation.	
AP9	How did you FIRST learn about <%UTILITY>'s program? [DO NOT READ ANSWERS]	
1	Bill insert	AP9a
2	Program literature	AP9a
3	Account representative	AP9a
4	Program approved vendor	AP9a
5	Program representative	AP9a
6	Utility or program website	AP9a
7	Trade publication	AP9a
8	Conference	AP9a
9	Newspaper article	AP9a
10	Word of mouth	AP9a
11	Previous experience with it	AP9a
12	Company used it at other locations	AP9a
13	Contractor	AP9a
14	Result of an audit	AP9a
15	Part of a larger expansion or remodeling effort	AP9a
77	Other (RECORD VERBATIM)	AP9a
88	Refused	A1b
99	Don't know	A1b
	If AP9 in (1-77) then ask; else skip to N33	
AP9a	How ELSE did you learn about <%UTILITY>'s program? [DO NOT READ LIST, ACCEPT MULTIPLES]	
1	Bill insert	N33
2	Program literature	N33
3	Account representative	N33
4	Program approved vendor	N33
5	Program representative	N33
6	Utility or program website	N33
7	Trade publication	N33
8	Conference	N33
9	Newspaper article	N33
10	Word of mouth	N33
11	Previous experience with it	N33
12	Company used it at other locations	N33
13	Contractor	N33
14	Result of an audit	N33
15	Part of a larger expansion or remodeling effort	N33

66	No other sources	N33
77	Other (RECORD VERBATIM)	N33
88	Refused	N33
99	Don’t know	N33
	If AP9 = 3 or AP9A = 3 then ask; else skip to NEXT SECTION (MEASURE BATTERY)	
N33	You mentioned that you have a Utility or Program Administrator Account Rep. Can you give me his or her name? !!___Do you have his/her email address? !___Do you have a phone number for him/her? !___Do you have a cell phone number for him/her?\,	
77	RECORD NAME, Phone, Email, etc.	NEXT SECTION (MEASURE BATTERY)
88	Refused	NEXT SECTION (MEASURE BATTERY)
99	Don't know	NEXT SECTION (MEASURE BATTERY)
	REFRIGERATION CASE LED LIGHTING EQUIPMENT	
	Ask if REFLEDLIGHTING = 1; else skip to NET TO GROSS BATTERY	
Comment	One way that organizations like yours can reduce their energy use is to install more energy efficient lighting equipment. I would like to ask you about the refrigeration case LED lighting you recently installed as part of your participation in <%UTILITY>'s program.	LED99
	CONTINUE IF REFLEDLIGHTING = 1	
LED99	Our records indicate that your organization installed REFRIGERATION CASE LED LIGHTING EQUIPMENT through the program. It is described as <%REFLEDLIGHTING_MEASURE>. Is this correct?	
1	Yes	LED100
2	No	DISPLAY
88	Refused	DISPLAY
99	Don't know	DISPLAY
	Ask if LED99 = 2, 88, 99; else skip to LED100.	
DISPLAY	We cannot continue this study unless we can speak to someone at your organization that is familiar with the refrigeration case LED lighting equipment that was installed through the program. Is there another person we can speak to?	Go to next person and loop back to LED99

	Ask if LED99 = 1; else T&T	
LED100	What types and sizes [IF NEEDED: bulb lengths] of Refrigeration Case LED lighting were installed as part of this installation?	<$2>
77	Other (PLEASE SPECIFY)	LED101C ($4)
88	Refused	LED101C (_4)
99	Don't know	LED101C (_4)
LED101C (_4)	Were any of the program provided <REFLEDLIGHTING_MEASURE> placed/installed at another facility? If so, what percentage would you estimate?	
1	Yes, #record percentage	LED101D <_5>
2	No	LED101D <_5>
88	Refused	LED101D <_5>
99	Don't know	LED101D <_5>
LED101D (_5)	What type of lighting equipment was removed and replaced when you installed <REFLEDLIGHTING_MEASURE> through the program?	
1	T12 Linear Fluorescent <= 5 ft Unit	LED101F <_7>
2	T12 Linear Fluorescent > 5 ft Unit	LED101F <_7>
3	T8 Linear Fluorescent <= 5 ft Unit	LED101F <_7>
4	T8 Linear Fluorescent > 5 ft Unit	LED101F <_7>
5	LED Case Lighting <= 5 ft Unit	LED101F <_7>
6	LED Case Lighting > 5 ft Unit	LED101F <_7>
66	Did not replace anything - new equipment	OP1
77	Other (PLEASE SPECIFY)	LED101F <_7>
88	Refused	LED101F <_7>
99	Don't know	LED101F <_7>
	Ask if LED101D <_5> DOES NOT EQUAL 66; else skip to OP1	
LED101F (_7)	Approximately how old was the Refrigerator Case lighting that was removed and replaced with <REFLEDLIGHTING_MEASURE>? Would you say...	
1	Less than 5 years old	LED101G <_8>
2	Between 5 and 10 years old	LED101G <_8>
3	Between 10 and 15 years old	LED101G <_8>
4	More than 15 years old	LED101G <_8>
88	Refused	LED101G <_8>
99	Don't know	LED101G <_8>

LED101G (_8)	How would you describe the condition of the removed Refrigerator Case lighting equipment? Would you say they were in…	
1	Poor condition	LED101H <_9>
2	Fair condition	LED101H <_9>
3	Good condition	LED101H <_9>
88	Refused	LED101H <_9>
99	Don’t know	LED101H <_9>
LED101H (_9)	Approximately what percentage of the Refrigerator Case lighting that was removed and replaced was broken or not working prior to installing <REFLEDLIGHTING_MEASURE>?	
%	Percent	LED101I (_10A)
88	Refused	LED101I (_10A)
99	Don't know	LED101I (_10A)
LED101I (_10A)	Did you replace the Refrigerator Case at the same time as you installed the <REFLEDLIGHTING_MEASURE> through the PROGRAM?	
1	Yes	OP1
2	No	LED101I (_10)
88	Refused	LED101I (_10)
99	Don't know	LED101I (_10)
LED101I (_10)	Approximately how old are the Refrigerator Cases with the lighting that was removed and replaced with <_2>? Would you say...	
1	Less than 5 years old	LED101J (_11)
2	Between 5 and 10 years old	LED101J (_11)
3	Between 10 and 15 years old	LED101J (_11)
4	More than 15 years old	LED101J (_11)
88	Refused	LED101J (_11)
99	Don't know	LED101J ($11)
LED101J ($11)	How many years do you anticipate are left in the refrigerated case itself until you will replace the entire case?	
# Yrs	RECORD Number of years left	OP1
88	Refused	OP1
99	Don't know	OP1

Operating Schedule for Refrigeration Case Lighting		
DISPLAY	The next few questions are to help us get a full understanding of the hours of operation for the refrigeration display case lighting.	
OP1	Does the refrigeration display case lighting operate 24 hours a day, 7 days a week?	
1	Yes	OP5
2	No	OP2
88	Refused	OP5
99	Don't know	OP5
OP2	Are there certain days of the week when the refrigeration display case lighting operates less than 24 hours?	
1	Yes	OP3
2	No	OP5
88	Refused	OP5
99	Don't know	OP5
OP3	Which days are they [IF NEEDED: when the refrigeration display case lighting operates less than 24 hours]?	
1	Monday	OP4
2	Tuesday	OP4
3	Wednesday	OP4
4	Thursday	OP4
5	Friday	OP4
6	Saturday	OP4
7	Sunday	OP4
88	Refused	OP5
99	Don't know	OP5
[FOR EACH DAY MENTIONED IN OP3, ASK]		
OP4	What hours does the refrigeration display case lighting operate on those days, in terms of the starting and ending times?	
1	Monday starting/ending hours [RECORD]	OP5
2	Tuesday starting/ending hours [RECORD]	OP5
3	Wednesday starting/ending hours [RECORD]	OP5
4	Thursday starting/ending hours [RECORD]	OP5
5	Friday starting/ending hours [RECORD]	OP5
6	Saturday starting/ending hours [RECORD]	OP5
7	Sunday starting/ending hours [RECORD]	OP5
88	Refused	OP5
99	Don't know	OP5

OP5	Does the refrigeration display case lighting schedule vary by the type of product stored in the refrigerated cases?	
1	Yes	OP5a
2	No	OP6
88	Refused	OP6
OP5a	Please explain [IF NEEDED: how the lighting schedule varies by the type of product stored in the refrigerated cases].	
77	RECORD VERBATIM	OP6
88	Refused	OP6
99	Don't know	OP6
OP6	Do you lower the level of illumination in the refrigeration display cases at certain times?	
1	Yes	OP6a
2	No	SP1
88	Refused	SP1
OP6a	What approach do you use to lower the level of illumination in the refrigeration display cases at certain times? [IF NEEDED: what technology do you use?]	
77	RECORD VERBATIM	SP1
88	Refused	SP1
99	Don't know	SP1
LEDs as Standard Practice		
SP1	Do you consider LED refrigerator case lighting to be standard practice for firms like yours? [IF NEEDED: by this, we mean that the majority of firms like yours install LED refrigerator case lighting on a routine basis either at the time of equipment replacement or on an accelerated schedule.}	
1	Yes	SP1a
2	No	SP1b
88	Refused	NTG BATTERY
SP1a	Why do you consider LED refrigerator case lighting to be standard practice for firms like yours?	
77	RECORD VERBATIM	NTG BATTERY
88	Refused	NTG BATTERY
99	Don't know	NTG BATTERY
SP1b	What do you consider to be standard practice when replacing lighting in refrigerator cases?	
77	RECORD VERBATIM	NTG BATTERY
88	Refused	NTG BATTERY
99	Don't know	NTG BATTERY

PROCESS PUMPING VFDs

IF PROCPUMPVFD =1 THEN ASK, ELSE SKIP TO NTG BATTERY

Comment	One way that organizations like yours can reduce their energy use is to install variable frequency drive flow controls on pumps used for irrigation. Throughout this survey I'll refer to this equipment as VFD flow controls. I would like to ask you about the VFD flow controls you recently installed as part of your participation in <%UTILITY>'s program.	VFD99
VFD99	Our records indicate that your organization installed VFD FLOW CONTROLS through the PROGRAM. More specifically, you installed <PROCPUMPVFD_MEASURE>. To the best of your knowledge is this correct?	
1	Yes	VFD100
2	No	DISPLAY
88	Refused	DISPLAY
99	Don't know	DISPLAY
	Ask if VFD99 = 2, 88, 99; else skip to VFD100.	
DISPLAY	We cannot continue this study unless we can speak to someone at your organization that is familiar with the VFD flow controls installed through the program. Is there another person we can speak to?	Go to next person and loop back to VFD99
	Ask if VFD99 = 1; else NET TO GROSS BATTERY	
VFD100	According to our records you installed VFD flow controls on a <PUMP_TYPE> pump with a motor size of <HORSEPOWER> horsepower. Is this correct?	
1	Yes	VFD101D
2	No	VFD100A
77	Other (PLEASE SPECIFY)	VFD101D
88	Refused	VFD101D
99	Don't know	VFD101D

VFD100A	In your own words please correct our pumping system description as best you are able.	
77	Other (PLEASE SPECIFY)	VFD101D
88	Refused	VFD101D
99	Don't know	VFD101D
VFD101D	Along with the new VFD flow controls, was a new pump also installed at the same time? [PROBE TO FIND CORRECT RESPONSE BELOW]	
1	Replaced existing pump (new pump)	VFD102A
2	Added a new pump	VFD102A
3	Added VFD to an existing pump (retained existing pump)	VFD101F
88	Refused	VFD102A
99	Don't know	VFD102A
	Ask if VFD101D EQUALS 3; else skip to VFD102A	
VFD101F	Approximately how old is the pump being controlled by the VFD flow controls? Would you say...	
1	Less than 5 years old	VFD101G
2	Between 5 and 10 years old	VFD101G
3	Between 10 and 15 years old	VFD101G
4	More than 15 years old	VFD101G
77	Enter age in years (PLEASE SPECIFY)	VFD101G
88	Refused	VFD101G
99	Don't know	VFD101G
VFD101G	How would you describe the condition of the pump being controlled by the VFD flow controls? Would you say it is in…	
1	Poor condition	VFD101J
2	Fair condition	VFD101J
3	Good condition	VFD101J
88	Refused	VFD101J
99	Don’t know	VFD101J
VFD101J	How many years are left in the pump itself until you will replace it?	
# Yrs	RECORD Number of years left	VFD101K
88	Refused	VFD101K
99	Don't know	VFD101K
VFD101K	What type of pump flow controls were in place BEFORE the VFD was installed? [PROBE TO FIND CORRECT RESPONSE BELOW]	
1	None, pump was uncontrolled	VFD102
2	Throttle valve controls	VFD101L
3	VFD controls	VFD101L
77	Other (PLEASE SPECIFY)	VFD101L
88	Refused	VFD101L
99	Don't know	VFD101L

VFD101L	Approximately how old were the flow controls that you replaced with the VFD? Would you say...	
1	Less than 5 years old	VFD101M
2	Between 5 and 10 years old	VFD101M
3	Between 10 and 15 years old	VFD101M
4	More than 15 years old	VFD101M
77	Enter age in years (PLEASE SPECIFY)	VFD101M
88	Refused	VFD101M
99	Don't know	VFD101M
VFD101M	How would you describe the condition of the flow controls that you replaced with the VFD? Would you say the controls were…	
1	Not working	VFD102A
2	In poor condition	VFD102A
3	In fair condition	VFD102A
4	In good condition	VFD102A
88	Refused	VFD102A
99	Don't know	VFD102A
	Ask ALL	
VFD102A	What was the main reason you decided to install a VFD to control your pump flow?	
1	Existing controls were not functioning properly	VFD102D
2	Using alternative controls was not a feasible solution (such as throttling or running an uncontrolled pump)	VFD102D
3	The pump and VFD were sold as an integrated unit	VFD102D
4	Wanted improved pump performance or functionality	VFD102D
5	Wanted remote monitoring and control capabilities	VFD102D
6	Wanted automatic speed controls	VFD102D
77	Other (PLEASE SPECIFY)	VFD102D
88	Refused	VFD102D
99	Don't know	VFD102D
VFD102D	What type of pump does the VFD control?	
1	Vertical turbine pump	NTG BATTERY
2	Submersible pump	NTG BATTERY
3	Centrifugal pump	NTG BATTERY
77	Other (PLEASE SPECIFY)	NTG BATTERY
88	Refused	NTG BATTERY
99	Don't know	NTG BATTERY

NET TO GROSS BATTERY

IF MULTIPLE = 1, THEN ASK. ELSE A1c

A1b. Our records show that your organization installed more than one MEASURE at <%ADDRESS> through the <%UTILITY>'s <%PROGRAM> Program. They are … <%QTY_1> <%MEASURE1>, <%QTY_2> <%MEASURE2>, <%QTY_3> <%MEASURE3>. Was there a single decision making process for the installation of this equipment, or was there a separate decision making process for each type of equipment?

1	Single decision making process	A1c.
2	Separate decision making process for each type of equipment	A1c.
88	Refused	A1c.
99	Don't know	A1c.

IF MULTADD = 1, THEN ASK. ELSE AA3

A1c. Our records also show that your organization installed the same MEASURE at other addresses. Applications were submitted for the following addresses: <%ADDRESS1>, <%ADDRESS2>, <%ADDRESS3> … <%ADDRESS20>. Was the decision making process the same for all of these addresses or was it different at each address?

1	Same decision making process for all addresses	AA3
2	Different decision making process for all addresses	AA3
88	Refused	AA3
99	Don't know	AA3

DISPLAY	For the sake of expediency, during this next battery we will be referring to the ..... program as THE PROGRAM and we will be referring to the installation of ...<%NTGMEASURE>... as THE MEASURE.	
AA3	There are usually a number of reasons why an organization like yours decides to participate in energy efficiency programs like this one. In your own words, can you tell me why you decided to participate in this program?	
1	To replace old or outdated equipment	AA3a
2	As part of a planned remodeling, build-out, or expansion	N2
3	To gain more control over how the equipment was used	N2
4	Maintenance downtime/associated expenses for old equipment were too high	A3a
5	Had process problems and were seeking a solution	N2
6	To improve equipment performance	N2
7	To improve production as a result of the change in equipment	N2
8	To comply with codes set by regulatory agencies	N2
9	To improve visibility/plant safety	N2
10	To comply with company policies regarding regular equipment retrofits or remodeling	A3a

11	To get a rebate from the program	N2
12	To protect the environment	N2
13	To reduce energy costs	N2
14	To reduce energy use/power outages	N2
15	To update to the latest technology	N2
16	To improve the comfort level of the facility	N2
77	RECORD VERBATIM	N2
88	Don't know	N2
99	Refused	N2
IF A3=1, 4 or 10 and PROCESS PUMPING VFDS = 1, THEN ASK. ELSE N2		
AA3a	Had the equipment that you replaced reached the end of its useful life?	
1	Yes	N2
2	No	N2
88	Refused	N2
99	Don't know	N2
N2	Did your organization make the decision to install this new equipment before, after, or at the same time as you became aware of that rebates [IF NEEDED: to reduce the cost of the measure] were available through the PROGRAM?	
1	Before	N3a
2	After	N3a
3	Same time	N3a
88	Refused	N3a
99	Don't know	N3a
DISPLAY	Next, I'm going to ask you to rate the importance of the program as well as other factors that might have influenced your decision to install this equipment through the program. Using a scale of 0 to 10 where 0 means not at all important and 10 means extremely important, how would you rate the importance of...	
N3a	The age or condition of the old equipment	
#	Record 0 to 10 score (_______)	N3aa
88	Refused	N3b
99	Don't know	N3b
	IF N3a > 5 and NTG_TYPE >= 2 THEN ASK	
N3aa	How, specifically, did this enter into your decision to install this equipment?	
77	RECORD VERBATIM	N3b
88	Don't know	N3b
99	Refused	N3b

N3b	Availability of the PROGRAM rebate [IF NEEDED: to reduce the cost of the measure]	
#	Record 0 to 10 score (_______)	N3bb
88	Refused	N3c
99	Don't know	N3c
	IF N3b > 7 AND NTG_TYPE >= 2, THEN ASK	
N3bb	Why do you give it this rating?	
77	Record VERBATIM	N3c
88	Refused	N3c
99	Don't know	N3c
	IF A1B(1)|ID0(1) THEN ASK; ELSE SKIP TO N3d	
N3c	Please rate the degree of importance of information provided through...A1B(1)|<ID0(1)/The Facility or System AUDIT/>	
#	Record 0 to 10 score (_______)	N3cc
88	Refused	N3d
99	Don't know	N3d
	IF N3c > 7 and NTG_TYPE >= 2, THEN ASK	
N3cc	Why do you give it this rating?	
77	Record VERBATIM	N3d
88	Refused	N3d
99	Don't know	N3d
	If V1 = 1 THEN ASK; ELSE SKIP TO N3e	
N3d	Recommendation from an equipment vendor that sold you the equipment and/or installed it for you **[VENDOR_1]**	
#	Record 0 to 10 score (_______)	N3e
88	Refused	N3e
99	Don't know	N3e
N3e	Your previous experience with similar types of energy efficient projects?	
#	Record 0 to 10 score (_______)	N3f
88	Refused	N3f
99	Don't know	N3f
N3f	Your previous experience with <%UTILITY>'s program or a similar utility program?	
#	Record 0 to 10 score (_______)	N3g
88	Don't know	N3g
99	Refused	N3g
	NTG_TYPE >= 3 THEN ASK, ELSE N3h	

N3g	Information from the Program, Utility, or Program Administrator training course?	
#	Record 0 to 10 score (_______)	N3gg
88	Refused	N3h
99	Don't know	N3h
	IF N3g > 5, THEN ASK, ELSE N3h	
N3gg	What type of information was provided during the training?	
77	Record VERBATIM	N3ggg
88	Refused	N3h
99	Don't know	N3h
N3ggg	How, specifically, did this enter into your decision to install this equipment?	
77	RECORD VERBATIM	N3h
88	Don't know	N3h
99	Refused	N3h
N3h	Information from the Program, Utility, or Program Administrator Marketing materials?	
#	Record 0 to 10 score (_______)	N3hh
88	Refused	N3j
99	Don't know	N3j
	IF N3h > 5 and NTG_TYPE >= 2, THEN ASK	
N3hh	What type of information was provided that pertained to the project?	
77	Record VERBATIM	N3hhh
88	Refused	N3j
99	Don't know	N3j
	IF N3hh = 77, THEN ASK	
N3hhh	How, specifically, did this enter into your decision to install this energy efficient equipment?	
77	RECORD VERBATIM	N3j
88	Don't know	N3j
99	Refused	N3j
	IF NTG_TYPE >= 2	
N3j	Standard practice in your business/industry	
#	Record 0 to 10 score (_______)	N3l
88	Refused	N3l
99	Don't know	N3l
	If AP9 = 3 or AP9a = 3 THEN ASK; ELSE SKIP TO N3m	

N3l	Endorsement or recommendation by your account rep?	
#	Record 0 to 10 score (_______)	N3ll
88	Refused	N3m
99	Don't know	N3m
	IF N3l > 5 & NTG_TYPE >1 THEN ASK	
N3ll	What did they recommend?	
77	Record VERBATIM	N3lll
88	Refused	N3m
99	Don't know	N3m
	IF N3LL(77)	
N3lll	How specifically did this enter into your decision to install this energy efficient equipment?	
77	RECORD VERBATIM	N3m
88	Don't know	N3m
99	Refused	N3m
	IF NTG_TYPE >= 2, ASK	
N3m	Corporate policy or guidelines	
#	Record 0 to 10 score (_______)	N3mm
88	Refused	N3n
99	Don't know	N3n
	IF N3m > 5, THEN ASK	
N3mm	How, specifically, did this enter into your decision to install this energy efficient equipment?	
77	RECORD VERBATIM	N3n
88	Don't know	N3n
99	Refused	N3n
N3n	Payback or return on investment of installing this equipment	
#	Record 0 to 10 score (_______)	N3o
88	Refused	N3o
99	Don't know	N3o
N3o	Improved product quality	
#	Record 0 to 10 score (_______)	N3oo
88	Refused	N3p
99	Don't know	N3p
	IF N3o > 5, THEN ASK	

N3oo	How, specifically, did this enter into your decision to install this energy efficient equipment?	
77	RECORD VERBATIM	N3p
88	Don't know	N3p
99	Refused	N3p
	IF FM050 = 12 AND NTG_TYPE >1, THEN ASK, ELSE SKIP TO N3r	
N3p	Compliance with state or federal regulations such as Title 24, air quality, OSHA, or FDA regulations	
#	Record 0 to 10 score (________)	N3pp
88	Refused	N3r
99	Don't know	N3r
	IF N3p > 5, THEN ASK	
N3pp	How, specifically, did this enter into your decision to upgrade to energy efficient equipment?	
77	RECORD VERBATIM	N3r
88	Don't know	N3r
99	Refused	N3r
	ASK IF NTG_TYPE >=2	
N3r	Compliance with your organization's normal remodeling or equipment replacement practices?	
#	Record 0 to 10 score (________)	N3rrr
88	Refused	N3s
99	Don't know	N3s
	IF AA3(2|10)&N3R(6||10);	
N3RRR	According to your organization's remodeling and equipment replacement policies, how often are you supposed to replace this type of equipment? [IF NEEDED: in terms of the number of years]	
# yrs	Record Number of Years	N3rr
88	Refused	N3rr
99	Don't know	N3rr
	IF N3r > 5, THEN ASK	
N3rr	How, specifically, did this enter into your decision to install this energy efficient equipment?	
77	RECORD VERBATIM	N3s.
88	Don't know	N3s.
99	Refused	N3s.

N3s	Were there any other factors we haven't discussed that were influential in your decision to install this energy efficient MEASURE?	
1	Nothing else influential	CC1
77	Record verbatim	N3ss
88	Refused	CC1
99	Don't know	CC1
	ASK IF N3s = 77	
N3ss	Using the same zero to 10 scale, how would you rate the influence of this factor?	
#	Record 0 to 10 score (_______)	CC1
88	Refused	CC1
99	Don't know	CC1
	CONSISTENCY CHECKS ON N3p, N3q and N3r	
	If NTG_TYPE = 4	
	IF AA3 = 8, AND N3p < 4, THEN ASK	
CC1	You indicated earlier that compliance with codes or regulatory policies was one of the reasons you did the project. However, just now you scored the importance of compliance with state or federal regulations or standards such as Title 24, air quality, OSHA, or FDA regulations in your decision making fairly low, why is that?	
77	RECORD VERBATIM	CC1a
88	Don't know	CC1a
99	Refused	CC1a
	IF AA3 ^= 8, and N3p > 7, THEN ASK	
CC1a	You indicated earlier that compliance with codes or regulatory policies was not one of the primary reasons you did the project. However, just now you scored the importance of compliance with state or federal regulations or standards such as Title 24,air quality, OSHA, or FDA regulations in your decision making fairly high, why is that?	
77	RECORD VERBATIM	NCC3
88	Don't know	NCC3
99	Refused	NCC3
	IF AA3 = 2 or 10, AND N3r < 4, THEN ASK	
NCC3	You indicated earlier that a regularly scheduled retrofit was one of the reasons you did the project. However, just now you scored the importance of compliance with your company's regularly scheduled retrofit or equipment replacement in your decision making fairly low, why is that?	
77	RECORD VERBATIM	NCC3a
88	Don't know	NCC3a
99	Refused	NCC3a
	IF AA3 ^= 2 and AA3 ^= 9 and AA3^=10 AND N3r > 7 THEN ASK	

NCC3a	You indicated earlier that a regularly scheduled retrofit was NOT one of the reasons you did the project. However, just now you scored the importance of compliance with your company's regularly scheduled retrofit or equipment replacement in your decision making fairly high, why is that?	
77	RECORD VERBATIM	P1
88	Don't know	P1
99	Refused	P1
	PAYBACK BATTERY	
	If INCENT <> 100 AND NTG_TYPE >= 2, THEN ASK; ELSE SKIP TO N41	
P1	What financial calculations does your company typically make before proceeding with the installation of energy efficient equipment like you installed through the program?	
1	Payback	P2A
2	Return on investment	P2B
77	Record VERBATIM	P3
88	Don't know	P3
99	Refused	P3
	If P1 = 1 THEN ASK; ELSE SKIP TO P2B	
P2A	What is your threshold in terms of the payback or return on investment your company uses before deciding to proceed with installing energy efficient equipment like you installed through the program? Is it…	
1	0 to 6 months	P3
2	6 months to 1 year	P3
3	1 to 2 years	P3
4	2 to 3 years	P3
5	3 to 5 years	P3
6	Over 5 years	P3
88	Don't know	P3
99	Refused	P3
	IF P1 = 2 THEN ASK	
P2B	What is your ROI?	
1	Record ROI____;	P3
P3	Did the rebate move your energy efficient equipment project within this acceptable range?	
1	Yes	P4
2	No	P3a
88	Don't know	P3a
99	Refused	P3a
	If P3 = 1 THEN ASK; ELSE SKIP TO P3A	

P4	On a scale of 0 to 10, with a zero meaning NOT AT ALL IMPORTANT and 10 meaning Very Important, how important in your decision was it that the project was in the acceptable range?	
#	Record 0 to 10 score (_______)	P3a
88	Refused	P3a
99	Don't know	P3a
	CONSISTENCY CHECKS ON N3b and P3	
	IF P3 = 1, AND N3b < 5, THEN ASK	
P3a	The rebate seemed to make the difference between meeting your financial criteria and not meeting them, but you are saying that the rebate didn't have much effect on your decision, why is that?	
77	Record VERBATIM	P3e
88	Don't know	P3e
99	Refused	P3e
	IF P3 = 2, AND N3b > 5, THEN ASK	
P3e	The rebate didn't cause the installation of energy efficient equipment to meet your company's financial criteria, but you said that the rebate had an impact on the decision to install this energy efficient equipment. Why did it have an impact?	
77	Record VERBATIM	N41
88	Don't know	N41
99	Refused	N41

	ASK ALL.	
DISPLAY	Next, with regard to your decision to implement this energy efficient MEASURE *instead of either less energy efficient or standard efficiency equipment*, I would like you to rate the importance of the PROGRAM as opposed to other Non-program factors that may have influenced your decision such as...(SCAN BELOW AND READ TO THEM THOSE FACTORS WITH RATINGS OF 8 OR HIGHER THAT INFLUENCED THEIR DECISION)	
	(READ ITEMS WHERE THEY GAVE A RATING OF 8 or higher)	
	Program-related factors	
	<%N3B> Availability of the PROGRAM rebate	...@[%N3B>@
	<%N3G> Information from the Program, Utility, or Program Administrator training course?	...@[%N3G>@
	<%N3H> Information from the Program, Utility, or Program Administrator Marketing materials?	...@[%N3H>@
	<%N3L> Endorsement or recommendation by your account rep?	...@[%N3L>@
	Non-Program factors	
	<%N3A>The age or condition of the old equipment	...@[%N3A>@
	<%N3C>Information provided through the Facility or System AUDIT/>	...@[%N3C>@
	<%N3D> Equipment Vendor recommendation	...@[%N3D>@
	<%N3E> Previous experience with this measure	...@[%N3E>@
	<%N3F> Previous experience with this program	...@[%N3F>@

	<%N3J> Standard practice in your business/industry	...@[%N3J>@
	<%N3M> Corporate policy or guidelines	...@[%N3M>@
	<%N3N> Payback on investment.	...@[%N3N>@
	<%N3O> To improve production as a result of lighting,	...@[%N3O>@
	<%N3P> Compliance with state or federal regulations or standards such as Title 24, air quality, OSHA, or FDA regulations	...@[%N3P>@
	<%N3R> Compliance with normal maintenance or retrocommissioning policies or your companies regularly scheduled retrofit or lighting replacement	...@[%N3R>@
	IF N3B<8 and N3G<8 AND N3H<8 and N3I<8, THEN READ:	
	Just now, you provided low to medium scores for the importance of several program-related factors in your decision making.	
	IF N3A<8 and N3C<8 and N3D<8 and N3E<8 AND N3F<8 and N3J<8 and N3J<8 and N3M<8 AND N3N<8 AND N3O<8 and N3P<8 and N3R<8 THEN READ:	
	Just now, you provided low to medium scores for the importance of several non-program related factors in your decision making.	
	IF N3B<8 and N3G<8 AND N3H<8 and N3I<8 and N3A<8 and N3C<8 and N3D<8 and N3E<8 AND N3F<8 and N3J<8 and N3J<8 and N3M<8 AND N3N<8 AND N3O<8 and N3P<8 and N3R<8, THEN READ:	
	Just now, you provided low to medium scores for the importance of all of the program and non-program related factors in your decision making.	
DISPLAY	If you were given 10 points to award in total, how many points would you give to the importance of the program and how many points would you give to these other non-program factors?	
N41	How many of the ten points would you give to the importance of the PROGRAM in your decision?	
#	Record 0 to 10 score (_______)	N42
88	Refused	N42
99	Don't know	N42
N42	and how many points would you give to all of these other non-program factors?	
#	Record 0 to 10 score (_______)	N41P
88	Refused	N41P
99	Don't know	N41P

	If N41 NOT EQUAL TO 88 OR 99 and N42 NOT EQUAL TO 88 OR 99 , compute N41 + N42. IF N41+N42 DOES NOT EQUAL 10, display:	
	__We want these two sets of numbers to equal 10.	
	<%N41> for Program influence and	
	<%N42> for Non Program factors	
DISPLAY	Next, I would like for you to consider the importance of the PROGRAM in your decision to install your equipment ***at the time you did*** rather than waiting to install new equipment sometime in the future, regardless of the actual efficiency of the equipment you selected. Please rate the importance of the program on this timing decision as opposed to other non-program factors that may have influenced your decision.	
	If Needed - else skip…	
	If you were given 10 points to award in total, how many points would you give to the importance of the program and how many points would you give to these other non-program factors in your decision to install your equipment **at the time you did** rather than waiting to install new equipment sometime in the future.	
N41P	How many of the ten points would you give to the importance of the PROGRAM in your decision TO INSTALL YOUR EQUIPMENT AT THE TIME YOU DID?	
#	Record 0 to 10 score (_______)	N42P
88	Refused	N42P
99	Don't know	N42P
N42P	and how many points would you give to all of these other non-program factors?	
#	Record 0 to 10 score (_______)	REPLACE
88	Refused	REPLACE
99	Don't know	REPLACE
	If N41 NOT EQUAL TO 88 OR 99 and N42 NOT EQUAL TO 88 OR 99 , compute N41 + N42. IF N41+N42 DOES NOT EQUAL 10, display:	
	__We want these two sets of numbers to equal 10.	
	<%N41P> for Program influence and	
	<%N42P> for Non Program factors	
	ASK ALL.	
REPLACE	Was the installation of this measure....<%NTGMEASURE> ...a replacement of existing equipment or was it additional equipment you installed in your facility?	
1	Replace/Modification/Retrofit	DISPLAY
2	Add-on	DISPLAY
88	Refused	N6
99	Don't know	N6

DISPLAY	Now I would like you to think about the action you would have taken with regard to the installation of this equipment if the program had not been available.	
	IF REPLACE =1 THEN ASK; ELSE SKIP TO N5aa	
N5	Using a likelihood scale from 0 to 10, where 0 is not at all likely and 10 is extremely likely, if THE PROGRAM had NOT BEEN AVAILABLE, what is the likelihood that you would have installed exactly the same program-qualifying energy efficient equipment that you did for this project regardless of when you would have installed it?	
#	Record 0 to 10 score (_______)	N5a
88	Refused	N5B
99	Don't know	N5B
	IF REPLACE =2 THEN ASK; ELSE SKIP TO N6	
N5aa	Using a likelihood scale from 0 to 10, where 0 is Not at all likely and 10 is Extremely likely, if THE PROGRAM had NOT BEEN AVAILABLE, what is the likelihood that you would have installed exactly the same energy efficient equipment at the same time as you did?	
#	Record 0 to 10 score (_______)	N6
88	Don't know	N6
99	Refused	N6
	CONSISTENCY CHECKS	
	IF N3b > 7 and N5 > 7, THEN ASK	
N5a	When you answered ...<%N3B> ... for the question about the influence of the rebate, I would interpret that to mean that the rebate was quite important to your decision to install. Then, when you answered ..<%N5>... for how likely you would be to install the same equipment **without** the rebate, it sounds like the rebate was not very important in your installation decision. I want to check to see if I am misunderstanding your answers or if the questions may have been unclear. Will you explain in your own words, the role the rebate played in your decision to install this efficient equipment?	
77	Record VERBATIM	NN5aa
88	Don't know	NN5aa
99	Refused	NN5aa

NN5aa	Would you like for me to change your score on the importance of the rebate that you gave a rating of <%N3B> and/or change your rating on the likelihood you would install the same equipment without the rebate which you gave a rating of <%N5> and/or we can change both if you wish?	
1	No change	N5b
77	Record how they would rate rebate influence and how they would rate likelihood to install without the rebate	N5b
88	Don't know	N5b
99	Refused	N5b
	ASK IF REPLACE=1	
N5b	Using the same scale as before, if the program had not been available, what is the likelihood that you would have done this project at the same time as you did?	
#	Record 0 to 10 score (________)	DISPLAY
88	Refused	DISPLAY
99	Don't know	DISPLAY
	If N5b < 9 THEN ASK; ELSE SKIP TO N6	
N5bb	Why do you say that?	
77	Record VERBATIM	N6
88	Don't know	N6
99	Refused	N6
	ADDITIONAL BASELINE INPUT	
N6	Now I would like you to think one last time about what action you would have taken if the program had not been available. Which of the following alternatives would you have been MOST likely to do?	
1	Install fewer units	N6aa
2	Install standard efficiency equipment or whatever required by code	N6aa
3	Installed equipment more efficient than code but less efficient than what you installed through the program	N6aa
4	Done nothing (keep existing equipment as is)	N6ba
5	Done the same thing I would have done as I did through the program	N6aa
6	Repair/rewind or overhaul the existing equipment	N7
77	Something else (specify what ______________)	N6ca
88	Don't know	N6ca
99	Refused	N6ca
	If N6 = 1,2,3,5 ASK, ELSE N6ba	

N6aa	Would you have [FILL IN RESPONSE TO N6 for N6 = 1,2, 3, 5] at the same time as you did under the program, within a year, or at a later time?	
1	Same time	N7
2	Within one year	N7
3	At a later time	N6ab
88	Don't know	N7
99	Refused	N7
N6ab	How many years later would it have been?	
77	Record VERBATIM	N7
88	Don't know	N6ac
99	Refused	N7
N6ac	Would it have been….	
1	Less than one year	N7
2	About a year	N7
3	A couple of years	N7
4	A few years	N7
5	More than four years	N7
88	Don't know	N7
99	Refused	N7
	If N6 = 4 THEN ASK, ELSE N6ca	
N6ba	How long would you have waited to replace your equipment?	
1	Less than one year	N7
2	About a year	N7
3	A couple of years	N7
4	A few years	N7
5	More than four years	N7
88	Don't know	N7
99	Refused	N7
	IF N6=77, 88, 99 THEN ASK, ELSE N7	
N6ca	Would you still have replaced your equipment at the same time as you did under the program, within a year, or at a later time?	
1	Same time	N7
2	Within one year	N7
3	At a later time	N6cb
88	Don't know	N7
99	Refused	N7
N6cb	How many years later would it have been?	
77	Record VERBATIM	N6
88	Don't know	N6cc
99	Refused	N6

N6cc	Would it have been….	
1	Less than one year	N7
2	About a year	N7
3	A couple of years	N7
4	A few years	N7
5	More than four years	N7
88	Don't know	N7
99	Refused	N7
CONSISTENCY CHECK		
	Ask if N6 = (1, 2, 3, 4) and ((N5 > 8 and N5b > 8) OR N5aa > 8)	
N7	In an earlier response, you said that if the program had not been available, there was a very high likelihood that you would have installed exactly the same equipment as you did through the program. However, just now you have indicated that you would not have installed the same equipment as you did without the benefit of the program. Can you explain to me why there is this difference?	
77	Record VERBATIM	N6a
88	Don't know	N6a
99	Refused	N6a
	Ask if N6(1);	
N6a	How many fewer units would you have installed/Delamped? (It is okay to take an answer such as ...HALF...or 10 percent fewer ... etc.)	
77	RECORD VERBATIM	ER2
88	Refused	ER2
99	Refused	ER2
	Ask if N6(3);	
N6b	Can you tell me what model or efficiency level you were considering as an alternative? (It is okay to take an answer such as … 10 percent more efficient than code or 10 percent less efficient than the program equipment)	
77	RECORD VERBATIM	ER2
88	Don't know	ER2
99	Refused	ER2

	Ask if N6(6);	
N6c	How long do you think the repaired equipment would have lasted before requiring replacement?	
77	RECORD VERBATIM	EARLY REPLACEMENT BATTERY
88	Don't know	EARLY REPLACEMENT BATTERY
99	Refused	EARLY REPLACEMENT BATTERY
	EARLY REPLACEMENT BATTERY	
	[IF N5b < 8 and A3 = 1, 4, 8, or 10 THEN ASK. ELSE SKIP TO PP1]	
DISPLAY	Earlier, when I asked you a question about why you decided to implement the project using high efficiency equipment, you gave reasons related to <A3> Now I would like to ask you some follow up questions regarding these responses you gave me.	ER2
	IF REPLACE = 1 AND N6c IS UNRECORDED;	
ER2	How many more years do you think your equipment would have gone before failing and required replacement?	
77	___ Estimated Remaining Useful Life (in years)	ER6
88	Don't know	ER6
99	Refused	ER6
	IF AA3 = 4, THEN ASK	
ER6	How much downtime did you experience in the past year?	
77	______Downtime Estimate (in weeks)	ER9
88	Don't know	ER9
99	Refused	ER9
ER9	In your opinion, based on the economics of operating this equipment, for how many more years could you have kept this equipment functioning?	
Yrs	___ Estimated Remaining Useful Life	ER15
88	Don't know	ER15
99	Refused	ER15
	IF AA3 = 8, THEN ASK	
ER15	Can you briefly describe the specific code/regulatory requirements that this project addressed?	
77	RECORD VERBATIM	ER19
88	Don't know	ER19
99	Refused	ER19

	IF AA3 = 10, THEN ASK	
ER19	Can you briefly describe the specific company policies regarding regular/normal maintenance/replacement policy(ies) that were relevant to this project? Or briefly describe the specific company policies regarding regular equipment retrofits and remodeling?	
77	RECORD VERBATIM	PP1
88	Don't know	PP1
99	Refused	PP1
	PROCESS QUESTIONS - ASK ALL	
PP1	What do you believe the PROGRAM'S primary strengths are?	
77	Record VERBATIM	PP2
88	Don't know	PP2
99	Refused	PP2
PP2	What concerns do you have about the PROGRAM, if any? (IF NEEDED: What do you view as the primary features that need to be improved?)	
77	Record VERBATIM	PP4
88	Don't know	PP4
99	Refused	PP4
PP4	On a scale of 0 - 10, where 0 is completely dissatisfied and 10 is completely satisfied, how would you rate your OVERALL satisfaction with the <%PROGRAM>?	
#	Record 0 to 10 score (________)	PP5
88	Refused	PP5
99	Don't know	PP5
	IF PP4 < 4 THEN ASK; ELSE SKIP TO LT2	
PP5	Why do you say that?	
77	Record VERBATIM	LONG TERM INFLUENCE
88	Don't know	LONG TERM INFLUENCE
99	Refused	LONG TERM INFLUENCE

	LONG TERM INFLUENCE	
	IF N3f > 4, THEN ASK, ELSE OPERATING HOURS SECTION	
DISPLAY	Now I'd like you to think about your organization's experiences with %UTILITY's energy efficiency programs and efforts over the longer term, for example, over the past 5, 10, or even 20 years. In an earlier question, you indicated that your previous experience with utility energy efficiency programs was a factor that influenced your decision to implement this PROJECT. I would like to ask you a few questions about this experience.	LT2
LT2	For how many years have you been participating in %UTILITY's energy efficiency programs?	
# yrs	Record Number of Years	LT3
88	Refused	LT3
99	Don't know	LT3
LT3	During this time, how many times has your organization participated in these PROGRAM(s)?	
1	7 to 10 times, or more	CA6
2	4 to 7 times	CA6
3	2 to 4 times	CA6
4	less than 2 times	CA6
88	Refused	LT6
99	Don't know	LT6
	IF LT3 = 1, 2, 3 or 4, THEN ASK. ELSE LT8	
CA6	What type of equipment did you install through this (these) program(s)? [READ RESPONSE CATEGORIES]	
1	Indoor lighting	LT6
2	Cooling equipment	LT6
3	Natural gas equipment, such as water heater, furnace or appliances	LT6
4	Insulation or windows	LT6
5	Refrigeration	LT6
6	Industrial process equipment	LT6
7	Greenhouse heat curtains	LT6
8	Food service equipment	LT6
77	OPEN \SOMETHING OTHER (specify)	LT6
88	Refused	LT6
99	Don't Know	LT6
LT6	What factors led you to participate in these program(s)?	
77	Record VERBATIM	LT7
88	Refused	LT7
99	Don't know	LT7

LT7	And exactly how did that experience help to convince you to install this energy efficient equipment?	
77	Record VERBATIM	LT8
88	Refused	LT8
99	Don't know	LT8
	IF LT3 = 1 or 2, THEN ASK. ELSE GO TO OPERATING HOURS SECTION	
LT8	Have these programs had any long-term influence on your organization's energy efficiency related practices and policies that go beyond the immediate effect of incentives on individual projects? [DO NOT READ: Examples are causing them to add energy efficiency procurement policies, internal incentive or reward structures for improving energy efficiency, or adoption of energy management best practices.]	
1	Yes	OPERATING HOURS SECTION
2	No	OPERATING HOURS SECTION
88	Refused	OPERATING HOURS SECTION
99	Don't know	OPERATING HOURS SECTION

	OPERATING HOURS	
DISPLAY	The next few questions are to help us get a full understanding of your organization's operational hours.	
ALWAYS	Is your organization operation 24 hours a day, 7 days a week?	
1	Yes	HOLIDAYS
2	No	HOLIDAYS
88	Refused	HOLIDAYS
HOLIDAYS	Does your facility closed for any holidays during the year? If so, which one(s)?	
1	New Year's Day - January 1	DAYS
2	Martin Luther King Jr. Day (3rd Monday in January)	DAYS
3	President's Day (3rd Monday in February)	DAYS
4	Memorial Day (Last Monday in May)	DAYS
5	Independence Day - July 4th (Or Surrounding Monday/Friday if July 4 is a weekend)	DAYS
6	Labor Day (First Monday in September)	DAYS
7	Thanksgiving (4th Thursday in November)	DAYS
8	Day after Thanksgiving	DAYS

9	Christmas Eve - December 24	DAYS
10	Christmas Day - December 25	DAYS
66	NO HOLIDAY CLOSURES	DAYS
77	Other - Specify	DAYS
88	Refused	DAYS
99	Don't Know	DAYS
	Ask if ALWAYS = 2; else skip to OS_REC;	
DAYS	Is your facility closed any of the 7 days of the week? If so, which days are you CLOSED?	
1	Monday	MONDAY_OPEN
2	Tuesday	MONDAY_OPEN
3	Wednesday	MONDAY_OPEN
4	Thursday	MONDAY_OPEN
5	Friday	MONDAY_OPEN
6	Saturday	MONDAY_OPEN
7	Sunday	MONDAY_OPEN
66	Open EVERYDAY	MONDAY_OPEN
88	REFUSED	MONDAY_OPEN
99	DON'T KNOW	MONDAY_OPEN
	Ask if ALWAYS(2)&^DAYS(1); else skip to TUESDAY_OPEN;	
MONDAY_ OPEN	What time do you open your facility on MONDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	MONDAY_CLOSE
88	REFUSED	MONDAY_CLOSE
99	DON'T KNOW	MONDAY_CLOSE
	IF MONDAY_OPEN(1||64)	
MONDAY_ CLOSE	What time do you close your facility on MONDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	TUESDAY_OPEN
88	REFUSED	TUESDAY_OPEN
99	DON'T KNOW	TUESDAY_OPEN
	Ask if ALWAYS(2)&^DAYS(2); else skip to WEDNESDAY_OPEN;	
TUESDAY_ OPEN	What time do you open your facility on TUESDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	TUESDAY_CLOSE
88	REFUSED	TUESDAY_CLOSE
99	DON'T KNOW	TUESDAY_CLOSE
	IF TUESDAY_OPEN(1||65)	

TUESDAY_ CLOSE	What time do you close your facility on TUESDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	WEDNESDAY_OPEN
88	REFUSED	WEDNESDAY_OPEN
99	DON'T KNOW	WEDNESDAY_OPEN
	Ask if ALWAYS(2)&^DAYS(3); else skip to THURSDAY_OPEN;	
WEDNESD AY_OPEN	What time do you open your facility on WEDNESDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	WEDNESDAY_CLOSE
88	REFUSED	WEDNESDAY_CLOSE
99	DON'T KNOW	WEDNESDAY_CLOSE
	IF WEDNESDAY_OPEN(1||65)	
WEDNESD AY_CLOSE	What time do you close your facility on WEDNESDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	THURSDAY_OPEN
88	REFUSED	THURSDAY_OPEN
99	DON'T KNOW	THURSDAY_OPEN
	Ask if ALWAYS(2)&^DAYS(4); else skip to FRIDAY_OPEN;	
THURSDAY _OPEN	What time do you open your facility on THURSDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	THURSDAY_CLOSE
88	REFUSED	THURSDAY_CLOSE
99	DON'T KNOW	THURSDAY_CLOSE
	IF THURSDAY_OPEN(1||65)	
THURSDAY _CLOSE	What time do you close your facility on THURSDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	FRIDAY_OPEN
88	REFUSED	FRIDAY_OPEN
99	DON'T KNOW	FRIDAY_OPEN

	Ask if ALWAYS(2)&^DAYS(5); else skip to SATURDAY_OPEN;	
FRIDAY_OPEN	What time do you open your facility on FRIDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	FRIDAY_CLOSE
88	REFUSED	FRIDAY_CLOSE
99	DON'T KNOW	FRIDAY_CLOSE
	IF FRIDAY_OPEN(1||65)	
FRIDAY_CLOSE	What time do you close your facility on FRIDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	SATURDAY_OPEN
88	REFUSED	SATURDAY_OPEN
99	DON'T KNOW	SATURDAY_OPEN
	Ask if ALWAYS(2)&^DAYS(6); else skip to SUNDAY_OPEN;	
SATURDAY_OPEN	What time do you open your facility on SATURDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	SATURDAY_CLOSE
88	REFUSED	SATURDAY_CLOSE
99	DON'T KNOW	SATURDAY_CLOSE
	IF SATURDAY_OPEN(1||65)	
SATURDAY_CLOSE	What time do you close your facility on SATURDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	SUNDAY_OPEN
88	REFUSED	SUNDAY_OPEN
99	DON'T KNOW	SUNDAY_OPEN
	Ask if ALWAYS(2)&^DAYS(7); else skip to DIFF_SCHEDULE;	
SUNDAY_OPEN	What time do you open your facility on SUNDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	SUNDAY_CLOSE
88	REFUSED	SUNDAY_CLOSE
99	DON'T KNOW	SUNDAY_CLOSE
	IF SUNDAY_OPEN(1||65)	

SUNDAY_CLOSE	What time do you close your facility on SUNDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	DIFF_SCHEDULE
88	REFUSED	DIFF_SCHEDULE
99	DON'T KNOW	DIFF_SCHEDULE
DIFF_SCHEDULE	Some organizations have different schedules for certain times of the year. Does your organization maintain a different schedule for certain months of the year?	
1	Yes	MONTHS
2	No	OS_REC
88	REFUSED	OS_REC
99	DON'T KNOW	OS_REC
	Ask if DIFF_SCHEDULE = 1; Else skip to OS_REC;	
MONTHS	Which months of the year does the schedule vary from the times I just recorded?	
1	January	ALT_DAYS
2	February	ALT_DAYS
3	March	ALT_DAYS
4	April	ALT_DAYS
5	May	ALT_DAYS
6	June	ALT_DAYS
7	July	ALT_DAYS
8	August	ALT_DAYS
9	September	ALT_DAYS
10	October	ALT_DAYS
11	November	ALT_DAYS
12	December	ALT_DAYS
88	REFUSED	ALT_DAYS
99	DON'T KNOW	ALT_DAYS
ALT_ALWAYS	Is your organization operation 24 hours a day, 7 days a week?	
1	Yes	HOLIDAYS
2	No	HOLIDAYS
88	Refused	HOLIDAYS
	If ^ALT_ALWAYS(1) then ask; Else skip to OS_REC;	

ALT_DAYS	During this alternate schedule, is your facility closed any of the 7 days of the week? If so, which days are you CLOSED?	
1	Monday	ALT_MONDAY_OPEN
2	Tuesday	ALT_MONDAY_OPEN
3	Wednesday	ALT_MONDAY_OPEN
4	Thursday	ALT_MONDAY_OPEN
5	Friday	ALT_MONDAY_OPEN
6	Saturday	ALT_MONDAY_OPEN
7	Sunday	ALT_MONDAY_OPEN
66	Open EVERYDAY	ALT_MONDAY_OPEN
88	REFUSED	ALT_MONDAY_OPEN
99	DON'T KNOW	ALT_MONDAY_OPEN
	Ask if DIFF_SCHEDULE(1)&^ALT_DAYS(1); else skip to ALT_TUESDAY_OPEN;	
ALT_MONDAY_OPEN	For the alternate schedule, what time do you open your facility on MONDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_MONDAY_CLOSE
88	REFUSED	ALT_MONDAY_CLOSE
99	DON'T KNOW	ALT_MONDAY_CLOSE
	IF ALT_MONDAY_OPEN(1||64)	
ALT_MONDAY_CLOSE	What time do you close your facility on MONDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_TUESDAY_OPEN
88	REFUSED	ALT_TUESDAY_OPEN
99	DON'T KNOW	ALT_TUESDAY_OPEN
	Ask if DIFF_SCHEDULE(1)&^ALT_DAYS(2); else skip to ALT_WEDNESDAY_OPEN;	
ALT_TUESDAY_OPEN	What time do you open your facility on TUESDAY during your alternate schedule?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_TUESDAY_CLOSE
88	REFUSED	ALT_TUESDAY_CLOSE
99	DON'T KNOW	ALT_TUESDAY_CLOSE
	IF ALT_TUESDAY_OPEN(1||65)	

ALT_TUESDAY_CLOSE	What time do you close your facility on TUESDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_WEDNESDAY_OPEN
88	REFUSED	ALT_WEDNESDAY_OPEN
99	DON'T KNOW	ALT_WEDNESDAY_OPEN
	Ask if DIFF_SCHEDULE(1)&^ALT_DAYS(3); else skip to ALT_THURSDAY_OPEN;	
ALT_WEDNESDAY_OPEN	What time do you open your facility on WEDNESDAY during your alternate schedule?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_WEDNESDAY_CLOSE
88	REFUSED	ALT_WEDNESDAY_CLOSE
99	DON'T KNOW	ALT_WEDNESDAY_CLOSE
	IF ALT_WEDNESDAY_OPEN(1||65)	
ALT_WEDNESDAY_CLOSE	What time do you close your facility on WEDNESDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_THURSDAY_OPEN
88	REFUSED	ALT_THURSDAY_OPEN
99	DON'T KNOW	ALT_THURSDAY_OPEN
	Ask if DIFF_SCHEDULE(1)&^ALT_DAYS(4); else skip to ALT_FRIDAY_OPEN;	
ALT_THURSDAY_OPEN	What time do you open your facility on THURSDAY during your alternate schedule?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_THURSDAY_CLOSE
88	REFUSED	ALT_THURSDAY_CLOSE
99	DON'T KNOW	ALT_THURSDAY_CLOSE
	ALT_THURSDAY_OPEN(1||65)	
ALT_THURSDAY_CLOSE	What time do you close your facility on THURSDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_FRIDAY_OPEN
88	REFUSED	ALT_FRIDAY_OPEN
99	DON'T KNOW	ALT_FRIDAY_OPEN

	Ask if DIFF_SCHEDULE(1)&^ALT_DAYS(5); else skip to ALT_SATURDAY_OPEN;	
ALT_FRIDAY_OPEN	What time do you open your facility on FRIDAY during this alternate schedule?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_FRIDAY_CLOSE
88	REFUSED	ALT_FRIDAY_CLOSE
99	DON'T KNOW	ALT_FRIDAY_CLOSE
	IF ALT_FRIDAY_OPEN(1||65)	
ALT_FRIDAY_CLOSE	What time do you close your facility on FRIDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_SATURDAY_OPEN
88	REFUSED	ALT_SATURDAY_OPEN
99	DON'T KNOW	ALT_SATURDAY_OPEN
	Ask if DIFF_SCHEDULE(1)&^ALT_DAYS(6); else skip to ALT_SUNDAY_OPEN;	
ALT_SATURDAY_OPEN	I recorded that during your alternate schedule you are also open on Saturday. What time do you open your facility on SATURDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_SATURDAY_CLOSE
88	REFUSED	ALT_SATURDAY_CLOSE
99	DON'T KNOW	ALT_SATURDAY_CLOSE
	IF ALT_SATURDAY_OPEN(1||65)	
ALT_SATURDAY_CLOSE	What time do you close your facility on SATURDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_SUNDAY_OPEN
88	REFUSED	ALT_SUNDAY_OPEN
99	DON'T KNOW	ALT_SUNDAY_OPEN
	Ask if DIFF_SCHEDULE(1)&^ALT_DAYS(7); else skip to OS_REC;	
ALT_SUNDAY_OPEN	I recorded that during your alternate schedule you are also open on Sunday. What time do you open your facility on SUNDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	ALT_SUNDAY_CLOSE
88	REFUSED	ALT_SUNDAY_CLOSE
99	DON'T KNOW	ALT_SUNDAY_CLOSE
	IF ALT_SUNDAY_OPEN(1||65)	

ALT_SUNDAY_CLOSE	What time do you close your facility on SUNDAY?	
	Record Time 1AM - 12:30 AM in 12 hour format by half hour as 1-24	CUSTOMER CHARACTERISTICS
88	REFUSED	CUSTOMER CHARACTERISTICS
99	DON'T KNOW	CUSTOMER CHARACTERISTICS

	CUSTOMER CHARACTERISTICS	
	We're almost finished. Now, I'd like to ask you questions regarding your facility.	
CC2a	What is the total square footage at this facility?	
77	RECORD Square feet	CC2c
888888	Refused	CC3
999999	Don't know	CC3
	IF CC2a IN (88, 99)	
CC3	Would you say that the floor area is ...?	
1	less than 1,500 sq. ft.	CC2c
2	1,500 - 5,000 sq. ft.	CC2c
3	5,000 - 10,000 sq. ft.	CC2c
4	10,000 – 25,000 sq. ft.	CC2c
5	25,000 – 50,000 sq. ft.	CC2c
6	50,000 – 75,000 sq. ft.	CC2c
7	75,000 – 100,000 sq. ft.	CC2c
8	over 100,000 sq. ft. (ag area)	CC2c
88	Refused	CC2c
99	Don't know	CC2c
CC2c	Is the entire floor area of this facility heated or cooled?	
1	Yes	CC3a
2	No	CC2d
88	Refused	C0
99	Don't know	C0
CC2d	What percentage of the floor area is heated or cooled?	
77	Percent	CC3a
101	Refused	C0
102	Don't know	C0
	If CC2d > 0 or CC2c = 1; else skip to C0	

CC3a	Is your space heated using electricity or gas or something else?	
1	Electricity	C0
2	Gas	C0
3	Both electricity and gas	C0
4	Propane	C0
77	OPEN\Other-record	C0
88	Refused	C0
99	Don't know	C0
C0	About what percentage of your operating costs does energy account for?	
1	Less than 1 percent	CC4
2	1-2 percent	CC4
3	3-5 percent	CC4
4	6-10 percent	CC4
5	11-15 percent	CC4
6	16-20 percent	CC4
7	21-50 percent	CC4
8	Over 51 percent	CC4
88	Refused	CC4
99	Don't Know	CC4
CC4	Does your organization own, lease, or manage the facility?	
1	Own	C5
2	Lease/Rent	C5
3	Manage	C5
88	Refused	C5
99	Don't know	C5
C5	How many locations does your organization have. Is it....	
1	This facility only	CC6
2	2 to 4 locations	CC6
3	5 to 10 locations	CC6
4	11 to 25 locations	CC6
5	more than 25 locations	CC6
88	Don't know	CC6
99	Refused	CC6

CC6	How active a role does your organization take in making purchase decisions related to energy using equipment at this facility? Would you say you are…	
1	Very active – involved in all phases and have veto power	CC7
2	Somewhat active – we approve decisions and provide some input and review	CC7
3	Slightly active – we have a voice but it's not the dominant voice	CC7
4	Not active at all – we're part of a larger firm	CC7
5	Not active at all – our firm doesn't get involved in these issues	CC7
88	Refused	CC7
99	Don't know	CC7

CC7	Does your firm have a maintenance company that you use to maintain any of your building systems such as lighting, HVAC, refrigeration, or food service equipment?	
1	Yes	CC12a
2	No	CC12a
88	Refused	CC12a
99	Don't Know	CC12a

CC12a	In what year was this organization established at this location?	
7777	Year	BC090
8888	Refused	CC12b
9999	Don't know	CC12b
	If CC12a in (88, 99) then ask; else skip to BC090	
CC12b	Would you say it was…	
1	After 2010	BC090
2	Between 2006 and 2010	BC090
3	Between 2000 and 2005	BC090
4	In the 1990s	BC090
5	In the 1980s	BC090
6	In the 1970s	BC090
7	In the 1960s or	BC090
8	Before 1960	BC090
88	Don't know	BC090
99	Refused	BC090

	ADDITIONAL FACILITY CHARACTERISTICS	
BC090	Has the square footage of the facility increased, decreased or remained the same since January 2017?	
1	Increase in square footage	BC100
2	Decrease in square footage	BC110
3	Stayed the same	V1
88	Refused	V1
99	Don't know	V1
	If BC090 = 1 then ask; else skip to BC110	
BC100	How many square feet were added?	
77	Square feet	BC120
88	Refused	BC120
99	Don't know	BC120
	If BC090 = 2 then ask; else skip to BC120	
BC110	By how many square feet was the facility reduced?	
77	Square feet	BC120
88	Refused	BC120
99	Don't know	BC120
	If BC090 in (1, 2) then ask; else skip to CA15	
BC120	In what year did this <%BC090> occur?	
1	2017	Vendor_Name
2	2018	Vendor_Name
88	Refused	Vendor_Name
99	Don't know	Vendor_Name
	CLOSING	
	Ask if V1(1)	
Vendor_Name	Earlier you stated that you had a vendor/contractor that helped you with the installation of the <%MEASURE> that was installed through the <%UTILITY> Program. Could you provide me with their name and phone number?	
1	Cannot provide	END
77	Record Name, Phone Number, Email Address or any other information they can provide. More is better.	END
88	Refused	END
99	Don't know	END
END	Those are all the questions I have for you today. On behalf of the CPUC, I would like to thank you very much for your kind cooperation. Have a good day.	

VENDOR TELEPHONE SURVEY INSTRUMENT

Introduction

AA1 This is %n calling on behalf of the CPUC [California Public Utilities Commission] from <%SURVEY FIRM>> regarding your firm's involvement with the sales and/or installations of ...<%MEASURE>... through ...<%PROGRAM> ... between January 1, 2018 and December 31, 2018._____Our records indicate that ...<%CONTACT>... would be the person most knowledgeable about this. Are they available?

1 Yes AA7

2 No AA2

AA2 Who would be the person most knowledgeable about your firm's involvement with ...<%PROGRAM> during 2018?

1 Record name and start over

A1 <%UTILITY>... has indicated that your firm implements the <% PROGRAM NAME> and was involved in selling and/or installing energy-efficient...<%MEASURE> throughout their service territory during 2018. Is this correct?

1 Yes A2

2 No Thank and Terminate

[DO NOT READ: The following question will determine if we ask about influences on their recommendations. Please be sure to be thorough with this question. If they truly only installed this equipment, then a "No" is fine]

A2 According to <%UTILITY>, your firm promotes and sells ...<%MEASURE> through the <% PROGRAM NAME> [ADJUST TO PROGRAM DESCRIPTION]. Is that correct??

1 Yes A3

2 No A11

A3 Now, I'm going to ask you about the various strategies you might have used to sell program-qualified equipment. Please indicate which ones you have used. [READ]

___ Upsell contractors to purchase program-qualified units

___ Upsell customers to purchase program-qualified units

___ Conduct training workshops for contractors

___ Increase marketing of program-qualified units

___ Reduce the prices of program-qualified units

___ Increase the stocking or assortment of program-qualified units

___ Discuss the benefits of program-qualified units with contractors

___ Discuss the benefits of program-qualified units with customers

___ Other (Please describe: ____)

Next, I am going to ask you to rate the importance of the various PROGRAM and NON-PROGRAM factors in influencing your decision to recommend this MEASURE to distributors/ customers. Think of the degree of importance as being shown on a scale with equally spaced units from 0 to 10, where 0 means not at all important and 10 means very important, so that an importance rating of 8 shows twice as much influence as a rating of 4.

A4 Using this 0-to-10 scale, please rate the following in terms of their importance in your decision to recommend this MEASURE to ...<%CUSTOMER>.and other customers

Program incentive	Record 0 to 10 score (_______)
Information about the cost-effectiveness of more efficient units	Record 0 to 10 score (_______)
Program promotional materials	Record 0 to 10 score (_______)
Program-provided training of sales staff	Record 0 to 10 score (_______)

Next, I am going to ask you to rate the importance of the PROGRAM in general in influencing your decision to recommend this MEASURE to <%UTILITY's> contractors/distributors/customers.

A5 Using this 0 to 10 scale where 0 is NOT AT ALL IMPORTANT and 10 is EXTREMELY IMPORTANT, how important was the PROGRAM, including incentives as well as program services and information, in influencing your decision to recommend that <%UTILITY's> contractors/distributors/customers purchase the energy efficiency MEASURE at this time?

Record 0 to 10 score (_______) A5A

A5a. Now, if you were given 10 points to award in total, how many points would give to the importance of the program factors as a group and how many points would you give to the non-program factors as a group?

Record 0 to 10 value (_______) A6

A6 And using a 0 to10 likelihood scale where 0 is NOT AT ALL LIKELY and 10 is EXTREMELY LIKELY, if the PROGRAM, including incentives as well as program services and information, had not been available, what is the likelihood that you would have recommended this specific MEASURE to <%UTILITY's> contractors/distributors/customers?

Record 0 to 10 score (_______) A7

A7 Approximately, in what percent of sales situations did you recommend this MEASURE before you learned about the PROGRAM?

% Record PERCENTAGE A8

A8 And approximately in what percent of sales situations do you recommend this MEASURE now that you have worked with the PROGRAM?

% Record PERCENTAGE A8a

A8a In what most important other way has the PROGRAM influenced your recommendations regarding this MEASURE?

RECORD ANSWER HERE:

A8aa Using a 0 to 10 scale, how important was this influence on this recommendation?

Record 0 to 10 score (_______) A8b

A8b. Was there another way the PROGRAM influenced your recommendations regarding this MEASURE?

1 No other way A9a

77 **Record SECOND mention here:**

A8bb Using a 0 to 10 scale, how important was this influence on this recommendation?

Record 0 to 10 score (_______) A9a

A9a Using the same scale as before, how important was the TRAINING SEMINAR provided by <%UTILITY> in your recommendation?

Record 0 to 10 score (_______) A9b

A9b And how important was the information provided by the <%UTILITY> website?

Record 0 to 10 score (_______) A9c

A9c And how important was your firm's past participation in a rebate or audit program sponsored by <%UTILITY>?

Record 0 to 10 score (_______) A10

A10 Approximately, what percentage of your sales over the last 12 months of this...<%MEASURE_TYPE> installed in <%UTILITY>'s service territory are energy efficient models…that qualify for incentives from the program?

% Record PERCENTAGE A11

A11 On a 0 to 100 percent scale, in what percent of sales situations do you encourage your contractors/distributors/customers in <%UTILITY>'s territory to purchase program qualifying ...<%MEASURE_TYPE>...?

% Record PERCENTAGE A11a

IF A11 << 100;

A11a In what situations do you NOT encourage your contractors/distributors/customers to purchase energy efficient models if they qualify for a rebate? Why is that?

RECORD ANSWER HERE:

A12 Of those installations of ...<%MEASURE_TYPE>... in <%UTILITY>'s service territory that qualify for incentives, approximately what percentage do not receive the incentive?

RECORD ANSWER HERE:

IF A12 >> 0;

A13 Why do you think they do not receive the incentive?

RECORD ANSWER HERE:

A14 Do you also sell ...<%MEASURE_TYPE>.. in areas where contractors/distributors/customers do not have access to incentives for energy efficient models?

1 Yes A15

2 No A16

A15 About what percent of your sales of ...<%MEASURE_TYPE> ... are represented by these areas where incentives are not offered?

RECORD ANSWER HERE:

IF A15 >> 10 & A15 << 101;

A15a And approximately what percentage of your sales of this ...<%MEASURE_TYPE>..in these areas are the energy efficient models that would qualify for incentives in <%UTILITY>'s service territory?

RECORD ANSWER HERE:

A16 Have you changed your stocking practices as a result of the <%UTILITY> Program?\,

1 Yes A17

2 No A17

IF A14=1

A17 Do you promote energy efficient models equally in areas with and without incentives?

1 Yes END

2 No END

END Those are all the questions I have for you today. Thank you very much for your time. END OF SURVEY

APPENDIX B SMALL COMMERCIAL SECTOR ON-SITE SURVEY INSTRUMENTS

- Refrigeration Case LED On-Site Survey Instrument
- Process Pumping VFD On-Site Survey Instrument
- Agricultural Irrigation On-Site Survey Instrument
- ESPI Tankless Water Heater On-Site Survey Instrument

REFRIGERATION CASE LED ON-SITE SURVEY INSTRUMENT

Non-Residential Deemed Refrigeration Measure Data Collection On-Site Survey Form

General Site Information (from phone survey & IOU tracking database)

Itron SiteID	«nrfsiteid»

Corporate (Multi-Site) Name	«ServiceAccountName»		
Business Name (Tracking Data)			
Actual Business Name			
Service Address	«SiteAddress»		
City	«SiteCity»	Zip Code	«SiteZipCode»
CORRECTIONS TO SITE INFORMATION			
Revised Corp. (Multi-Site) Name			
Revised Business Name			
Revised Service Address			
Revised City		Revised Zip	

Site Contact Information

PS Completion Date:		Length (min)		Respondent:		Date of Install:	

	Contacted	Contact Name	Phone Number	Alternate Phone	Email Address
OS Primary	☐	*«Onsite_ContactName»*	*«Onsite_ContactNumber»*		
OS Back-up	☐				
OS Other	☐				

Note: Use the "Contacted" check box to indicate the actual contact(s) for the site visit.

Scheduling Notes/Special Instructions for On-site Visit: «Schedule_Notes»

Survey Tracking Information

Survey Company:		Assigned Surveyor's Initials:	
Survey Travel Mileage:	miles	Total Travel Time	hrs
Survey Duration (24 hr clock)	Start:	Survey Duration (24 hr clock)	End:
Total Onsite Time	hrs	Total Time to Fill Out Survey Form	hrs

	Date:	Initials
Field survey completed:	__ __ / __ __ / __ __	__ __ __
Survey received from surveyor:	__ __ / __ __ / __ __	__ __ __
Initial QC check completed:	__ __ / __ __ / __ __	__ __ __
Survey sent back to surveyor (*if needed*):	__ __ / __ __ / __ __	__ __ __
Received from surveyor (*if needed*):	__ __ / __ __ / __ __	__ __ __
Itron QC completed:	__ __ / __ __ / __ __	__ __ __
Data entry (DE) completed:	__ __ / __ __ / __ __	__ __ __
Logger extraction DE complete:	__ __ / __ __ / __ __	__ __ __
Follow-up Logger Extraction DE complete:	__ __ / __ __ / __ __	__ __ __

IOU Tracking Data Measure Summary Sheet

This is a summary of all of the measures implemented at this site as extracted from the IOU tracking database. All of the measures listed here should also be found on the measure-level verification forms.

Claim ID	Measure Code	IOU MeasureName	Rebated # of Units	Unit Basis
«CLaimID_1»	«OS_MeasCode_1»	«OS_MeasDescription_1»	«OS_NumUnits_1»	«OS_InstalledNormUnit_1»
«CLaimID_2»	«OS_MeasCode_2»	«OS_MeasDescription_2»	«OS_NumUnits_2»	«OS_InstalledNormUnit_2»
«CLaimID_3»	«OS_MeasCode_3»	«OS_MeasDescription_3»	«OS_NumUnits_3»	«OS_InstalledNormUnit_3»
«CLaimID_4»	«OS_MeasCode_4»	«OS_MeasDescription_4»	«OS_NumUnits_4»	«OS_InstalledNormUnit_4»
«CLaimID_5»	«OS_MeasCode_5»	«OS_MeasDescription_5»	«OS_NumUnits_5»	«OS_InstalledNormUnit_5»

Premise-Level Schedule Definitions

Standard Holidays *(check all that apply)*

☐ **N/A**

Indicate below which, if any, standard holidays that the business is closed or operation deviates drastically from normal/typical operations,and indicate on Form BUS_HRS what the holiday operation hours are. Indicate any additional holidays in the comment block.

New Year's Eve	☐	July 4th Celebrated	☐
New Year's Day	☐	Labor Day	☐
New Year's Day Celebrated	☐	Columbus Day	☐
Martin Luther King Day	☐	Veterans' Day	☐
Presidents' Day	☐	Thanksgiving	☐
St. Patrick's Day	☐	Thanksgiving Friday	☐
Easter Sunday	☐	Christmas Eve	☐
Memorial Day	☐	Christmas Day	☐
Flag Day	☐	Christmas Day Celebrated	☐
July 4th	☐	Caesar Chavez Day	☐
Other (1) ___________________	☐	Other (2)__________________	☐

Business Schedule

Primary Business Hours

Define typical operation for all Day Types listed below and specify hours in military time (00 to 24). For partial (i.e. not full) operation days, also indicate the approximate % of full operation as Partial Op %.

Day Type	From Phone Survey	Corrected Business Hours	Closed All Day?	Open 24 hrs?	PartialOp%
Monday	from ________ to ________	from ________ to________			
Tuesday	from ________ to ________	from ________ to________			
Wednesday	from ________ to ________	from ________ to________			
Thursday	from ________ to ________	from ________ to________			
Friday	from ________ to ________	from ________ to________			
Saturday	from ________ to ________	from ________ to________			
Sunday	from ________ to ________	from ________ to________			
Holidays	from ________ to ________	from ________ to________			

Seasonal Operation Business Hours – Time Period 2 ☐ N/A

Day Type	From Phone Survey	Corrected Business Hours	Closed All Day?	Open 24 hrs?	PartialOp%
Monday	from ________ to ________	from ________ to________			
Tuesday	from ________ to ________	from ________ to________			
Wednesday	from ________ to ________	from ________ to________			
Thursday	from ________ to ________	from ________ to________			
Friday	from ________ to ________	from ________ to________			
Saturday	from ________ to ________	from ________ to________			
Sunday	from ________ to ________	from ________ to________			
Holidays	from ________ to ________	from ________ to________			

Seasonal Operation Business Hours – Time Period 3 ☐ N/A

Day Type	Business Hours	Closed All Day?	Open 24 hrs?	PartialOp%
Monday	from ________ to________	Y N	Y N	
Tuesday	from ________ to________	Y N	Y N	
Wednesday	from ________ to________	Y N	Y N	
Thursday	from ________ to________	Y N	Y N	
Friday	from ________ to________	Y N	Y N	
Saturday	from ________ to________	Y N	Y N	
Sunday	from ________ to________	Y N	Y N	
Holidays	from ________ to________	Y N	Y N	

Hourly Operation Schedules –Refrigeration Case Lightng

Use this form if refrigerated case lighting operation is independent of Business Hours as indicated on Form BUS_HRS. Use one block for each unique/seasonal schedule. Indicate the applicable daytypes for each unique/seasonal schedule, and account for all day types including holidays. Specify the % of max. lighting power for all time periods and be sure to accurately capture transition periods.

Hour		12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12

Schedule #___ ControlType_____ Description________________________________

Applicable DayTypes		% Equipment On Temp Setpoint											
M T W T F S S H	AM												
	PM												
M T W T F S S H	AM												
	PM												
M T W T F S S H	AM												
	PM												
M T W T F S S H	AM												
	PM												

Schedule #___ ControlType_____ Description________________________________

Applicable DayTypes		% Equipment On Temp Setpoint											
M T W T F S S H	AM												
	PM												
M T W T F S S H	AM												
	PM												
M T W T F S S H	AM												
	PM												
M T W T F S S H	AM												
	PM												

Schedule #___ ControlType_____ Description________________________________

Applicable DayTypes		% Equipment On Temp Setpoint											
M T W T F S S H	AM												
	PM												
M T W T F S S H	AM												
	PM												
M T W T F S S H	AM												
	PM												
M T W T F S S H	AM												
	PM												

Premise/Site-Plan Sketch

This sketch should provide a high-level view of the interior space and the layout of the refrigeration display cases. Please include quantity of doors by case and locations of lighting logger installation. Use multiple sheets/drawings if necessary. Also indicate the "front" or primary entrance for each building.

Premise/Site-Plan sketch comments:

____

____

____

LED Case Lighting Measure 1

IOU Tracking Data		Claim Id	«CLaimID_1»
		Measure Code	*«OS_MeasCode_1»*
		Measure Name	«OS_MeasDescription_1»
		Rebated #of Units	«OS_NumUnits_1»
		IOU Unit Basis	*«OS_InstalledNormUnit_1»*
		Anticipated ex-ante Qty of LED Fixtures	«OS_Qty_5ft_6ft_1»
Physical Measure Verification Data		Can Rebated measures be clearly identified?	Y N
		Check box if Fixtures are NOT accessible (explain below)	☐
		# of LED Fixtures/Lamps physically inspected	
		LED Fixture Manufacturer	
		LED Fixture Model Number	
		LED LampType (tube or strip)	
		LED Lamp Length	
		# of LED Lamps per Fixture	
		LED Fixture Wattage	
Measure Verification Location and Counts	**Glass-door Reach-in Display Cases**	Total # of Reach-In Cases	
		Total # of Reach-In Doors	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	
		Low temp or Med?	
	Open Display Cases	Total Length of Open Cases	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	
Verification Summary	**(VS.A) Total Quantity Installed & Operational of LED Fixtures (ex post qty.)**		
	(VS.B) Is the ex post qty. of verified LED fixtures equal to the anticipated ex-ante qty. of LED fixtures? **If NO and site is in PG&E, answer (VS.C)** **If NO and site is in SDG&E, answer (VS.D)**		**Y N**
	(VS.C) For PG&E measure codes with baseline lamps <=5', does the ex-post quantity match anticipated quantity of LED fixtures using the 4' baseline? (anticipated quantity needs to be calculated by surveyor on-site as Rebated # of units divided by 4)		**Y N NA**
	(VS.D) For SDG&E measure codes, is the total number of verified Reach-in Doors equal to the ex-ante Rebated#of Units (doors)?		**Y N NA**
	If no to either VS.C or VS.D, please attempt to explain differences between verified ex-post quantities and anticipated ex-ante quantities (e.g. Qty not installed and in storage, Qty installed but non-operational, more refrigerated cases added since initial retrofit, etc,):		

Baseline System Specific to Measure Code	**Anticipated Baseline Lighting**	«OS_BaselineDesc_1»	
	Is post-installation operation the same as pre-retrofit operation?	Y N	B SC E
	-- If pre-retrofit operation was different, specify Sched #		
	Control (switch, panel, occ sensor)		B SC E
	Lamp Type Code		B SC E
	(If LF Baseline) - **Tube Length (e.g. 4ft, 5ft, 6ft)**		B SC E
	(If LF Baseline) **- Tube Type (e.g. T8, T12)**		B SC E
	If NOT LF Baseline: Fixture Description (e.g. LED)		B SC E
	Lamp Wattage		B SC E
	# Lamps per Fixture		B SC E
	Fixture Wattage		B SC E
	Total # of Fixtures		B SC E
	Please provide additional comments on how you determined the baseline lighting system characteristics and, if there are differences between antipated baseline lighting and baseline as you verified.		
	Were there changes to the quantities of refrigerated cases and doors remain at time of lighting retrofit?	Y N	B SC E
	If Yes, there were changes to refrigerated cases and doors, please explain the alterations (e.g. if any were removed or new ones added) and list total # cases and doors in existing system		

LED Case Lighting Measure 2

IOU Tracking Data	Claim Id		«CLaimID_2»
	Measure Code		*«OS_MeasCode_2»*
	Measure Name		«OS_MeasDescription_2»
	Rebated #of Units		«OS_NumUnits_2»
	IOU Unit Basis		*«OS_InstalledNormUnit_2»*
	Anticipated ex-ante Qty of LED Fixtures		«OS_Qty_5ft_6ft_2»
Physical Measure Verification Data	Can Rebated measures be clearly identified?		Y N
	Check box if Fixtures are NOT accessible (explain below)		☐
	# of LED Fixtures/Lamps physically inspected		
	LED Fixture Manufacturer		
	LED Fixture Model Number		
	LED LampType (tube or strip)		
	LED Lamp Length		
	# of LED Lamps per Fixture		
	LED Fixture Wattage		
Measure Verification Location and Counts	**Glass-door Reach-in Display Cases**	Total # of Reach-In Cases	
		Total # of Reach-In Doors	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	
		Low temp or Med?	
	Open Display Cases	Total Length of Open Cases	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	

Verification Summary	**(VS.A) Total Quantity Installed & Operational of LED Fixtures (ex post qty.)**	
	(VS.B) Is the ex post qty. of verified LED fixtures equal to the anticipated ex-ante qty. of LED fixtures? **If NO and site is in PG&E, answer (VS.C)** **If NO and site is in SDG&E, answer (VS.D)**	**Y N**
	(VS.C) For PG&E measure codes with baseline lamps <=5', does the ex-post quantity match anticipated quantity of LED fixtures using the 4' baseline? (anticipated quantity needs to be calculated by surveyor on-site as Rebated # of units divided by 4)	**Y N NA**
	(VS.D) For SDG&E measure codes, is the total number of verified Reach-in Doors equal to the ex-ante Rebated#of Units (doors)?	**Y N NA**
	If no to either VS.C or VS.D, please attempt to explain differences between verified ex-post quantities and anticipated ex-ante quantities (e.g. Qty not installed and in storage, Qty installed but non-operational, more refrigerated cases added since initial retrofit, etc,):	

Baseline System Specific to Measure Code	**Anticipated Baseline Lighting**	«OS_BaselineDesc_2»	
	Is post-installation operation the same as pre-retrofit operation?	**Y N**	**B SC E**
	-- If pre-retrofit operation was different, specify Sched #		
	Control (switch, panel, occ sensor)		**B SC E**
	Lamp Type Code		**B SC E**
	(If LF Baseline) - **Tube Length (e.g. 4ft, 5ft, 6ft)**		**B SC E**
	(If LF Baseline) **- Tube Type (e.g. T8, T12)**		**B SC E**
	If NOT LF Baseline: Fixture Description (e.g. LED)		**B SC E**
	Lamp Wattage		**B SC E**
	# Lamps per Fixture		**B SC E**
	Fixture Wattage		**B SC E**
	Total # of Fixtures		**B SC E**
	Please provide additional comments on how you determined the baseline lighting system characteristics and, if there are differences between antipated baseline lighting and baseline as you verified.		
	Were there changes to the quantities of refrigerated cases and doors remain at time of lighting retrofit?	**Y N**	**B SC E**
	If Yes, there were changes to refrigerated cases and doors, please explain the alterations (e.g. if any were removed or new ones added) and list total # cases and doors in existing system		

LED Case Lighting Measure 3

IOU Tracking Data	Claim Id		«CLaimID_3»
	Measure Code		*«OS_MeasCode_3»*
	Measure Name		«OS_MeasDescription_3»«OS_MeasDescription_3»
		Rebated #of Units	«OS_NumUnits_3»
		IOU Unit Basis	*«OS_InstalledNormUnit_3»*
		Anticipated ex-ante Qty of LED Fixtures	«OS_Qty_5ft_6ft_3»
Physical Measure Verification Data		Can Rebated measures be clearly identified?	Y N
		Check box if Fixtures are NOT accessible (explain below)	☐
		# of LED Fixtures/Lamps physically inspected	
		LED Fixture Manufacturer	
		LED Fixture Model Number	
		LED LampType (tube or strip)	
		LED Lamp Length	
		# of LED Lamps per Fixture	
		LED Fixture Wattage	
Measure Verification Location and Counts	**Glass-door Reach-in Display Cases**	Total # of Reach-In Cases	
		Total # of Reach-In Doors	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	
		Low temp or Med?	
	Open Display Cases	Total Length of Open Cases	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	
Verification Summary	**(VS.A) Total Quantity Installed & Operational of LED Fixtures (ex post qty.)**		
	(VS.B) Is the ex post qty. of verified LED fixtures equal to the anticipated ex-ante qty. of LED fixtures? **If NO and site is in PG&E, answer (VS.C)** **If NO and site is in SDG&E, answer (VS.D)**		**Y N**
	(VS.C) For PG&E measure codes with baseline lamps <=5', does the ex-post quantity match anticipated quantity of LED fixtures using the 4' baseline? (anticipated quantity needs to be calculated by surveyor on-site as Rebated # of units divided by 4)		**Y N NA**
	(VS.D) For SDG&E measure codes, is the total number of verified Reach-in Doors equal to the ex-ante Rebated#of Units (doors)?		**Y N NA**
	If no to either VS.C, VS.D, please attempt to explain differences between verified ex-post quantities and anticipated ex-ante quantities (e.g. Qty not installed and in storage, Qty installed but non-operational, more refrigerated cases added since initial retrofit, etc,):		

Baseline System Specific to Measure Code	**Anticipated Baseline Lighting**	«OS_BaselineDesc_3»	
	Is post-installation operation the same as pre-retrofit operation?	Y N	B SC E
	-- If pre-retrofit operation was different, specify Sched #		
	Control (switch, panel, occ sensor)		B SC E
	Lamp Type Code		B SC E
	(If LF Baseline) - **Tube Length (e.g. 4ft, 5ft, 6ft)**		B SC E
	(If LF Baseline) **- Tube Type (e.g. T8, T12)**		B SC E
	If NOT LF Baseline: Fixture Description (e.g. LED)		B SC E
	Lamp Wattage		B SC E
	# Lamps per Fixture		B SC E
	Fixture Wattage		B SC E
	Total # of Fixtures		B SC E
	Please provide additional comments on how you determined the baseline lighting system characteristics and, if there are differences between antipated baseline lighting and baseline as you verified.		
	Were there changes to the quantities of refrigerated cases and doors remain at time of lighting retrofit?	Y N	B SC E
	If Yes, there were changes to refrigerated cases and doors, please explain the alterations (e.g. if any were removed or new ones added) and list total # cases and doors in existing system		

LED Case Lighting Measure 4

IOU Tracking Data	Claim Id		«CLaimID_4»
	Measure Code		*«OS_MeasCode_4»*
	Measure Name		«OS_MeasDescription_4»
	Rebated #of Units		«OS_NumUnits_4»
	IOU Unit Basis		*«OS_InstalledNormUnit_4»*
	Anticipated ex-ante Qty of LED Fixtures		«OS_Qty_5ft_6ft_4»
Physical Measure Verification Data	Can Rebated measures be clearly identified?		Y N
	Check box if Fixtures are NOT accessible (explain below)		☐
	# of LED Fixtures/Lamps physically inspected		
	LED Fixture Manufacturer		
	LED Fixture Model Number		
	LED LampType (tube or strip)		
	LED Lamp Length		
	# of LED Lamps per Fixture		
	LED Fixture Wattage		
Measure Verification Location and Counts	**Glass-door Reach-in Display Cases**	Total # of Reach-In Cases	
		Total # of Reach-In Doors	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	
		Low temp or Med?	
	Open Display Cases	Total Length of Open Cases	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	
Verification Summary	**(VS.A) Total Quantity Installed & Operational of LED Fixtures (ex post qty.)**		
	(VS.B) Is the ex post qty. of verified LED fixtures equal to the anticipated ex-ante qty. of LED fixtures? **If NO and site is in PG&E, answer (VS.C)** **If NO and site is in SDG&E, answer (VS.D)**		**Y N**
	(VS.C) For PG&E measure codes with baseline lamps <=5', does the ex-post quantity match anticipated quantity of LED fixtures using the 4' baseline? (anticipated quantity needs to be calculated by surveyor on-site as Rebated # of units divided by 4)		**Y N NA**
	(VS.D) For SDG&E measure codes, is the total number of verified Reach-in Doors equal to the ex-ante Rebated#of Units (doors)?		**Y N NA**
	If no to either VS.C or VS.D, please attempt to explain differences between verified ex-post quantities and anticipated ex-ante quantities (e.g. Qty not installed and in storage, Qty installed but non-operational, more refrigerated cases added since initial retrofit, etc,):		

Baseline System Specific to Measure Code	**Anticipated Baseline Lighting**	«OS_BaselineDesc_4»	
	Is post-installation operation the same as pre-retrofit operation?	**Y N**	**B SC E**
	-- If pre-retrofit operation was different, specify Sched #		
	Control (switch, panel, occ sensor)		**B SC E**
	Lamp Type Code		**B SC E**
	(If LF Baseline) - **Tube Length (e.g. 4ft, 5ft, 6ft)**		**B SC E**
	(If LF Baseline) **- Tube Type (e.g. T8, T12)**		**B SC E**
	If NOT LF Baseline: Fixture Description (e.g. LED)		**B SC E**
	Lamp Wattage		**B SC E**
	# Lamps per Fixture		**B SC E**
	Fixture Wattage		**B SC E**
	Total # of Fixtures		**B SC E**
	Please provide additional comments on how you determined the baseline lighting system characteristics and, if there are differences between antipated baseline lighting and baseline as you verified.		
	Were there changes to the quantities of refrigerated cases and doors remain at time of lighting retrofit?	**Y N**	**B SC E**
	If Yes, there were changes to refrigerated cases and doors, please explain the alterations (e.g. if any were removed or new ones added) and list total # cases and doors in existing system		

LED Case Lighting Measure 5

IOU Tracking Data		Claim Id	«CLaimID_5»
		Measure Code	«OS_MeasCode_5»
		Measure Name	«OS_MeasDescription_5»
		Rebated #of Units	«OS_NumUnits_5»
		IOU Unit Basis	*«OS_InstalledNormUnit_5»*
		Anticipated ex-ante Qty of LED Fixtures	«OS_Qty_5ft_6ft_5»
Physical Measure Verification Data		Can Rebated measures be clearly identified?	Y N
		Check box if Fixtures are NOT accessible (explain below)	☐
		# of LED Fixtures/Lamps physically inspected	
		LED Fixture Manufacturer	
		LED Fixture Model Number	
		LED LampType (tube or strip)	
		LED Lamp Length	
		# of LED Lamps per Fixture	
		LED Fixture Wattage	
Measure Verification Location and Counts	**Glass-door Reach-in Display Cases**	Total # of Reach-In Cases	
		Total # of Reach-In Doors	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	
		Low temp or Med?	
	Open Display Cases	Total Length of Open Cases	
		Total # of operating LED Fixtures	
		Total Length of operating LED Fixtures	
		Control (switch, panel, occ sensor)	
Verification Summary	**(VS.A) Total Quantity Installed & Operational of LED Fixtures (ex post qty.)**		
	(VS.B) Is the ex post qty. of verified LED fixtures equal to the anticipated ex-ante qty. of LED fixtures? **If NO and site is in PG&E, answer (VS.C)** **If NO and site is in SDG&E, answer (VS.D)**		**Y N**
	(VS.C) For PG&E measure codes with baseline lamps <=5', does the ex-post quantity match anticipated quantity of LED fixtures using the 4' baseline? (anticipated quantity needs to be calculated by surveyor on-site as Rebated # of units divided by 4)		**Y N NA**
	(VS.D) For SDG&E measure codes, is the total number of verified Reach-in Doors equal to the ex-ante Rebated#of Units (doors)?		**Y N NA**
	If no to either VS.C or VS.D, please attempt to explain differences between verified ex-post quantities and anticipated ex-ante quantities (e.g. Qty not installed and in storage, Qty installed but non-operational, more refrigerated cases added since initial retrofit, etc,):		

Baseline System Specific to Measure Code	**Anticipated Baseline Lighting**	«OS_BaselineDesc_5»	
	Is post-installation operation the same as pre-retrofit operation?	Y N	B SC E
	-- If pre-retrofit operation was different, specify Sched #		
	Control (switch, panel, occ sensor)		B SC E
	Lamp Type Code		B SC E
	(If LF Baseline) - **Tube Length (e.g. 4ft, 5ft, 6ft)**		B SC E
	(If LF Baseline) **- Tube Type (e.g. T8, T12)**		B SC E
	If NOT LF Baseline: Fixture Description (e.g. LED)		B SC E
	Lamp Wattage		B SC E
	# Lamps per Fixture		B SC E
	Fixture Wattage		B SC E
	Total # of Fixtures		B SC E
	Please provide additional comments on how you determined the baseline lighting system characteristics and, if there are differences between antipated baseline lighting and baseline as you verified.		
	Were there changes to the quantities of refrigerated cases and doors remain at time of lighting retrofit?	Y N	B SC E
	If Yes, there were changes to refrigerated cases and doors, please explain the alterations (e.g. if any were removed or new ones added) and list total # cases and doors in existing system		

Overall Project Baseline Characterization

Please describe why all lights at the project level were changed to LEDs instead of any other lighting technology.	

Approximate age of existing lighting system prior to retrofit (years)	
Condition of original fixtures prior to retrofit (**G**ood, **F**air, **P**oor)	**G F P**
What % of original fixtures were completely burned out?	
What % of original fixtures were partially burned out?	
On a scale of 1-10, Please rate the following topics on their level of influence for retrofitting the lighting fixtures:	
Burned out fixtures	
Adequate lighting levels	
Major Renovation / Re-Modeling	
Safety of Occupants	
Productivity of Occupants	
Other (*describe in comments*)	
Considering all of the influential factors above, in the absence of an energy efficiency rebate program: How long would you have continued to operate the original fixtures before replacing them? (years)	

Comments: ____

____

____

Refrigeration System Characteristics

Refrigeration Equipment	Refrigeration Itron #		1	2	3
	Remote Refrigeration or Self Contained		RR SC	RR SC	RR SC
	Case Temperature	**LT** = Low (Ice Cream /Frozen **MT** = Medium (Fresh Meat / **HT** = High (Produce/Prep Areas) **OT** = Other (describe)	LT MT HT OT	LT MT HT OT	LT MT HT OT
	IF SC	Case Make/Manufacturer			
		Case Model Number			
		Number of Cases			
	IF RR	Compressor Type			
		Number of Compressors			
		Compressor Make			
		Compressor Model Number			
		CondenserType			
		Condenser Make/Manufacturer			
		Mocdel Number			

LED Fixture - Activity Area Assignment Table (AAAT) Measure Code: ________

Use the AAAT below to associate lighting fixtures to measure codes, equipment oper. schedules, and lighting loggers. The values in the ***"Represented Verified Qty LED"*** *column must add up to the* ***total # of Installed and Operational*** *units.*

- *If ONLY FIXTURE* ***DENT LL****: Only fill out* ***AAAT*** *below.*
- *If* ***DENT LL & (DENT CT or HOBO)****: Fill out* ***AAAT*** *with logger info* ***&*** *the* ***HIGHBAY*** *Form ffor Panel Metering*
- *If ONLY* ***PANEL METERING****: Check* ***N/A*** *box and only fill out* ***HIGHBAY*** *Form.*

Circle all that apply: *(If Verify Only, circle 'NA', and fill out AAAT)*

Metering Type:	DENT LL	DENT CT	HOBO	NA

☐ **N/A**

Refrig. #	Sched #	Item #	Control Type Code	Repres. Verified Qty LED	% of Total Verified Qty LED	Primary Logger S/N	Ref. Logger	Back-up Logger S/N	Comments
					%		☐		
					%		☐		
					%		☐		
					%		☐		
					%		☐		
					%		☐		
					%		☐		
					%		☐		
					%		☐		
					%		☐		
					%		☐		
					%	<= Total # of Installed & Operational Units check *(no data entry)*			

Logger Installation Form

Use this table to record information for installed measurement devices such as lighting loggers.

Installation Date		**Extraction Date**	
Installer's Initials		**Extraction Initials**	
Scheduled Extraction Date			

Installation

Logger Serial				
Primary or Backup Logger?	**P B**	**P B**	**P B**	**P B**
Case Temperature	**MT HT**	**MT HT**	**MT HT**	**MT HT**
Case Control Type				
Placement Description Include building, floor, room #, etc. and be descriptive enough that it can be located for extraction.				
Schedule #				

Extraction

Logger Intact? See	**Y N L** ***P***	**Y N L** ***P***	**Y N L** ***P***	**Y N L** ***P***
Logger Tested "OK"	**Y N** NA	**Y N** NA	**Y N** NA	**Y N** NA
% "ON" Time	%	%	%	%
Extraction Comments				
Logger Date&Time (HH:MM)				
Computer Date&Time (HH:MM)				
Alternate Extraction Date				

Logger Intact: "Y" – If logger is as originally installed, does not appear to be tampered with, and display indicates the logger is working **Logger Tested "OK"** – If Logger Intact was "Y" then is it properly logging the light ON/OFF, "Y" or "N"? If Logger Intact was "N" use "NA"

Logger Installation Form (continued)

Use this table to record information for installed measurement devices such as lighting loggers.

Installation

Logger Serial Number				
Primary or Backup Logger?	**P B**	**P B**	**P B**	**P B**
Case Temperature	**MT HT**	**MT HT**	**MT HT**	**MT HT**
Case Control Type				
Placement Description Include building, floor, room #, etc. and be descriptive enough that it can be located for extraction.				
Schedule #				

Extraction

Logger Intact?	**Y N L** ***P***	**Y N L** ***P***	**Y N L** ***P***	**Y N L** ***P***
Logger Tested "OK"	**Y N** NA	**Y N** NA	**Y N** NA	**Y N** NA
% "ON" Time	%	%	%	%
Extraction Comments				
Logger Date&Time (HH:MM)				
Computer Date&Time (HH:MM)				
Alternate Extraction Date				

Logger Intact: "Y" – If logger is as originally installed, does not appear to be tampered with, and display indicates the logger is working

Logger Tested "OK" – If Logger Intact is "Y" then is it properly logging the light ON/OFF, "Y" or "N"? If Logger Intact is "N" use "NA"

General Comments

Item #	Form Name	Comments

Site Photo Log

Record site photo information here including the PhotoID (i.e. digital file name) and a brief description of the photo where needed. Site Photos should include the site entrance and entire building, rebated measures, and close-up photos of nameplates, lamp codes, and other make/model identification. Refer to the training manual for more on what photos to take. Photo/file naming conventions is SiteID_Item# or SiteID 00# (e.g. PGE_056789_1.jpg, PGE_056789 001.jpg).

Item #	Description/Comments/Measure Code *(no data entry)*
1	
2	
3	
4	
5	
6	
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8	
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10	
11	
12	
13	
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23	
24	

Incentive Payment
My signature acknowledges that I received a participation incentive in the form of a $____ gift card for the survey effort.

Print Name		**Date Received**	
Gift Card Company		**Gift Card Serial #**	
Signature			

PROCESS PUMPING VFD ON-SITE SURVEY INSTRUMENT

Process Pumping VFD On-Site Data Collection Form

Project Information			
IOU			
ApplicationCode or ProjectID			
Program ID			
Program Name			
Point of Sale Purchase?			
IOU Claim ID(s)	Measure 1:		
	Measure 2:		
IOU Measure Description	Measure 1:		Put units from tracking system below
	Measure 2:		<NormUnit>
Number of Units Installed	Measure 1:		
	Measure 2:		
Project Application Date			
Project Installation Date			Engineer update below as needed [ENTER]:
Business Name			
Business Street Address			
Business City			
Customer Contact Name			
Customer Contact Phone Number			
Customer Contact E-mail Address			
Vendor Business Name			
Vendor Contact Name			
Vendor Contact Phone Number			
Vendor Contact E-mail Address			
Site Information			
Assigned Engineer Name			
Assigned Engineer Firm			
Site Visit Consent Granted Y/N			
Date of First On-Site Visit			
Utility Meter Information			Engineer update below as needed [ENTER]:
Account Number from Tracking Data	Measure 1:		
Dedicated Electric Meter for Pump			
If no, describe other loads on meter			
Associated Electric Meter Number for			
Account Number from Tracking Data	Measure 2:		
Dedicated Electric Meter for Pump			
If no, describe other loads on meter			
Associated Electric Meter Number for			

Process Pumping VFD On-Site Data Collection Form

Recruitment Checklist

Application # ____________________________

Meeting	
Location of Meeting	
Directions to Meeting Spot	
Date of Meeting	
Time of Meeting	
Site Contact Name	
Site Contact Phone Number	
Site Contact E-mail	
VFD Measure #1	
Is the pump/VFD served by a dedicated electric meter, or are there other loads such as pumps on the same electric meter?	
If shared load -- what other loads are on the electric meter including horsepower associated with additional pumps?	
VFD Measure #2	
Is the pump/VFD served by a dedicated electric meter, or are there other loads such as pumps on the same electric meter?	
If shared load -- what other loads are on the electric meter including horsepower associated with additional pumps?	
VFD Information	
Does VFD Have Trending Capability?	
If yes, do you trend data, such as kWh every hour, VFD Hz, etc?	
Can you share that with us?	
If yes, can you trend data for us, including kWh every hour, VFD Hz, etc?	
Project Information Requested from Participants	
Project invoices	
Monthly water usage data for last three years	
Pump test data (OPE) from VFD post-installation period	
Pump test data (OPE) from VFD pre-installation period	

Process Pumping VFD On-Site Data Collection Form

Business Activity

Application # ___________________________

[Circle One Below]	What is the main business ACTIVITY at this facility?	
1	Offices (non-medical)	
2	Restaurant/Food Service	
3	Food Store (grocery/liquor/convenience)	
4	Agricultural (farms, greenhouses)	
5	Retail Stores	
6	Warehouse	
7	Health Care	
8	Education	
9	Lodging (hotel/rooms)	
10	Public Assembly (church, fitness, theatre, library, museum, convention)	
11	Services (hair, nail, massage, spa, gas, repair)	
12	Industrial (food processing plant, manufacturing)	
13	Laundry (Coin Operated, Commercial Laundry Facility, Dry Cleaner)	
14	Condo Assoc./Apartment Mgr (Garden Style, Mobile Home Park, High-rise, Townhouse)	
15	Public Service (fire/police/postal/military)	
77	Other / Record Business Activity [ENTER] ====>	

Provide additional comments as needed [ENTER] ===>

Provide specifics on activity [ENTER] ===>
(i.e., industrial bakery or commercial greenhouse)

Process Pumping VFD On-Site Data Collection Form

EE Measure Replacement Battery

Application # ___________________________ <=== Enter Application Code

[Circle One Entry]	[Answer for Measure #1] Along with the new VFD, was a new pump also installed at the same time? [PROBE TO FIND CORRECT RESPONSE BELOW]	[Circle One Entry]	[Answer for Measure #2] Along with the new VFD, was a new pump also installed at the same time? [PROBE TO FIND CORRECT RESPONSE BELOW]
1	Replaced existing pump	1	Replaced existing pump
2	Added a new pump	2	Added a new pump
3	Added VFD to existing pump	3	Added VFD to existing pump
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

(Circle One Entry)	[Answer for Measure #1] Approximately how old is the pump being controlled by the VFD? Would you say...	(Circle One Entry)	[Answer for Measure #2] Approximately how old is the pump being controlled by the VFD? Would you say...
4	Less than 5 years old	4	Less than 5 years old
5	Between 5 and 10 years old	5	Between 5 and 10 years old
6	Between 10 and 15 years old	6	Between 10 and 15 years old
7	More than 15 years old	7	More than 15 years old
8	Stated age _______ years	8	Stated age _______ years
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Process Pumping VFD On-Site Data Collection Form

EE Measure Replacement Battery

Application # ___________________________ <=== Enter Application Code

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

[Answer for Measure #1] [Circle One Entry]	How would you describe the condition of the pump being controlled by the VFD? Would you say it is in…	**[Answer for Measure #2]** [Circle One Entry]	How would you describe the condition of the pump being controlled by the VFD? Would you say it is in…
9	Poor condition	**9**	Poor condition
10	Fair condition	**10**	Fair condition
11	Good condition	**11**	Good condition
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

[Answer for Measure #1] [Circle One Entry]	How many years are left in the pump itself until you will replace it?	**[Answer for Measure #2]** [Circle One Entry]	How many years are left in the pump itself until you will replace it?
12	Remaining pump life _______ years	**12**	Remaining pump life _______ years
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Process Pumping VFD On-Site Data Collection Form

EE Measure Replacement Battery

Application # ___________________________ <=== Enter Application Code

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

[Answer for Measure #1]		**[Answer for Measure #2]**	
[Circle One Entry]	What type of pump flow controls were in place BEFORE the VFD was installed?	**[Circle One Entry]**	What type of pump flow controls were in place BEFORE the VFD was installed?
13	None; pump was uncontrolled	**13**	None; pump was uncontrolled
14	Throttle valve controls	**14**	Throttle valve controls
15	VFD controls	**15**	VFD controls
16	Other / Provide Related Commentary Below:	**16**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

[Answer for Measure #1]		**[Answer for Measure #2]**	
(Circle One Entry)	Approximately how old were the replaced pump flow controls? Would you say...	**(Circle One Entry)**	Approximately how old were the replaced pump flow controls? Would you say...
17	Less than 5 years old	**17**	Less than 5 years old
18	Between 5 and 10 years old	**18**	Between 5 and 10 years old
19	Between 10 and 15 years old	**19**	Between 10 and 15 years old
20	More than 15 years old	**20**	More than 15 years old
21	Stated age _______ years	**21**	Stated age _______ years
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Process Pumping VFD On-Site Data Collection Form

EE Measure Replacement Battery

Application # ___________________________ <=== Enter Application Code

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

[Answer for Measure #1]		**[Answer for Measure #2]**	
[Circle One Entry]	How would you describe the condition of the replaced pump flow controls? Would you say the controls were …	**[Circle One Entry]**	How would you describe the condition of the replaced pump flow controls? Would you say the controls were …
22	Not working	**22**	Not working
23	In poor condition	**23**	In poor condition
24	In fair condition	**24**	In fair condition
25	In good condition	**25**	In good condition
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Process Pumping VFD On-Site Data Collection Form

EE VFD Battery

Application # ___________________________ <=== Enter Application Code

[Ask ALL]

[Circle One Entry]	**[Answer for Measure #1]** What was the main reason you decided to control your pump flow using a VFD?	**[Circle One Entry]**	**[Answer for Measure #2]** What was the main reason you decided to control your pump flow using a VFD?
26	Existing controls were not functioning adequately	**26**	Existing controls were not functioning adequately
27	Using alternative controls was not a feasible solution (such as throttling or running an uncontrolled pump)	**27**	Using alternative controls such as throttling or running an uncontrolled pump was not a feasible solution
28	The pump and VFD were sold as an integrated unit	**28**	The pump and VFD were sold as an integrated unit
29	Wanted improved pump performance or functionality	**29**	Wanted improved pump performance or functionality
30	Wanted remote monitoring and control capability	**29**	Wanted improved pump performance or functionality
31	Wanted automatic speed controls	**29**	Wanted improved pump performance or functionality
32	Other / Provide Related Commentary Below:	**30**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Process Pumping VFD On-Site Data Collection Form

EE VFD Battery

Application # ___________________________ <=== Enter Application Code

[Ask ALL]

[Circle One Entry]	**[Answer for Measure #1]** At the time of VFD installation, was the program or rebate important or influential in your decision to purchase a VFD?	**[Circle One Entry]**	**[Answer for Measure #2]** At the time of VFD installation, was the program or rebate important or influential in your decision to purchase a VFD?
33	Yes	**31**	Yes
34	No	**32**	No
35	Other / Provide Related Commentary Below:	**33**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Process Pumping VFD On-Site Data Collection Form

EE VFD Battery

Application # ___________________________ <=== Enter Application Code

[Ask ALL]

(Circle One Entry)	**[Answer for Measure #1]** If not for the program/rebate, approximately how much longer would you have waited to install VFD flow controls? Would you say...	**(Circle One Entry)**	**[Answer for Measure #2]** If not for the program/rebate, approximately how much longer would you have waited to install VFD flow controls? Would you say...
36	Within a one-year period	**34**	Within a one-year period
37	Between 2 and 3 years	**35**	Between 2 and 3 years
38	4 or more years	**36**	4 or more years
39	Would never have installed a VFD	**38**	Would never have installed a VFD
40	Stated _______ years	**37**	Stated _______ years
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Process Pumping VFD On-Site Data Collection Form

EE VFD Battery

Application # ___________________________ <=== Enter Application Code

[Ask ALL]

[Circle One Entry]	[Answer for Measure #1] What type of pump does the VFD control?	[Circle One Entry]	[Answer for Measure #2] What type of pump does the VFD control?
41	Vertical turbine pump	39	Vertical turbine pump
42	Submiersible pump	40	Submiersible pump
43	Centrifugal pump	41	Centrifugal pump
44	Other / Provide Related Commentary Below:	30	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] What is the horsepower rating of the pump that is being controlled by the VFD? Would you say...	(Circle One Entry)	[Answer for Measure #2] What is the horsepower rating of the pump that is being controlled by the VFD? Would you say...
45	Less than 25 hp	42	Less than 25 hp
46	Between 25 and 50 hp	43	Between 25 and 50 hp
47	Between 50 and 100 hp	44	Between 50 and 100 hp
48	Between 100 and 200 hp	45	Between 100 and 200 hp
49	Between 200 and 300 hp	46	Between 200 and 300 hp
50	More than 300 hp	47	More than 300 hp
51	Rated capacity _______ hp	48	Rated capacity _______ hp
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Process Pumping VFD On-Site Data Collection Form

2019 Pumping System Operation by Measure

Measure # ____________________________

Application # ____________________________

IOU Measure Description ____________________________

Number of units installed # ____________________________

Month of 2019	During what months did you irrigate using this pump? **[Check All that Apply]**	How many acres were served by this pump each month? **[Enter Acres]**	List crops grown that were served by this pump? **[Enter Crops and Percentage of Area Served if More Than One Crop]**	List crop age for each crop in years. **[Enter Crops and Age]**	List irrigation method served by this pump? **[Enter Drip, Sprinkler, flood, etc. and Percentages of Area Served if More Than One Method is Used]**	List water supply serving this pump? **[Enter Well Water, District Main, etc. and Percentages of Area Served if More Than One Source was Used]**	Describe the field configuration? **[Enter Number of Irrigation Sets and Associated Acres and Any Association with Each Crop]**
January							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							

	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]

Process Pumping VFD On-Site Data Collection Form

2018 Pumping System Operation by Measure

Measure # ___________________________

Application # ___________________________

IOU Measure Description ___________________________

Number of units installed # ___________________________

Month of 2018	During what months did you irrigate using this pump? **[Check All that Apply]**	How many acres were served by this pump each month? **[Enter Acres]**	List crops grown that were served by this pump? **[Enter Crops and Percentage of Area Served if More Than One Crop]**	List crop age for each crop in years. **[Enter Crops and Age]**	List irrigation method served by this pump? **[Enter Drip, Sprinkler, flood, etc. and Percentages of Area Served if More Than One Method is Used]**	List water supply serving this pump? **[Enter Well Water, District Main, etc. and Percentages of Area Served if More Than One Source was Used]**	Describe the field configuration? **[Enter Number of Irrigation Sets and Associated Acres and Any Association with Each Crop]**
January							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							

	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]

Process Pumping VFD On-Site Data Collection Form

2017 Pumping System Operation by Measure

Measure # ___________________________

Application # ___________________________

IOU Measure Description ___________________________

Number of units installed # ___________________________

Month of 2017	During what months did you irrigate using this pump? **[Check All that Apply]**	How many acres were served by this pump each month? **[Enter Acres]**	List crops grown that were served by this pump? **[Enter Crops and Percentage of Area Served if More Than One Crop]**	List crop age for each crop in years. **[Enter Crops and Age]**	List irrigation method served by this pump? **[Enter Drip, Sprinkler, flood, etc. and Percentages of Area Served if More Than One Method is Used]**	List water supply serving this pump? **[Enter Well Water, District Main, etc. and Percentages of Area Served if More Than One Source was Used]**	Describe the field configuration? **[Enter Number of Irrigation Sets and Associated Acres and Any Association with Each Crop]**
January							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							

Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]

Process Pumping VFD On-Site Data Collection Form

2019 Pumping System Operation by Measure (part 2)

Measure # ___________________________

Application # ___________________________

IOU Measure Description ___________________________

Number of units installed # ___________________________

An important modeling feature we want to define concerns the the ***predominant modes of operation*** that we can define, based on feedback from the farmer, and defined as the pump operating at a certain speed and flow rate.

Predominant Modes of Operation	Motor speed [expressed as percent of full speed] (%)	Pumping Flow Rate (gpm)	VFD Frequency (Hz)	Pump Operating Pressure (psi)	VFD Settings [Manual versus Auto]
Mode 1					
Mode 2					
Mode 3					
Full speed/flow					

Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]

Process Pumping VFD On-Site Data Collection Form

2019 Pumping System Operation by Measure (part 2)

Seasonal Operation by Mode	List Months with Common Irrigation Needs	Predominant Modes of Operation	Days per Week in Each Mode	Hours per Day in Each Mode	Percent of Irrigation During Weekday Afternoons
Spring		Mode 1			
		Mode 2			
		Mode 3			
		Full speed/flow			
Summer		Mode 1			
		Mode 2			
		Mode 3			
		Full speed/flow			
Fall		Mode 1			
		Mode 2			
		Mode 3			
		Full speed/flow			
Winter		Mode 1			
		Mode 2			
		Mode 3			
		Full speed/flow			

Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]	Provide additional comments as needed [ENTER BELOW]

Process Pumping VFD On-Site Data Collection Form

EE Measure Installation Verification

Measure # ____________________________
Application # ____________________________
IOU Measure Description ____________________________
Number of units installed # ____________________________

[Circle One Entry] Was the VFD found to be installed and operable at the time of the on-site inspection?

1	Yes	
2	No	
3	Other / Provide Related Commentary [ENTER] ====>	

Provide additional comments as needed [ENTER] ===>

[If 2/No above, then provide additional comments]

Provide additional comments to explain [ENTER] ===>

Process Pumping VFD On-Site Data Collection Form

EE Pumping System Specifications

Measure # ____________________________
Application # ____________________________
IOU Measure Description ____________________________
Number of units installed # ____________________________

[ENTER PUMP SPECIFICATIONS]	**[Circle One per Line or Write Down Units if Different]**
Manufacturer ____________________________	
Make ____________________________	
Model ____________________________	
Pump Type ____________________________	Vertical turbine Submersible Centrifugal
Year of manufacture ____________________________	
Pumping Application ____________________________	Booster pump Well pump
Current Operating Output Pressure ____________________________	PSIG
Current Operating Flow Rate ____________________________	gpm
[ENTER MOTOR SPECIFICATIONS]	
Manufacturer ____________________________	
Make ____________________________	
Model ____________________________	
Power Rating ____________________________	Horsepower
Voltage ____________________________	110 115 208 230 460
RLA ____________________________	Running load amps
Rated Motor Efficiency ____________________________	%
Motor Rated Speed ____________________________	rpm
Year of manufacture ____________________________	
[ENTER VFD EQUIPMENT SPECIFICATIONS]	
Manufacturer ____________________________	
Make ____________________________	
Model ____________________________	
	[Circle One per Line or Write Down Units if Different]
Rated VFD Efficiency ____________________________	%
Year of manufacture ____________________________	
Current Operating Frequency ____________________________	Hz
Current Operating Motor Speed ____________________________	rpm %
Cumulative Electric Usage ____________________________	kWh
Cumulative Run Hours ____________________________	Hours

Provide additional comments as needed [ENTER] ===>

[ENTER RELEVANT WELL CHARACTERISTICS]	**[Circle One per Line or Write Down Units if Different]**
Well depth ____________________________	Feet

Provide additional comments as needed [ENTER] ===>
Ask if well depth varies and if so describe

Process Pumping VFD On-Site Data Collection Form

Please provide of sketch of the Pumping Operation/ Field, depicting pump configuration

Process Pumping VFD On-Site Data Collection Form

Additional Notes from Site Visit

AGRICULTURAL IRRIGATION ON-SITE SURVEY INSTRUMENT

CPUC Agricultural Irrigation Prescriptive Measure Study

1. General Info		2. Site Visit Preparation Checklist
Site ID		□ Confirm site visit date/time/location
Visit Date & Time		
Field Engineer		**3. Data Requests**
Facility Name		□ Project invoices
Address		□ Utility bills - pre and post (up to 24 months)
Contact		□ Water usage data - pre and post (up to 24 months)
Phone		□ Copy of recent pump testing data (OPE)
Install Date		□ Copy of pre-installation pump testing data (OPE)
Operation Notes		□ Smart meter interval data

4. Site Visit Logistics

Where to meet and when?		Contact cell phone number:	
Who are we meeting?		Details of meeting spot:	

5. Farm Characteristics

Irrigation area impacted by project (acres)			
Growing season(s) - as detailed as possible			
Does irrigation occur outside of growing season(s)? Describe.			
Irrigation start (# month)		Irrigation end (# month)	
How is irrigation water supplied (well, district main, other)?			
Interview to determine if pre/post water use was atypical due to drought.			

6. Irrigation Characteristics

	Pre	Post
Irrigation method (flood, drip, sprinkler, vacant field, other)		
Crop type(s)		
Crop age(s)		
Quantity and average size of "sets" (sections of acreage irrigated at a time)		
Estimated count of trees/bushes/plants per acre		
Quantity of sprinkler nozzles/emitters per acre		
Nozzle/emitter manufacturer		
Nozzle/emitter casing color and/or model		
Nozzle/emitter rated flow rate (gpm - may need to look up after)		
Pump control configuration (constant, two-speed, VFD)		
If VFD, explain how speed is controlled - manually set or automatic?		
If VFD, estimate average pump speed during irrigation		
Estimated pump operating pressure (gauge readings) (psi)		
On average, how many times per month is each set irrigated?		
In the warmest/driest month, how many times per month is each set irrigated?		
How long is each set irrigated on average? (hours)		
Does irrigation occur during summer weekday afternoons?		
Additional pre-project notes		

7. Motor Nameplate Data

(Note: Record pre-install pump information if it has changed)

Motor #	Make	Model	Horsepower	Phase	Voltage	Rated Amps	RPM	Rated Efficiency
Motor 1								
Motor 2								
Motor 3								
Motor 4								
Motor 5								

8. Preexisting Equipment Details

How old was your existing irrigation equipment?

In what condition was the existing irrigation equipment?

How much longer do you think the irrigation system would have lasted if you had not replaced it?

Is this your first time using drip tape as an irrigation method?

[If yes] How is functioning so far? When are you anticipating to replace it next?

[If no] How long/How many times have you used drip tape? How frequently do you typically replace your drip tape?

ESPI TANKLESS WATER HEATER ON-SITE SURVEY INSTRUMENT

CPUC ESPI Tankless Water Heater Prescriptive Measure Study

1. General Info	ERS Site ID:
Visit Date & Time	
Field Engineer	
Facility Name	
Address	
Contact	
Phone	
Project Installation Date	
Decision maker contact info	
Contractor contact info	

2. Site Visit Preparation Checklist
□ Identify and check out equipment as needed
□ Bring site visit kit, gloves, Hobo thermocouple logger, IR gun
□ Confirm site visit date/time/location
□ Ask battery of pre-visit questions with site contact
□ Does facility have additional safety requirements?
□ Verify TWH installation with site contact (qty, size)

3. TWH Nameplate Information			Efficiency				4. Spot Measurements	
WH #	Make/Model	Max GPM (@ temp rise)	UEF or EF	Et (thermal eff)	Recovery Efficiency	Input Capacity (Btu/h)	Temp Out (F)*	Temp In (F)*
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

* Temperature inlet or outlet (in/exit), Spot check temperature with IR gun

5. Pre Existing WH Information	
Type (storage/ tankless)	
Fuel	
Tank Size (Gallon) or Capacity (kBtuh)	
Operating Condition	
Age†	
Quantity	
RUL (yrs)	

† Use increments of 5 years for estimation

6. Operational Information
What are the facility's typical hours of operation
Does the facility operate on holidays? Indicate holidays with no operation.
Does facility operation/production vary throughout the year? Please indicate fluctuation by season or by month.
Is there enough variation in facility operation to affect energy usage?

7. EUL Questions
1) Was your existing water heater equipment a storage or tankless water heater(s)?
2) How old was your existing water heater equipment?†
3) What condition wat the existing water heating equipment in?
4) How much longer do you think your existing water heater(s) would have lasted if you had not replaced it?
5) How is your new tankless water heater(s) functioning so far?
6) When are you anticipating replacing your water heater(s) next?

† Use increments of 5 years for estimation

Data Collection
- ❑ Collect TWH nameplate information (max GPM, UEF or EF, Input Capacity, Recovery Eff)
- ❑ Gather information on hot water end uses and survey the relatent hot water fixtures during walkthrough

Spot Measurements
- ❑ Request permission to spot measure TWH inlet temperature and supply (exit) temperature by puncturing small hole in insulation.
- ❑ Spot measurements of inlet and supply (exit) pipe surface temperature.

Baseline
- ❑ Survey site staff for information on project baseline and preexisting conditions at facility
- ❑ Determine the baseline water heater type, age, (and if possible, model, tank size (gal), model)

Facility Operating Conditions
- ❑ Survey site staff for information on facility's operating schedule and seasonal variation
- ❑ Inventory all gas meters at facility
- ❑ Inventory all gas uses at facility, by season (estimate gas usage share)

Checkout
- ❑ Provide contact information via business card

8. Notes

APPENDIX C ESPI MEASURE MAPPING

PA	ESPI Category	Measure Description
PGE	AG IRRIGATION	Sprinkler to Drip irrigation - Field/Vegs (well and non well)
PGE	PROCESS PUMPING VFD	AGR WELL PUMPS (LTE 75HP) VFD - ENHANCED SPECIFICATIONS
PGE	PROCESS PUMPING VFD	BOOSTER PUMPS (GT 75HP TO LTE 150HP) VFD - ENHANCED SPECIFICATIONS, RETROFIT AND NEW CONSTRUCTION
PGE	PROCESS PUMPING VFD	BOOSTER PUMPS (LTE 75HP) VFD - ENHANCED SPECIFICATIONS, RETROFIT AND NEW CONSTRUCTION
PGE	PROCESS PUMPING VFD	Glycol Pump VFD- 15HP
PGE	PROCESS PUMPING VFD	Glycol Pump VFD- 20HP
PGE	PROCESS PUMPING VFD	Glycol Pump VFD- 5HP
PGE	PROCESS PUMPING VFD	Variable Frequency Drive on Agricultural Booster Pumps (<=150hp)
PGE	PROCESS PUMPING VFD	Variable Frequency Drive on Agricultural Well Pumps (<=300hp)
PGE	PROCESS PUMPING VFD	WELL PUMPS (GT 75HP TO LTE 600HP) VFD - ENHANCED SPECIFICATIONS, RETROFIT AND NEW CONSTRUCTION
PGE	REFRIGERATION CASE LED LIGHTING	LIN FT T1 LED LTBAR <= 5FT UNIT NO OCC SENS CTRL REPLACE MULT LAMP PROFILE
PGE	REFRIGERATION CASE LED LIGHTING	LIN FT T1 LED LTBAR > 5FT UNIT NO OCC SENS CTRL REPLACE MULT LAMP PROFILE
PGE	REFRIGERATION CASE LED LIGHTING	LIN FT T2 LED LTBAR <= 5FT UNIT NO OCC SENS CTRL REPLACE MULT LAMP PROFILE
PGE	REFRIGERATION CASE LED LIGHTING	LIN FT T2 LED LTBAR > 5FT UNIT NO OCC SENS CTRL REPLACE MULT LAMP PROFILE
PGE	REFRIGERATION CASE LED LIGHTING	LIN FT T3 LED LTBAR <= 5FT UNIT NO OCC SENS CTRL REPLACE MULT LAMP PROFILE
PGE	REFRIGERATION CASE LED LIGHTING	LIN FT T3 LED LTBAR > 5FT UNIT NO OCC SENS CTRL REPLACE MULT LAMP PROFILE
PGE	REFRIGERATION CASE LED LIGHTING	REFRIG CASE LTG-TIER 1 LED LIGHTBAR <= 5-FOOT UNIT NO OCC SENSOR CONTROL
PGE	REFRIGERATION CASE LED LIGHTING	REFRIG CASE LTG-TIER 1 LED LIGHTBAR > 5-FOOT UNIT NO OCC SENSOR CONTROL
PGE	REFRIGERATION CASE LED LIGHTING	REFRIG CASE LTG-TIER 2 LED LIGHTBAR <= 5-FOOT UNIT NO OCC SENSOR CONTROL
PGE	REFRIGERATION CASE LED LIGHTING	REFRIG CASE LTG-TIER 2 LED LIGHTBAR > 5-FOOT UNIT NO OCC SENSOR CONTROL
PGE	REFRIGERATION CASE LED LIGHTING	REFRIG CASE LTG-TIER 3 LED LIGHTBAR <= 5-FOOT UNIT NO OCC SENSOR CONTROL

PA	ESPI Category	Measure Description
PGE	REFRIGERATION CASE LED LIGHTING	REFRIG CASE LTG-TIER 3 LED LIGHTBAR > 5-FOOT UNIT NO OCC SENSOR CONTROL
PGE	WATER HEATING TANKLESS WATER HEATER	Instantaneous Domestic Water Heater - Condensing, 76-200 kBTUh, TE > 90%
PGE	WATER HEATING TANKLESS WATER HEATER	Instantaneous Domestic Water Heater - Condensing, > 200 kBTUh, > 90% TE
PGE	WATER HEATING TANKLESS WATER HEATER	Instantaneous Domestic Water Heater, > 200 kBTUh, > 85% TE
SCE	PROCESS PUMPING VFD	VFD on Ag Booster Pumps (<=150hp) NEW Express Pump
SCE	PROCESS PUMPING VFD	VFD on Ag Well Pumps (<=300hp) NEW Express Pump
SCE	PROCESS PUMPING VFD	VFD on Agricultural Booster Pumps (<=150hp) Pump
SCE	PROCESS PUMPING VFD	VFD on Agricultural Well Pumps (<=300hp) Pump
SCE	PROCESS PUMPING VFD	Variable Frequency Drive on Agricultural Booster Pumps (<=150hp)
SCE	PROCESS PUMPING VFD	Variable Frequency Drive on Agricultural Well Pumps (<=300hp)
SCE	REFRIGERATION CASE LED LIGHTING	(1) 72in Retrofits in Medium Temp Reach-in Display Cases LED replacing (1) 72in T12 Linear Fluorescent
SCG	WATER HEATING TANKLESS WATER HEATER	Tankless Water Heater <=200 MBtu/hr (Small / Medium), Tier 1 (>=0.81 UEF)
SCG	WATER HEATING TANKLESS WATER HEATER	Tankless Water Heater <=200 MBtu/hr (Small / Medium), Tier 2 (>=0.87 UEF)
SCG	WATER HEATING TANKLESS WATER HEATER	TanklessWaterHeaters-Large(>200MBtuh)-Tier2(>=90%TE)
SDGE	PROCESS PUMPING VFD	VFD on Agricultural Booster Pumps for 150 HP and below
SDGE	REFRIGERATION CASE LED LIGHTING	Lighting - Premium Tier 5 foot Case Door
SDGE	REFRIGERATION CASE LED LIGHTING	Lighting - Premium Tier 6 foot Case Door

APPENDIX D NET-TO-GROSS SUPPORTING MATERIALS

This appendix provides the following materials to support the NTG Analysis:

- A document describing the updates made to the current Nonresidential Net-to-Gross (NTG) framework for this 2018 evaluation cycle.
- A detailed description of the NTG algorithm for both downstream and midstream programs. Also included are the individual survey responses for each customer and vendor survey, along with the PAI and vendor scores, and the resulting NTGRs used to develop the ex-post NTGR values for the Refrigeration Case Lighting, Process Pumping VFDs and Tankless Water Heating measures.

UPDATES TO NONRESIDENTIAL NET-TO-GROSS FRAMEWORK FOR 2018 EVALUATION

This Appendix describes updates made to the current Nonresidential Net-to-Gross (NTG) framework for this 2018 evaluation cycle. This framework has been used with minor modifications since the 2006-2008 evaluation cycle. Team members from both the Group A and Group D evaluation teams coordinated to develop two changes that have been incorporated into the 2018 Small Commercial and Lighting evaluations:

1. **An alternative to the current PAI-1 score.** This is designed to address problems identified in previous evaluation cycles.
2. **Expansion of the framework to address Midstream programs.** The expanded framework incorporates a Vendor score and combines it with the Participating Customer score if certain conditions are met.

The updates apply to the following nonresidential programs and measures for the PY2018 evaluation cycle. The Group A and Group D evaluation teams will consider modifications to these updates as well as expansion to additional measures for the PY2019 evaluations.

TABLE D-1: AFFECTED PROGRAMS AND MEASURES

NTG Component	Program Type	Program Year	Program	Measure
PAI_1	Deemed	PY18 & 19	All Relevant Nonresidential Downstream Deemed Programs	Agricultural Irrigation
				Process Pumping VFD
				Refrigeration Case LED Lighting
				Water Heating Tankless Water Heater
				Lighting Indoor LED Reflector Lamp
				Lighting Indoor LED Lamp
		PY19		Lighting Indoor LED Fixture
				Lighting Indoor LED High Bay Fixture
				Lighting Outdoor LED Fixture
				Ozone Laundry
	Calculated	PY18 & 19	All Nonresidential Calculated Program-Measures	
Midstream	Deemed	PY18	SCE Midstream Point of Purchase	Lighting Indoor LED lamps and fixtures
			SCE IDEEA365	Process Pumping VFD
			PG&E and SCG Commercial Deemed Incentives	Tankless Water Heaters
		PY19	TBD	TBD
	Calculated	PY18 & 19	None	None

D.1 BACKGROUND

Over the last several evaluation cycles, Net-to-Gross (NTG) analysis for Nonresidential programs has used a Self-Report Approach (SRA) that is based on the results of self-report telephone surveys with program participants. The existing Nonresidential Net-to-Gross (NTG) framework was originally developed by the Nonresidential Working Group during the 2006-2008 evaluation cycle and was updated modestly during the 2010-2012 cycle. This approach was designed to fully comply with the California Energy Efficiency Evaluation: Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals[1] (Protocols) and the Guidelines for Estimating Net-To-Gross Ratios Using the Self-Report Approaches (Guidelines), as demonstrated in the Nonresidential NTGR Methods (Appendix D-1 to the full WO033 Custom Final Report).

Standardized Nonresidential NTG Algorithm Improvements

Current Algorithm and Rationale

The standardized Nonresidential NTG framework incorporates a 0 to 10 scoring system for key questions used to estimate the NTGR. It consists of a 3-score structure, with each score representing a different way of characterizing program influence:

- **Program attribution index 1 (PAI–1)** score that reflects the influence of the most important of various program and non-program-related elements in the customer's decision to select the specific program measure at the time they did. Program influence through vendor recommendations is also incorporated in this score.
- **Program attribution index 2 (PAI–2)** score that captures the perceived importance of the program (whether rebate, recommendation, training, or other program intervention) relative to non-program factors in the decision to implement the specific measure that was eventually adopted or installed. This score is determined by asking respondents to assign importance values to both the program and most important non-program influences so that the two total 10. The program influence score is reduced in half if respondents say they had already made their decision to install the specific program qualifying measure before they learned about the program.
- **Program attribution index 3 (PAI–3)** score that captures the likelihood of various actions the customer might have taken at the time they did, and in the future, if the program had not been available (the counterfactual).

1 The TecMarket Works Team. California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals. Directed by the CPUC's Energy Division, and with guidance from Joint Staff, April 2006.

The resulting self-reported NTGR in most cases is simply the average of the PAI-1, PAI-2, and PAI-3 values, divided by 10. The one exception to this is when the respondent indicates a 10 in 10 probability of installing the same equipment at the same time in the absence of the program, in which case the NTGR is based on the average of the PAI-2, and PAI-3 values only. The reasoning is that the customer has responded with absolute certainty that the program did not influence their decisionmaking through their responses to PAI-3, whereas responses to the PAI-1 score typically indicate some level of program influence despite efforts to check and resolve the consistency of their responses.

The rationale for using three separate scores (triangulation [2]), rather than relying on a single metric, is as follows. The objective of the NTGR analysis is to determine the fraction of the gross savings that occurred because of the program. One minus this score is interpreted as freeridership. Some questions are designed to measure the counterfactual by asking the participant several questions about what they would have done in the absence of the program. Other questions attempt to get at the direct influence of the rebate and other forms of assistance on the decision to install efficient equipment. As part of this set of questions, the respondent is prompted to consider other possible non-program influences that might have played a role in the decision. Still other questions attempt to establish the chronology of when the participant first heard about the program and their decision to install the efficient equipment. These three different types of questions are trying to measure three slightly different things with some being more difficult than others for the respondent to assess. For example, it is easier for the respondent to recall whether they found out about the availability of the rebate before or after they decided to buy the efficient equipment than it is to imagine what they would have done in the absence of the program or assess the influence of the rebate. Nevertheless, all three types of questions provide information about the influence of the program that decision makers should find both meaningful and useful.

One of the problems inherent in asking program participants if they would have installed the same equipment or adopted the same energy-saving practices without the program is that we are asking them to recall what has happened in the past. Worse than that is the fact that what we are really asking them, among other things, is report on a hypothetical situation, what they would have done in the absence of the program. In many cases, the respondent may simply not know and/or cannot know what would have happened in the absence of the program. Even if the customer has some idea of what would have happened, there is, of necessity, uncertainty about it. The situation just described is a circumstance ripe for invalid answers (low construct validity) and answers with low reliability, where reliability is defined as the likelihood that a respondent will give the same answer to the same question whenever or wherever it is asked. It is well known in the interview literature that the more factual and concrete the information the survey requests, the more accurate responses are likely to be. Where we are asking for motivations

2 Triangulation, using a variety of research methods and data sources, is a strategy adopted ideally before the data are collected and reduces the risk of systematic biases. In some cases, the decision to use triangulation is adopted after the data are collected and found robust enough to support this approach.

and processes in hypothetical situations that occurred in the past, there is room for bias. Using a framework that combines scores based on three different concepts mutes the impact of such bias and increases the accuracy of the resulting NTGR for each project evaluated.

Changes Since the 2006-2008 Evaluation Cycle and Next Steps

The **PAI- 1** score has evolved since the original specification in 2008. The 2008 version called for the score to be based on the highest rating for a program element. Since most decisionmakers would choose to rate at least one program element highly, this often resulted in a PAI-1 score that was significantly higher than either the PAI-2 or PAI-3 scores, and in some cases, led to the elimination of PAI-1 due to it being an outlier. The score was revised in the 2010-2012 cycle to be based on the highest rating for a program influence divided by the sum of the highest-rating for a program influences plus the highest rating for a non-program influence, multiplied by 10. This revised normalized structure solved the problem with outlier results but led to a different issue due to the normalization process yielding mid-range values approximating 5 in nearly all cases, since most decisionmakers give a high score to at least one program element and one non-program element. This issue was flagged in the 2013-2015 Program Performance Assessment of the Nonresidential Downstream Programs, with a recommendation that PAI-1 be eliminated from the NTGR calculation until an alternative formulation could be developed.

The 2017 evaluation of Deemed measures continued use of this standard SRA framework with relatively minor modifications to NTG survey question batteries. Based on the 2013-2015 Program Performance Assessment recommendation, the PAI-1 score was eliminated from the NTG ratio computation. *The Nonresidential NTG Working Group was re-established, in part, to identify an alternative to the current PAI-1 scoring structure.*

Extend NTGR Framework to Accommodate Midstream Programs

The standardized Nonresidential NTG framework is primarily designed for Downstream programs. However, a small number of programs offered are classified as Midstream and, with the transition to predominantly third-party (3P) programs in 2020, they will become more predominant. *Thus, it is necessary to extend the standardized framework to accommodate Midstream programs.*

Dual Baseline NTGR Framework for Accelerated Replacement Projects

During the 2010-2012 evaluation cycle, the Nonresidential Net-to-Gross Working Group also identified the need to extend the standard NTG framework to accommodate early replacement dual baseline projects, based on a CPUC policy change to look at lifetime savings (D.11-07-030, July 15, 2011). This structure is intended to mirror the dual baseline framework adopted for Gross Savings at that time. The group identified some relatively modest changes to both the survey questions and the standard NTG algorithm for such projects, but the changes were not implemented at that time. During the 2017 and

2018 evaluations, the Net evaluation team for Deemed Measures considered modifying the NTG framework to incorporate a dual baseline NTG approach but decided to defer it to the 2019 evaluation cycle since there were very few measures in the 2018 cycle where the dual baseline approach applied.

The remainder of this memo will describe the proposed modifications to the current Nonresidential NTGR framework to address these two areas:

- the alternative to the current PAI-1 scoring structure
- the extension of the framework to accommodate Midstream programs

D.2 ALTERNATIVE TO CURRENT PAI-1 SCORING STRUCTURE

Issues with Current PAI-1 Score

As discussed previously, a number of issues with the PAI-1 score have emerged in previous evaluations. The observations below are specific to the 2017 Deemed evaluations where these problems resulted in a decision to exclude the PAI-1 score from the NTGR calculation.

The inclusion of the PAI-1 score biased the NTGR towards a value of 0.5. The PAI-1 score tended to converge to a value of around 5. Overall, the PAI-1 score averaged 4.9, with over 80 percent of the individual scores within 0.5 of that mean (i.e., between 4.4 and 5.4). This was likely due to respondents rating at least one program and one non-program factor very high. Respondents gave a 9 or 10 rating to at least one program factor 72 percent of the time, and at least one non-program factor 80 percent of the time. Furthermore, 66 percent of the time, the respondent's highest rated program and non-program factors were rated equally. Averaging in the PAI-1 score with PAI-2 and PAI-3 will therefore reduce the NTGR.

PAI-1 scores did not appear to be correlated with "no program" responses indicating free ridership. When PAI-1 scores were compared to other survey questions that would indicate a high likelihood for free ridership, they did not correlate well to these metrics. Specifically, we examined the relationship between PAI-1 and two survey questions that we felt were strong indications of free ridership:

N2: Did your organization make the decision to install this new equipment before, after, or at the same time as you became aware of the program rebate?

N6: Now I would like you to think one last time about what action you would have taken if the program had not been available. Which of the following alternatives would you have been MOST likely to do?

1	Install/Delamped fewer units
2	Install standard efficiency equipment or whatever required by code
3	Installed equipment more efficient than code but less efficient than what you installed through the program
4	Done nothing (keep existing equipment as is)
5	Done the same thing I would have done as I did through the program
6	Repair/rewind or overhaul the existing equipment
77	Something else (specify what _____________)

The first question (N2) concerns the timing of the decision to install the measure relative to when they became aware of program rebates. For this question, higher levels of free ridership would be expected for those that already made the decision to install their new equipment before they became aware of the program rebate, and PAI-1 scores would be substantially lower for this response than the other two responses. Our expectation was to see significant increases in the PAI scores for the Same Time and After responses, compared to the Before response. This was the case for PAI-2 and PAI-3 scores, however, the PAI-1 scores changed by only 0.08 points.

Another telling indication of program influence is the self-reported action that participants say they would have taken had the program not existed in question N6. Respondents were asked what they would have been most likely to do if the program had not been available. Two common responses were "done nothing and keep existing equipment as is", and "done the same thing I would have done as I did through the program". One would expect relatively high PAI scores for the "done nothing" and relatively low PAI scores for the "done the same thing" responses. The PAI-2 and PAI-3 scores did meet this expectation, but the PAI-1 score differed by only 0.10 points.

Non-program factors may actually be program factors. What we may think is a non-program factor, may actually be a marketing message of the program. For example, better lighting quality may be considered a non-program factor. However, this may be something the program promotes. Therefore, it may be that the influence of better lighting quality on their decision may have been due to the program.

Similarity in concept between PAI-1 and PAI-2 scores. The PAI-1 and PAI-2 scores are based on a similar concept of program influence and are based on self-reported influence scores for individual program and non-program elements. While both scores are intended to represent different ways of characterizing program influence, there is a high degree of similarity between them. Including both scores in the NTGR calculation amounts to assigning a two-thirds weight to similar program influence metrics and reduces the importance of the PAI-3 "no program" score in the overall calculation. It is possible that PAI-1 may represent another aspect of program influence that PAI-2 may not be capturing, but quantifying this is difficult to do, and it could be equally likely that instead they are capturing the same influence, accounting for double attribution of program influence. Additionally, removing PAI-1 will give a more consistent representation of program influence across respondents.

Alternatives to the PAI-1 Score

We examined a few different alternatives to the PAI_1 score and then calculated the resulting NTGR using each alternative by averaging it with the PAI_2 and PAI_3 scores. The alternatives we considered were as follows:

NTGR_2a – PAI-1 alternative 1 = ratio of average program element score to sum of average program plus non-program element scores. Average all the program element scores and divide by the average of all the program element scores plus the average of the non-program element scores. For example:

Program scores = 10, 8, 7, 6, 6 = average of 7.4
Nonprogram = 9, 9, 4, 4, 4 = average of 6.0
PAI_1 = 7.4/ (7.4+6.0) = 0.55

NTGR_2b – PAI-1 alternative 2 = Ratio of number of highly rated program factors to highly rated non-program factors
Identify the number of scores that rate an 8 or higher and set the PAI score equal to the ratio of the number of high program scores to high program and non-program scores. For example:

Program scores = 10, 8, 7, 6, 6 = 3 high scores
Nonprogram = 9, 9, 4, 4, 4 = 2 high scores
PAI_1 = 3/ (3+2) = 0.6
If you get no high scores, then NTG =0.5

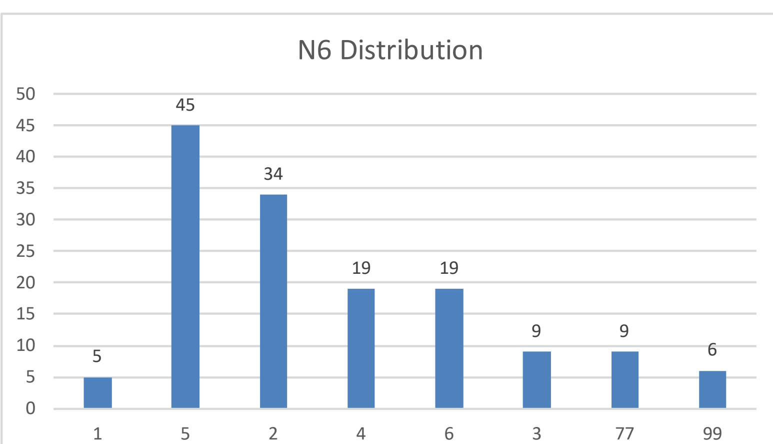
NTGR_2c – PAI-1 alternative 3 = Assign value based on No Program actions (N6). This Approach uses the N6 value and assigns a PAI score as follows.

- If N6 = 2,4 then NTGR = 1
  2 Install standard efficiency equipment or whatever required by code
  4 Done nothing (keep existing equipment as is)
- If N6=5 then NTGR = 0
  5 Done the same thing I would have done as I did through the program
- If N6=1, then NTGR = 1.00 minus the % share they would have installed
  1 Install/Delamped fewer units
- If N6=3, then NTGR =0.75
  3 Installed equipment more efficient than code but less efficient than what you installed through the program
- IF N6=6, NTGR=missing – this is an Accelerated Replacement and the efficiency of the action is unknown, therefore this response is excluded from the analysis
  6 Repair/rewind or overhaul the existing equipment
- If N6=77, the response is reviewed and a judgment made regarding the likely NTGR level, usually a 0, 0.5 or 1
  77 Something else (specify what _____________)

The overall NTGR_2c is the average of PAI-2, PAI-3, and PAI-N6.

Figure D-1 below shares results from the 2017 Deemed evaluations for question N6. The response category with the largest share is category 5 (Done the same thing I would have done as I did through the program, 45 percent). Other categories that were commonly selected were 2 (Install standard efficiency equipment or whatever required by code, 34 percent), 4 (Done nothing, 19 percent and 6 (Repair/rewind or overhaul the existing equipment, 19 percent).

FIGURE D-1: DISTRIBUTION OF RESPONSES TO QUESTION N6 IN SMALL COMMERCIAL EVALUATION



NTGR_2d – PAI-1 alternative 4 = Preponderance of Evidence approach. If there is significant evidence of free ridership, the value is set to 0, if there is significant evidence of program influence, the value is set to 1, or else the PAI-1 alternative algorithm of choice is used to determine the NTGR. Here is the algorithm.

First calculate PAI_2 and PAI_3 and use question N6 shown earlier:

If PAI_2 >= 7 then NTG_2 = 1
Else if PAI_2<= 3 then NTG_2 = -1
Else NTG_2 = 0

If PAI_3 >= 7 then NTG_3 = 1
Else if PAI_3<= 3 then NTG_3 = -1
Else NTG_3 = 0

IF N6 = 2, 4 (and possibly more options) then NTG_6 = 1
Else if N6 = 5 (and possibly more options) then NTG_6 = -1
Else NTG_6 = 0

THEN:
If sum of NTG2,3,6 >=2, then NTGR = 1 (so in other words you have at least 2 indicators of being net, and no contradictions)
Else, if sum of NTG2,3,6 <= -2, then NTGR = 0, (so in other words you have at least 2 indicators of being a free rider, and no contradictions)
ELSE = NTGR = the standard calculation (the average of PAI2, PAI3 and the PAI-1 alternative algorithm of choice)

Comparison of Results Across Methods

The following two figures graphically illustrate the NTGR results across methods, based on the data collected in the 2017 Deemed evaluations.

Figure D-2 illustrates the distribution of NTGR values for each of the methods tested. Note that NTGR is based on the approach used in the 2017 Deemed evaluation and represents the average of the PAI-2 and PAI-3 scores. NTGR_wPAI1 is the historic 3 score framework, and NTGR_2a through NTGR_2d are the variants described above.

FIGURE D-2: DISTRIBUTION OF NTGRS ACROSS ALTERNATIVE METHODS

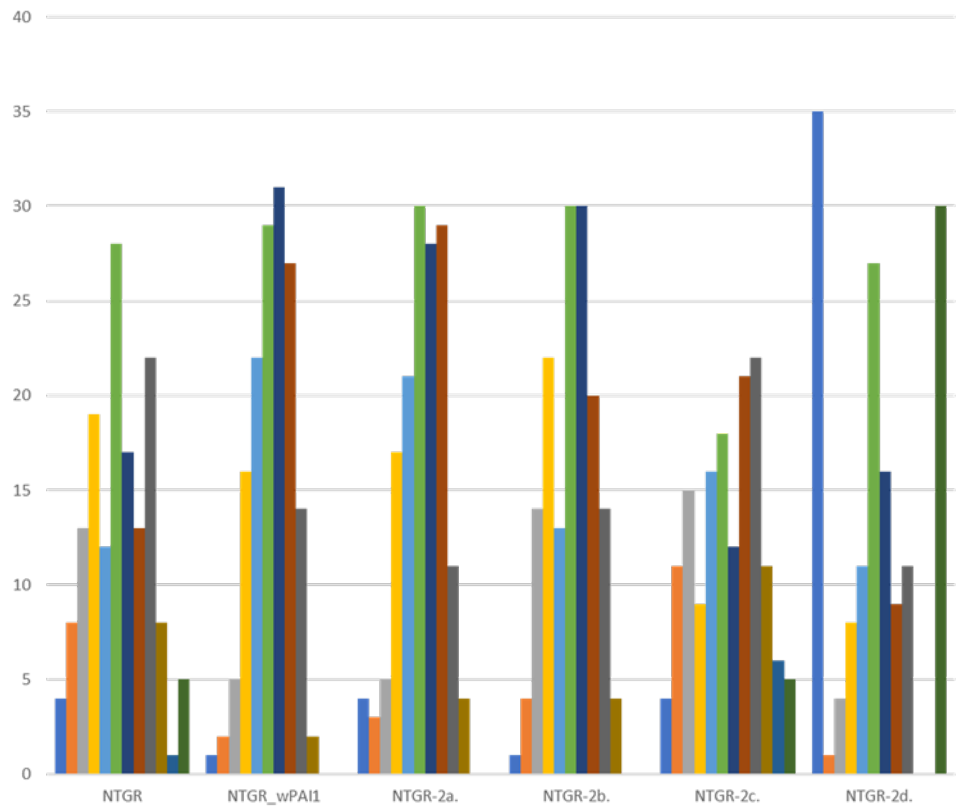
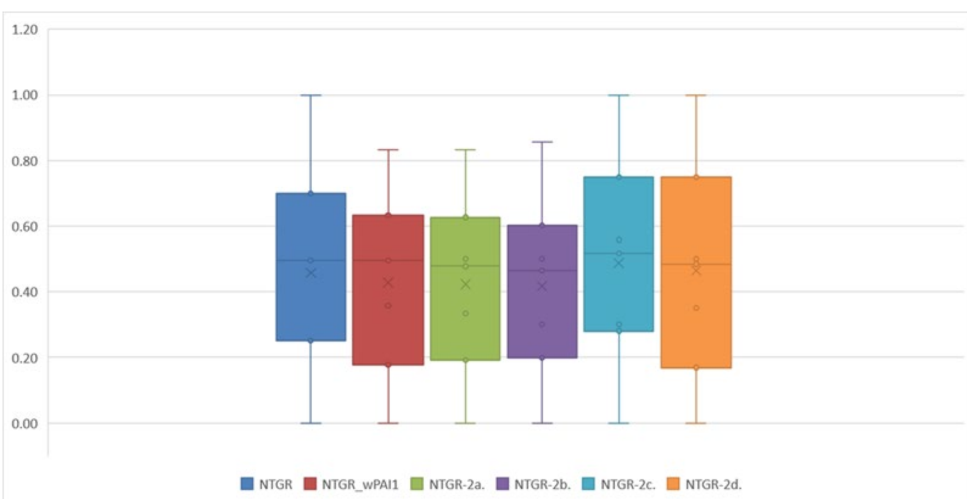


Figure D-3 below provides mean NTGR values and 90 percent confidence intervals across all six cases. The whiskers indicate the range of values analyzed.

FIGURE D-3: NTGR MEAN VALUES AND CONFIDENCE INTERVALS ACROSS ALTERNATIVE METHODS



The following observations can be made from these two figures:

- From Figure D-2:
  - NTGR_wPAI1 – note the clustering of NTGRs around the mid-range values of 0.4 to 0.7. This illustrates the issue with the PAI_1. In contrast, the NTGR case, which is based on PAI-2 and PAI-3 only, has a wider distribution of values.
  - NTGR_2a and NTGR_2b are still relatively narrowly distributed around the 0.5 value, while NTGR_2c and NTGR_2d show much wider variance. Similarly, NTGR_2a and NTGR_2b have relatively narrow standard deviations, while those for NTGR_2c and NTGR_2d are significantly wider.
  - NTGR_2c values are well-distributed and more homogeneous while NTGR_2d values tend toward the extreme 0 and 1 values in many instances.
- In Figure D-3, it is striking how relatively similar the mean NTGR values are, and likely reflects the contribution of the PAI-2 and PAI-3 scores (2/3 weight) in all cases.

Method Change 1

The core NTGR algorithm has been revised and the current PAI-1 score has been replaced with the N6-based score in NTGR_2c – PAI-1 alternative 3. This option leverages the counterfactual information from the survey more fully, with 2 of three scores derived from it. Further, as noted above, the NTGR_2c values have desirable qualities in that they are more normally distributed across each of the scoring intervals and have higher inter-item correlations.

The three PAI scores using the NTGR_2c approach all represent very different approaches and uses of survey information, whereas the other approaches still have the issue of the revised PAI-1 and PAI-2 scores utilizing similar information. We also feel there are some issues with the other alternate PAI_1 scores such as:

NTGR_2a – PAI-1 alternative 1 = ratio of average program element score to sum of average program plus non-program element scores. Consider the following example where an individual was highly influenced by a couple program factors, not at all influenced by the other program factors, and only moderately influenced by the non-program factors

Program scores = 10, 10, 0, 0, 0 = average of 4

Non-program scores = 4, 4, 4, 4, 4 = average of 4

PAI_1 = 4/(4+4) = 0.5

One could argue that the NTGR in this case should be very high because there was clear influence of the program by more than one factor, and no other factor seemed to be very influential. Yet the NTGR is 0.5, inconsistent with this observation. We do not like this alternative because of this issue, where low factor scores can offset high influential factors. A customer does not need all factors to be influential for the program to have influenced their decision.

NTGR_2b – PAI-1 alternative 2 = Ratio of number of highly rated program factors to highly rated non-program factors. This alternative tells us if there were multiple factors that influenced their decision, and how many influential program versus non program factors there are. But it does not tell us which of the influential factors were the most influential, and what may have really driven their decision. Even though a customer may rate two factors a 10 does not mean they were equally influential. The PAI-2 score does address this, however. So the PAI-2 score on its own is a more accurate representation of attribution than this approach.

NTGR_2d – PAI-1 alternative 4 = Preponderance of Evidence approach. If there is significant evidence of free ridership, the value is set to 0, if there is significant evidence of program influence, the value is set to 1, or else the PAI-1 alternative algorithm of choice is used to determine the NTGR. The issue with this approach is that is uses PAI-2 and PAI-3 in its construction, so it's obviously highly correlated with those values and does not provide as independent a result as, say, using the N6 questions in NTGR_2c.

Given the replacement of PAI-1, for projects that report a high level of vendor influence, it is necessary to incorporate vendor influence into one of the other scores. One option is to include it in PAI-3, and another alternative is to develop a fourth score that reflects vendor influence only.

D.3 EXTEND NTGR FRAMEWORK TO ACCOMMODATE MIDSTREAM PROGRAMS

The current Nonresidential NTG framework is designed mainly for Downstream programs, which are focused on delivering incentives directly to end-use customers. Some programs are positioned higher up in the supply chain, so that they work through vendors (e.g., distributors, contractors, and design professionals) to deliver incentives to customers. Such programs are classified as Midstream.

The current Downstream-centric framework relies primarily on findings from end-use customer surveys for determining NTGRs, which is appropriate, given the customer-focused program delivery approach. The method does allow for vendor input into the NTGR but only in cases where the customer rates the vendor higher than any other program or non-program element in their decisionmaking. The vendor is interviewed, and their input is incorporated into the PAI-1 score.

NTG Approach for Midstream Programs

The Midstream approach as described applies to programs delivered through vendors[3] that meaningfully change how they stock, promote and price program-qualified energy efficient equipment as a result of their participation in the program. There are multiple Midstream program delivery approaches, some for which the program intervention(s) is "invisible" to the end-use customer, and others where the end-use customer is fully aware of the program intervention(s). The design of the program, and the availability (vs. not) of customer data will determine the specific NTG approach to be used. Two such variants are:

- Programs that work through vendors, where customer contact data is collected, and where it is believed the end-user is either unaware or aware of the program (**Midstream A**).
- Programs that work entirely with vendors, customer contact data is not collected, and where it is believed the end-user may not be aware of the program (**Midstream B**).

Midstream Program Logic

Most Midstream programs transact directly with vendors and provide incentives in exchange for their promoting the program to their customers, developing projects, enrolling them in the program, and aiding them with program applications and paperwork. The approaches used typically work in the following manner:

- The programs work through participating vendors [usually distributors (including retailers) and contractors] to promote program-eligible energy efficient measures, develop projects and provide incentives to customers. Customers can either be contractors, installers, or end-users.
- Vendors provide instant incentives at the point-of-sale to reduce the upfront price to their customers by all or a portion of the incentive amount. If the customer of a distributor is a contractor or installer, they must pass down all or a portion of the incentive to ultimate purchasers (end-users) of the eligible measures.
- Vendors also aid their customers with program applications and paperwork.
- Periodically, vendors bundle applications together and submit them to the Program Administrator (PA) for reimbursement. As a result, transactions with the program are between the Vendor and the PA.

[3] "Vendors" in this discussion is being used broadly to refer to the entity that transacts with the program to deliver incentives and other program features to end-use customers. Vendors can include distributors, contractors or design professionals but they must have direct involvement with the program via a contract, application or other mechanism to obtain incentives from the program administrator and re-distribute them to the next level(s) down.

Having incentives available to buy down the cost of program measures to ultimate purchasers potentially motivates Vendors to change their behavior from "business as usual" in several ways. Knowing that they will receive an incentive for selling high efficiency units, and in some cases having received training and marketing support to encourage stocking and upselling, Vendors may choose to:

- Reduce prices of program-eligible units,
- Increase their stock of high efficiency units,
- Upsell high efficiency units to contractors and/or end-users,
- Offer training sessions or marketing campaigns aimed at engineers, architects, and contractors to increase awareness of these high efficiency units.

As a result of the program's actions:

- Contractors/customers may be more likely to purchase high efficiency units because they are in stock,
- Contractors/customers may be more likely to purchase high efficiency equipment because the distributor upsold these units,
- Contractors/customers may be more likely to purchase high efficiency units because the incremental cost is lower than it would have been without the incentive, and
- Design professionals and contractors may be more likely to specify or recommend high efficiency units because they are more aware or more familiar with these options.

The expected outcome is that a greater share of end-users will purchase high efficiency units. Ultimately, the overall market in a utility's service territory will become more efficient than it otherwise would have been, or it will achieve this efficiency sooner than if no intervention had occurred.

Midstream NTG Protocol

To assess impacts from Midstream A programs, evaluators need to continue to collect standard self-reported information from end-use customers regarding the importance of various program and non-program factors that influenced their decision, the relative importance of the program, and the likely actions they would have taken absent the program. In addition, for Midstream A and Midstream B programs, evaluators need to determine if the Vendor changed their practices in a way that ultimately influenced the customer's buying decision. Assessing the influence of the program on vendors involves conducting in-depth interviews with participating vendors and asking them how the program influenced their stocking, pricing and promotion practices, and alternatively, how they would behave in the absence of the program.

NTGR Estimation Methodology

For Midstream A programs where customer contact data is collected, surveys are conducted of both participating customers and participating vendors, Customer and Vendor-based estimates of free ridership are developed and are combined into a single NTGR metric. For Midstream B programs that work exclusively with vendors and customer information is not collected, telephone or web surveys with end-use customers are not feasible. However, in-store intercept surveys would allow for direct questioning of customers at the point-of-sale. If in-store or telephone/web surveys are not feasible, the NTGR is derived fully from the Vendor algorithm.

For the **Customer** component, the standard NTG framework is used, participating customer surveys are conducted, and the customer-based NTGR is calculated.

Vendor Component

The **Vendor** component of this methodology uses three indicators of free ridership, Program Importance Score, the Relative Program Influence Score (similar to PAI-2), and the No-Program Score (similar to PAI-3).

Vendor Surveys. During the in-depth interviews, the Vendor is asked which of the available sales strategies they used to promote program-qualified equipment:

A3 Now, I'm going to ask you about the various strategies you might have used to sell program-qualifying ***MEASURE****. Please indicate which ones you have used. [READ]*

___ Upsell contractors to purchase program-qualified units
___ Upsell customers to purchase program-qualified units
___ Conduct training workshops for contractors
___ Increase marketing of program-qualified units
___ Reduce the prices of program-qualified units
___ Increase the stocking or assortment of program-qualified units
___Increase stock for emergency replacements
___Increase signage on sales floor
___ Discuss the benefits of program-qualified units with contractors
___ Discuss the benefits of program-qualified units with customers
___ Other (Please describe: ____)

Next, the Vendor is asked to use a 0-to-10 importance scale to rate the importance of various program and non-program factors in their decision to recommend the program-qualifying measure to distributors/customers.

*A4 Using this 0-to-10 scale, please rate the following in terms of their importance in your **decision to recommend** MEASURE to contractors and your other customers*

Increased awareness of MEASURE benefits	*0 to 10 score (_______)*
Program-provided training of sales staff	*0 to 10 score (_______)*
Program promotional materials	*0 to 10 score (_______)*
Information from PROGRAM website	*0 to 10 score (_______)*
PROGRAM incentive	*0 to 10 score (_______)*
Reduced high-efficiency MEASURE prices from manufacturers	*0 to 10 score (_______)*
Availability of manufacturers' promotional rebates/spiffs	*0 to 10 score (_______)*
Information about the cost-effectiveness of more efficient units	*0 to 10 score (_______)*
Increased stocking of high-efficiency MEASURE	*0 to 10 score (_______)*
Past participation in PROGRAM	*0 to 10 score (_______)*

Next, Vendors are asked to rate the importance of the Program in influencing their decision to recommend the program-qualifying measure to distributors/customers, and a follow-up question regarding the relative importance of the Program in their decision. Finally, there is a counterfactual question regarding their likelihood to recommend the program-qualifying measure absent the program.

A5 Using this 0-to-10 scale where 0 is NOT AT ALL IMPORTANT and 10 is EXTREMELY IMPORTANT, how important was the PROGRAM, including incentives as well as program services and information, in influencing your decision to recommend that UTILITY's contractors/customers purchase the energy efficient MEASURE at this time?

Next, I would like you to rate the importance of the PROGRAM FACTORS as a group in your decision to implement these sales strategies as opposed to other NON-PROGRAM FACTORS as a group that might have influenced your decision.

> *Program factors include: [READ IN A MINIMUM OF TWO PROGRAM FACTORS, SELECTED BY CHOOSING THOSE THAT RECEIVED THE HIGHEST TWO SCORES AMONG ALL PROGRAM COMPONENTS IN THE PROGRAM COMPONENTS SECTION]*
>
> *Non-program factors include: [READ IN A MINIMUM OF TWO NON-PROGRAM FACTORS, SELECTED BY CHOOSING THOSE THAT RECEIVED THE HIGHEST TWO SCORES AMONG ALL NON-PROGRAM COMPONENTS IN THE PROGRAM COMPONENTS SECTION.]*

A5a. Now, if you were given 10 points to award in total, how many points would give to the importance of the program factors as a group and how many points would you give to the non-program factors as a group?

A6 And using a 0-to-10 likelihood scale where 0 is NOT AT ALL LIKELY and 10 is EXTREMELY LIKELY, if the PROGRAM, including incentives as well as program services and information, had not been available, what is the likelihood that you would have recommended this specific MEASURE to UTILITY's contractors /customers?

Vendor NTGR Algorithm. First the three separate scores are computed, then averaged to produce the Vendor NTGR. The three component scores are as follows:

- *Program Importance Score.* This score is based on the response to question A5 and is computed using the following equation:

  Program Importance Score = Program importance rating from A5.

- *Relative Program Influence Score.* Responses to question A5a are used to calculate this score as follows:

  Relative Program Influence Score = Program Points from A5a.

- *No-Program Score.* This represents the numeric score of the likelihood that the respondent would have recommended program-qualified equipment in the absence of the program. It is calculated from the response to question A6, using the following equation:

  No-Program FR Score = 10 minus No-Program Likelihood to Recommend

The Vendor-based NTGR is simply the average of these three scores divided by 10. Once this has been computed, the project-level NTGR is determined from a combination of findings from the participating customer and participating vendor surveys. The triangulation approach, combining customer and vendor input, is used. The algorithm uses the customer's input to guide the assessment, with input by the vendor if certain conditions are met. This Midstream scoring approach is shown below in Table D-2.

TABLE D-2: MIDSTREAM SCORING ALGORITHM

Scoring Criteria	Question Number	Decision Rule	Explanation
Criteria 1	N5aa	IF N5aa < 3 Then Use CUSTOMER NTGR only	Per decisionmaker, very low likelihood of installing same absent program. Vendor influence unimportant.
Criteria 2	N5aa	IF N5aa >7 Then Use CUSTOMER NTGR only	Per decisionmaker, very high likelihood of installing same at same time absent the program. Vendor influence unimportant.
Criteria 3	N5, N5b	If N5 < 3 and N6aa = 0 Then Use CUSTOMER NTGR only	Per decisionmaker, very low likelihood of installing same absent program. Vendor influence unimportant.
Criteria 4	N5, N5b	If N5 > 7and N6aa > 7, Then Use CUSTOMER NTGR only	Per decisionmaker, very high likelihood of installing same at same time absent program. Vendor influence unimportant.
Criteria 5	N6	If N6 = 2 and N6aa = Same Time, Then Use CUSTOMER NTGR only	Per decisionmaker, would have installed Standard efficiency at the same time absent the program
Criteria 6	N6	If N6 = 4 and N6aa = Same Time, Then Use CUSTOMER NTGR only	Per decisionmaker, would have Done Nothing at the same time absent the program. Vendor influence unimportant.
Criteria 7	N6	If N6 = 6 and N6aa = Same Time, Then Use CUSTOMER NTGR only	Per decisionmaker, would have Repaired/Rewound Existing equipment at the same time absent the program. Vendor influence unimportant.
Criteria 8	N6	If N6 = 5 and N6aa = Same Time, Then Use CUSTOMER NTGR only	Per decisionmaker, would have Done Same Thing at the same time absent the program. Vendor influence unimportant.
Criteria 9	V3, N3d, V4a	If V3 = Yes, N3d > 7 and V4a >7, and Criteria 1 through 8 not met, Vendor NTGR > 0.70, then use VENDOR NTGR only	Vendor recommended high efficiency, made customer aware of program, vendor was highly influential to the customer
Criteria 10	Multiple	If Criteria 1 through 9 not met, Average Customer and Vendor NTGRs	Moderate program influence and potential for vendor influence

Method Change 2

We have incorporated the Midstream NTG methodology as described for PY2018, and plan to use this method or refinements of it for future program years. This change allows for consideration of the vendor's assessment of the program's influence on the customer's decision to upgrade to program-qualifying equipment in cases where the program is working primarily through vendors.

DETAILED NTGR CALCULATION AND INDIVIDUAL RESPONSES

This appendix provides a detailed description of the NTG algorithm for both downstream and midstream programs, including every survey question used in the algorithm, and how each survey question is used to develop the NTGR.

Also provided are the individual survey responses for each customer and vendor survey, along with the PAI and vendor scores, and the resulting NTGRs used to develop the ex-post NTGR values for the Refrigeration Case Lighting, Process Pumping VFDs and Tankless Water Heating measures.

CUSTOMER NET-TO-GROSS ALGORITHM

The customer NTGR algorithm is based on six survey questions asked of participants, as shown below.

N2	Did your organization make the decision to install this new equipment before or, after, or at the same time as you became aware of that rebates [IF NEEDED: to reduce the cost of the measure] were available through the PROGRAM?
1	Before
2	After
3	Same time

	If you were given 10 points to award in total, how many points would you give to the importance of the program and how many points would you give to these other non-program factors?
N41	How many of the ten points would you give to the importance of the PROGRAM in your decision?
#	Record 0 to 10 score (_______)

REPLACE	Was the installation of this measure....<%NTGMEASURE> ...a replacement of existing equipment or was it additional equipment you installed in your facility?
1	Replace/Modification/Retrofit
2	Add-on

N5	Using a likelihood scale from 0 to 10, where 0 is not at all likely and 10 is extremely likely, if THE PROGRAM had NOT BEEN AVAILABLE, what is the likelihood that you would have installed exactly the same program-qualifying energy efficient equipment that you did for this project regardless of when you would have installed it?
#	Record 0 to 10 score (_______)

N5aa	Using a likelihood scale from 0 to 10, where 0 is Not at all likely and 10 is Extremely likely, if THE PROGRAM had NOT BEEN AVAILABLE, what is the likelihood that you would have installed exactly the same energy efficient equipment at the same time as you did?
#	Record 0 to 10 score (_______)

N6	Now I would like you to think one last time about what action you would have taken if the program had not been available. Which of the following alternatives would you have been MOST likely to do?
1	Install/Delamped fewer units
2	Install standard efficiency equipment or whatever required by code
3	Installed equipment more efficient than code but less efficient than what you installed through the program
4	Done nothing (keep existing equipment as is)
5	Done the same thing I would have done as I did through the program
6	Repair/rewind or overhaul the existing equipment
77	Something else (specify what _____________)

Three separate scores are calculated based on these questions, as follows:

PAI-2 Score:

The PAI-2 score utilizes the N2 and N41 questions, and is calculated as:

If N2 = after, then PAI-2 = N41/2

Else PAI-2 = N41

PAI-3 Score:

The PAI-3 score utilizes the REPLACE, N5 and N5aa questions, and is calculated as:

If REPLACE = 1, then PAI-3 = 10 – N5

Else PAI-3 = 10 – N5aa

PAI-N6 Score:

The third PAI score is based on Question N6, as follows:

- If N6 = 2,4 then PAI-N6 = 10
  - 2 Install standard efficiency equipment or whatever required by code
  - 4 Done nothing (keep existing equipment as is)
- If N6=5 then PAI-N6 = 0
  - 5 Done the same thing I would have done as I did through the program
- If N6=1, then PAI-N6 = 10* (1.00 minus the % share they would have installed)
  - 1 Install/Delamped fewer units
- If N6=3, then PAI-N6 =7.5
  - 3 Installed equipment more efficient than code but less efficient than what you installed through the program
- IF N6=6, PAI-N6=missing (This is a repair and the efficiency of the action ultimately taken is unknown, therefore this response is excluded from the analysis.)
  - 6 Repair/rewind or overhaul the existing equipment
- If N6=77, the response is reviewed and a judgment made regarding the likely PAI-N6 value, frequently a 0 or 10
  - 77 Something else (specify what _____________)

Customer NTGR Calculation:

Finally, the NTGR is calculated as the average of these three scores, divided by 10:

NTGR = ((PAI-2 + PAI-3 + PAI-N6)/3)/10

Note that is only two PAI scores are available, then the NTGR equals the average of those two PAI scores divided by 10. Finally, if only one PAI score is available, then the NTGR is set to missing.

For downstream programs, only the customer NTGR is used. For midstream programs, a combination of customer and vendor NTGRs are used, as discussed below.

REFRIGERATION CASE LED LIGHTING NET-TO-GROSS ALGORITHM

As discussed in Chapter 6 of the report, the protocol for the Refrigeration Case LED Lighting measure differs slighting from the standard approach listed above because this measure only provides savings when the lighting retrofit was accelerated and the case was not replaced at the same time.

Revised PAI-2 Score:

The PAI-2 score for Refrigeration Case LED lighting uses question N41P which is modified to include the effects of timing:

> Next, I would like for you to consider the importance of the PROGRAM in your decision to install your equipment ***at the time you did*** rather than waiting to install new equipment sometime in the future, regardless of the actual efficiency of the equipment you selected. Please rate the importance of the program on this timing decision as opposed to other non-program factors that may have influenced your decision.
>
> N41P - If you were given 10 points to award in total, how many points would you give to the importance of the program and how many points would you give to these other non-program factors in your decision to install your equipment ***at the time you did*** rather than waiting to install new equipment sometime in the future?

Therefore,

If N2 = after, then PAI-2 = N41P/2

Else PAI-2 = N41P

Revised PAI-3 Score:

The PAI-3 score for Refrigeration Case LED lighting uses question N5B which is modified to include the effects of timing:

> N5B- Using the same scale as before, if the program had not been available, what is the likelihood that you would have done this project ***at the same time as you did***?

Therefore,

PAI-3 = 10 – N5b

Revised N6 Score:

Because LED lighting is considered ISP, if the customer responded to N6 (shown above) that they would have installed whatever is required by code or something more efficient than code, then they would have installed LEDs and would be a free rider. Therefore, we modify the scoring using N6 as follows:

- If N6 = 2 or 3 then PAI-N6 = 0
  - 2 Install standard efficiency equipment or whatever required by code
  - 3 Installed equipment more efficient than code but less efficient than what you installed through the program

Also, if the customer responded to N6 saying that they would have repaired their equipment, we take this to mean they would not have retrofitted the lighting at that time and give them credit for an accelerated replacement and set the NTGR to 1 as follows:

- IF N6=6, PAI-N6 =10
  - 6 Repair/rewind or overhaul the existing equipment

Otherwise, the algorithm is the same as above:

- If N6 = 4 then PAI-N6 = 10
  - 4 Done nothing (keep existing equipment as is)
- If N6=5 then PAI-N6 = 0
  - 5 Done the same thing I would have done as I did through the program
- If N6=1, then PAI-N6 = 10* (1.00 minus the % share they would have installed)
  - 1 Install/Delamped fewer units
- If N6=77, the response is reviewed and a judgment made regarding the likely PAI-N6 value, frequently a 0 or 10
  - 77 Something else (specify what _____________)

Customer NTGR Calculation:

Finally, the NTGR is calculated as the average of these three scores, divided by 10, as above:

NTGR = ((PAI-2 + PAI-3 + PAI-N6)/3)/10

Note that is only two PAI scores are available, then the NTGR equals the average of those two PAI scores divided by 10. Finally, if only one PAI score is available, then the NTGR is set to missing.

VENDOR NET-TO-GROSS ALGORITHM

The vendor NTGR algorithm is based on three survey questions asked of distributors, as shown below.

A5 Using this 0 to 10 scale where 0 is NOT AT ALL IMPORTANT and 10 is EXTREMELY IMPORTANT, how important was the PROGRAM, including incentives as well as program services and information, in influencing your decision to recommend that <%UTILITY's> contractors/distributors/customers purchase the energy efficiency MEASURE at this time?

Record 0 to 10 score (_______) A5A

A5a. Now, if you were given 10 points to award in total, how many points would give to the importance of the program factors as a group and how many points would you give to the non-program factors as a group?

Record 0 to 10 value (_______) A6

A6 And using a 0 to 10 likelihood scale where 0 is NOT AT ALL LIKELY and 10 is EXTREMELY LIKELY, if the PROGRAM, including incentives as well as program services and information, had not been available, what is the likelihood that you would have recommended this specific MEASURE to <%UTILITY's> contractors/distributors/customers?

Record 0 to 10 score (_______) A7

Three separate scores are calculated using these survey questions, as follows:

PIS - Program Importance Score:

This score is based on the response to question A5 and is computed using the following equation:

PIS = A5.

RPIS - Relative Program Importance Score:

Responses to question A5a are used to calculate this score as follows:

RPIS = A5a.

NPS – No-Program Score:

This represents the numeric score of the likelihood that the respondent would have recommended program-qualified equipment in the absence of the program. It is calculated from the response to question A6, using the following equation:

NPS = 10 – A6

Vendor NTGR Calculation:

Finally, the NTGR is calculated as the average of these three scores, divided by 10:

NTGR = ((PIS + RPIS + NPS)/3)/10

Note that is only two scores are available, then the NTGR equals the average of those two scores divided by 10. Finally, if only one score is available, then the NTGR is set to missing.

MIDSTREAM NET-TO-GROSS ALGORITHM

For midstream programs, the project-level NTGR is determined from a combination of findings from the customer and vendor NTGRs. The triangulation approach, combining customer and vendor input, is used. In cases where customer contact information is not available, the midstream program NTGR is based solely on the vendor NTGR. The algorithm uses the customer's input to guide the assessment, with input by the vendor if certain conditions are met, based on the following questions.

NN5aa	Would you like for me to change your score on the importance of the rebate that you gave a rating of <%N3B> and/or change your rating on the likelihood you would install the same equipment without the rebate which you gave a rating of <%N5> and/or we can change both if you wish?
1	No change
77	Record how they would rate rebate influence and how they would rate likelihood to install without the rebate

N5	Using a likelihood scale from 0 to 10, where 0 is not at all likely and 10 is extremely likely, if THE PROGRAM had NOT BEEN AVAILABLE, what is the likelihood that you would have installed exactly the same program-qualifying energy efficient equipment that you did for this project regardless of when you would have installed it?
#	Record 0 to 10 score (_______)

N6aa	Would you have [FILL IN RESPONSE TO N6 for N6 = 1,2, 3, 5] at the same time as you did under the program, within a yea
1	Same time
2	Within one year
3	At a later time

N6	Now I would like you to think one last time about what action you would have taken if the program had not been available. Which of the following alternatives would you have been MOST likely to do?
1	Install/Delamped fewer units
2	Install standard efficiency equipment or whatever required by code
3	Installed equipment more efficient than code but less efficient than what you installed through the program
4	Done nothing (keep existing equipment as is)
5	Done the same thing I would have done as I did through the program
6	Repair/rewind or overhaul the existing equipment
77	Something else (specify what _____________)

N3d	Recommendation from an equipment vendor that sold you the equipment and/or installed it for you **[VENDOR_1]**
#	Record 0 to 10 score (_______)

V3	Did the contractor/vendor tell you about or recommend the program?
1	Yes
2	No

V4a	Using the same scale of 0 - 10 as before, how likely is it that your organization would have installed the new energy efficient equipment had the contractor/vendor not recommended it?
1	0-10 response

This Midstream scoring approach is shown below.

TABLE D-3: MIDSTREAM SCORING ALGORITHM

Scoring Criteria	Question Number	Decision Rule	Explanation
Criteria 1	N5aa	IF N5aa < 3 Then Use CUSTOMER NTGR only	Per decisionmaker, very low likelihood of installing same absent program. Vendor influence unimportant.
Criteria 2	N5aa	IF N5aa >7 Then Use CUSTOMER NTGR only	Per decisionmaker, very high likelihood of installing same at same time absent the program. Vendor influence unimportant.
Criteria 3	N5, N5b	If N5 < 3 and N6aa = 0 Then Use CUSTOMER NTGR only	Per decisionmaker, very low likelihood of installing same absent program. Vendor influence unimportant.
Criteria 4	N5, N5b	If N5 > 7and N6aa > 7, Then Use CUSTOMER NTGR only	Per decisionmaker, very high likelihood of installing same at same time absent program. Vendor influence unimportant.
Criteria 5	N6	If N6 = 2 and N6aa = Same Time, Then Use CUSTOMER NTGR only	Per decisionmaker, would have installed Standard efficiency at the same time absent the program
Criteria 6	N6	If N6 = 4 and N6aa = Same Time, Then Use CUSTOMER NTGR only	Per decisionmaker, would have Done Nothing at the same time absent the program. Vendor influence unimportant.
Criteria 7	N6	If N6 = 6 and N6aa = Same Time, Then Use CUSTOMER NTGR only	Per decisionmaker, would have Repaired/Rewound Existing equipment at the same time absent the program. Vendor influence unimportant.
Criteria 8	N6	If N6 = 5 and N6aa = Same Time, Then Use CUSTOMER NTGR only	Per decisionmaker, would have Done Same Thing at the same time absent the program. Vendor influence unimportant.
Criteria 9	V3, N3d, V4a	If V3 = Yes, N3d > 7 and V4a >7, and Criteria 1 through 8 not met, Vendor NTGR > 0.70, then use VENDOR NTGR only	Vendor recommended high efficiency, made customer aware of program, vendor was highly influential to the customer
Criteria 10	Multiple	If Criteria 1 through 9 not met, Average Customer and Vendor NTGRs	Moderate program influence and potential for vendor influence

TANKLESS WATERHEATER MIDSTREAM NET-TO-GROSS ALGORITHM

As mentioned in Chapter 6 of the report, the Tankless Water Heating measure offered by PG&E and SCG is delivered exclusively through a Midstream approach. The program falls into the Midstream B category discussed in the report, working exclusively through vendors, and does not collect any participating customer or contractor information. Therefore, telephone surveys with end-use customers are not feasible.

Therefore, the NTGR for the Tankless Water Heating measure is based solely on the Vendor NTG.

INDIVIDUAL SURVEY RESPONSES, PAI AND VENDOR SCORES AND NTGRS

The following tables provide the survey responses for each customer and vendor survey, and along with the PAI and vendor scores, and resulting NTGR used to develop the ex-post NTGR values for Refrigeration Case Lighting, Process Pumping VFDs and Tankless Water Heating.

TABLE D-4: INDIVIDUAL SURVEY RESPONSES, PAI SCORES AND NTGRS FOR REFRIGERATION CASE LED LIGHTING

Measure Group	n41p	n2	PAI2	n5b	PAI3	n6	PAI4	NTGR
Refrigeration Case LED Lighting	5	2	5	6	4	2	0	**0.30**
Refrigeration Case LED Lighting	8	1	4	10	0	5	0	**0.13**
Refrigeration Case LED Lighting	4	2	4	0	10	5	0	**0.47**
Refrigeration Case LED Lighting	7	2	7	5	5	4	10	**0.73**
Refrigeration Case LED Lighting	7	2	7	5	5	4	10	**0.73**
Refrigeration Case LED Lighting	6	3	6	0	10	2	0	**0.53**
Refrigeration Case LED Lighting	10	2	10	0	10	6	10	**1.00**
Refrigeration Case LED Lighting		2		3	7	5	0	**0.35**
Refrigeration Case LED Lighting		3		5	5	5	0	**0.25**
Refrigeration Case LED Lighting	5	3	5	0	10	4	10	**0.83**
Refrigeration Case LED Lighting		3		5	5	2	0	**0.25**
Refrigeration Case LED Lighting	9	1	4.5	0	10	4	10	**0.82**
Refrigeration Case LED Lighting	10	99	10	10	0	4	10	**0.67**
Refrigeration Case LED Lighting	8	2	8	10	0	4	10	**0.60**
Refrigeration Case LED Lighting	10	1	5	0	10	4	10	**0.83**
Refrigeration Case LED Lighting		1		0	10	4	10	**1.00**
Refrigeration Case LED Lighting	5	3	5	6	4	2	0	**0.30**
Refrigeration Case LED Lighting	5	3	5	0	10	4	10	**0.83**
Refrigeration Case LED Lighting	0	1	0	10	0	3	0	**0.00**
Refrigeration Case LED Lighting	9	3	9	1	9	4	10	**0.93**
Refrigeration Case LED Lighting	8	2	8	0	10	4	10	**0.93**

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TABLE D-5: PG&E INDIVIDUAL SURVEY RESPONSES, PAI SCORES AND NTGRS FOR PROCESS PUMPING VFDS

PA	Measure Group	n41	n2	PAI2	Replace	n5aa	n5	PAI3	n6	n6_77	n6a_Pct	PAI-N6	NTGR
PG&E	Process Pumping VFDs		1		2	8		2	5			0	**0.10**
PG&E	Process Pumping VFDs	3	2	3	1		7	3	2			10	**0.53**
PG&E	Process Pumping VFDs	7	3	7	2	8		2	2			10	**0.63**
PG&E	Process Pumping VFDs	5	3	5	1		10	0	5			0	**0.17**
PG&E	Process Pumping VFDs	4	3	4	1		6	4	4			10	**0.60**
PG&E	Process Pumping VFDs	3	1	1.5	99				5			0	**0.08**
PG&E	Process Pumping VFDs	8	2	8	2	3		7	2			10	**0.83**
PG&E	Process Pumping VFDs	7	3	7	2	10		0	5			0	**0.23**
PG&E	Process Pumping VFDs	5	2	5	2	4		6	1		2	9.8	**0.69**
PG&E	Process Pumping VFDs	5	2	5	2	5		5	77	10		10	**0.67**
PG&E	Process Pumping VFDs	4	1	2	2	10		0	5			0	**0.07**
PG&E	Process Pumping VFDs	9	1	4.5	2	5		5	77	10		10	**0.65**
PG&E	Process Pumping VFDs	3	2	3	1	6	10	0	1		50	5	**0.27**
PG&E	Process Pumping VFDs	7	2	7	1	0	0	10	4			10	**0.90**
PG&E	Process Pumping VFDs	6	1	3		0	8		5			0	**0.15**
PG&E	Process Pumping VFDs	0	1	0	2	7	7	3	5			0	**0.10**
PG&E	Process Pumping VFDs		1		1		5	5	5			0	**0.25**
PG&E	Process Pumping VFDs	3	1	1.5	1		3	7	4			10	**0.62**
PG&E	Process Pumping VFDs	2	3	2	1		9	1	5			0	**0.10**
PG&E	Process Pumping VFDs		3		1		5	5	4			10	**0.75**
PG&E	Process Pumping VFDs	6	1	3	2	10		0	5			0	**0.10**
PG&E	Process Pumping VFDs		3		2	1		9	4			10	**0.95**
PG&E	Process Pumping VFDs	10	2	10	1		10	0	5			0	**0.33**
PG&E	Process Pumping VFDs	7	1	3.5	2	10		0	5			0	**0.12**
PG&E	Process Pumping VFDs	7	1	3.5	2	8		2	5			0	**0.18**
PG&E	Process Pumping VFDs	4	2	4	1		8	2	6				**0.30**
PG&E	Process Pumping VFDs	5	1	2.5	1		10	0	5			0	**0.08**
PG&E	Process Pumping VFDs	0	1	0	2	10		0	5			0	**0.00**
PG&E	Process Pumping VFDs		1		1		10	0	5			0	**0.00**
PG&E	Process Pumping VFDs	4	1	2	2	5		5	6				**0.35**
PG&E	Process Pumping VFDs	6	2	6	2	5		5	5			0	**0.37**
PG&E	Process Pumping VFDs	3	1	1.5	99				5			0	**0.08**
PG&E	Process Pumping VFDs	8	2	8	2	1		9	77	10		10	**0.90**
PG&E	Process Pumping VFDs	5	2	5	2	4		6	1		2	9.8	**0.69**
PG&E	Process Pumping VFDs	5	2	5	2	5		5	77	10		10	**0.67**
PG&E	Process Pumping VFDs	4	1	2	2	10		0	5			0	**0.07**
PG&E	Process Pumping VFDs	9	1	4.5	2	5		5	77	10		10	**0.65**
PG&E	Process Pumping VFDs	3	2	3	1	6	10	0	1		50	5	**0.27**
PG&E	Process Pumping VFDs	5		5	2	0	0	10	4			10	**0.83**
PG&E	Process Pumping VFDs	2	2	2	2	5	5	5	3			7.5	**0.48**
PG&E	Process Pumping VFDs	6	1	3		0	8		5			0	**0.15**
PG&E	Process Pumping VFDs	0	1	0	2	7	7	3	5			0	**0.10**
PG&E	Process Pumping VFDs	3	3	3	2	7	7	3	5			0	**0.20**

TABLE D-6: SCE INDIVIDUAL SURVEY RESPONSES, PAI SCORES AND NTGRS FOR PROCESS PUMPING VFDS

PA	Measure Group	n41	n2	PAI2	Replace	n5aa	n5	PAI3	n6	n6_77	n6a_Pct	PAI-N6	NTGR
SCE	Process Pumping VFDs	7	2	7	2	3		7	4			10	**0.80**
SCE	Process Pumping VFDs	2	1	1	1		10	0	5			0	**0.03**
SCE	Process Pumping VFDs	8	3	8	2	2		8	4			10	**0.87**
SCE	Process Pumping VFDs	8	2	8	1		4	6	77	10		10	**0.80**
SCE	Process Pumping VFDs		1		2	10		0	5			0	**0.00**
SCE	Process Pumping VFDs	5	2	5	1		4	6	4			10	**0.70**
SCE	Process Pumping VFDs	8	1	4	1		4	6	3			7.5	**0.58**
SCE	Process Pumping VFDs	6	3	6	2	4		6	6				**0.60**
SCE	Process Pumping VFDs	2	3	2	2	10		0	5			0	**0.07**
SCE	Process Pumping VFDs	9	3	9	2	10		0	5			0	**0.30**
SCE	Process Pumping VFDs	7	1	3.5	1		6	4	5			0	**0.25**
SCE	Process Pumping VFDs	5	2	5	2	7		3	1		30	7	**0.50**
SCE	Process Pumping VFDs	3	3	3	2	8		2	5			0	**0.17**
SCE	Process Pumping VFDs	8	3	8	2	10	3	0	3			7.5	**0.52**
SCE	Process Pumping VFDs	10	2	10	2	6	6	4	2			10	**0.80**
SCE	Process Pumping VFDs		1		2	10		0	5			0	**0.00**
SCE	Process Pumping VFDs	10	2	10	2	6	6	4	2			10	**0.80**

TABLE D-7: INDIVIDUAL SURVEY RESPONSES, VENDOR SCORES AND NTGRS FOR TANKLESS WATER HEATING

Measure Group	A5	PIS Score 1	A5a	RPIS Score 2	A6	NPS Score 3	NTGR
Tankless Water Heating	9	9	8	8	4	6	**0.77**
Tankless Water Heating	10	10	7	7	7	3	**0.67**
Tankless Water Heating	10	10	5	5	10	0	**0.50**
Tankless Water Heating	5	5	4	4	9	1	**0.33**
Tankless Water Heating	10	10	7	7	4	6	**0.77**
Tankless Water Heating	9	9	8	8	8	2	**0.63**

APPENDIX E RESPONSE TO COMMENTS

Submitted by	Section	Topic	Page	Comment	Evaluator Response
SCE		Industry Standard Practice		SCE recommends the reintroduction of market share tracking studies to determine on a regular basis these key inputs (baseline mix, useful lives, sales trends etc.) as opposed to one off ISP studies or Dispositions. There are better ways to determine these key parameters.	Thank you for the comment. We acknowledge that market share tracking studies can provide useful information to help inform the development of measure baselines.
SCE		NTG Result		ACEEE's State Scorecard Annual report uses NTG values from every state except California. California leads and has led the country in Energy Efficiency, Solar and now GHG abatement. We surely can find a way to lead in the measurement of program impacts and SCE looks forward to working with the team in moving in this direction.	Thank you for your comments. We expect there will be a NTG webinar scheduled in the future which would provide a forum for your collaboration and feedback.
SCG		Program Delivery Approach	p .3-15	For Tankless Water Heaters (TWH), upstream and midstream delivery are mentioned. This appears to be all midstream for TWH. Can you confirm and edit as needed?	Acknowledged, but upstream is one of the labels used in the tracking system for this subset of claims. This includes the majority of the SCG records and one PG&E record. However, the evaluation team has come to understand the TWH measure delivery is actually midstream, and has edited the report accordingly.
SCG		NTG Approach	p. 6-4	Changing methodology seems appropriate given the issues with the PAI-1 score. Replacing that score with question N6 asks 'what action you would have taken if the program had not been available'. This is very similar to the PAI-3 score and may lead to an over-emphasis on the non-program responses. Would it be better to combine question N6 into the PAI-3 score?	Each of these (PAI-3 and PAI-N6) represents a different way of reflecting program influence. PAI-3 signifies the likelihood of doing the same project at the same time absent the program. PAI-N6 reflects the specific action they would have taken if there had been no program. They are related, but they are different.
SCG		NTG Result	p. 3-21 and p. D-30	Given the newness of the midstream vendor NTG survey for TWHs, and the fact that interviews were conducted with only 6 vendors (with 2 for SCG and 4 for PG&E), the results may not be representative and should be informative only. We do realize that these vendors account for most of the TWH installations. That said, one of the six vendors has a very low NTG score and could be an outlier. Moreover, it is possible that midstream program influences are 'felt' by the customers (e.g., price effects, better promotion and information, etc.) and as end users their input should be considered.	Thank you for your observations. The Midstream framework relies on a combination of customer and vendor NTG findings. However, the utility could not provide any customer contact information so our choices were to either: (1) use vendor findings only; or (2) pass through savings based on the ex-ante NTG value. We elected to use vendor findings since, as you noted, they do represent the majority of program activity/savings. Note that the resulting vendor-centric NTGR of 0.55 is very similar to the ex-ante NTGR value of 0.58. We have strongly recommended that Program Administrators collect full contact information for the customers that purchase the program-qualifying measure so that we are able to use the full Midstream framework in the future.

Submitted by	Section	Topic	Page	Comment	Evaluator Response
SCG		Recommendations	p. 8-7	The recommendation to provide better customer contact information for midstream programs is good. Please consider expanding that to possibly include program design or requirements to have vendors indicate to all participating customers that the IOU/PAs are providing support and rebates in the state's energy efficiency program.	Thank you for this suggestion. The recommendation in the report was adjusted as suggested.
SCG		TWH Gross Impact Result, and Report Content	p. 3-21 and p. D-30	For TWHs, it is not clear how the hot water fixtures and the temperature increases are used to recalculate evaluated savings. Later sections discuss the use of recirculation systems and the fact that the entering temperature are higher and temperature differences are less (between the inlet and outlet temperature). A spot measurement which does not consider fluctuations over time to reflect various cold water inputs to the water heater during the day does not yield a good estimate of savings. Standby losses in recirculation loops (baseline and new) also should be considered. In the absence of better information, workpaper assumptions should be used. The survey instrument should be edited to include capture of the presence of recirculation loops and their controls. It may be useful to readers to have the relevant workpapers included in an appendix.	Evaluators referenced the workpapers' underlying DEER model inputs in the ex-post savings calculation. The spot-measured temperature rise was used in place of the DEER-assumed temperature delta to recreate unit energy savings with field-verified data. Refer to the below PG&E comment and response that references page 5-48; this addresses concerns expressed here regarding inlet water temperature fluctuations. We agree that additional data should be collected with regard to the presence and characteristics of a recirculation loop. We were in fact surprised to see TWHs used with recirculating systems. While the applicable workpapers do not expressly bar TWH installations for use with a recirc loop, they acknowledge that such systems are inefficient TWH uses. The report has been revised with footnotes and links to the applicable workpapers.
SCG		TW Gross Impact Result, and Report Content	p. 5-37	Several times in the report there is mention that one TWH 'project occurred at a service address that had no evidence of recent TWH installation'. Can you explain this in more detail, and whether or not this is a customer refusal, if a site visit was conducted, and other context and evidence collected.	The site visit was conducted as planned. However, upon comprehensive inspection of the facility, the field engineer found no evidence of a TWH system, much less one installed in recent years. The facility representative had no knowledge of a TWH project. Since no TWH system could be found at the service address claimed in the tracking data, evaluators were forced to apply a 0% RR for this isolated project.
SCG		TW Gross Impact Result, and Report Content	p. 5-51	Given the poor relative precision (RP) of +/-24% for SCG and +/- 40% for PG&E, with respective realization rates of 42% and 56%, it will be necessary to study the TWH measures in future years to produce reliable updates. Until that time, savings should utilize the approved workpapers.	We agree that the TWH measure warrants further study in future evaluation years. In fact, the TWH measure appears on the 2019 uncertain measure list. The evaluation report does not recommend that the programs degrade the savings with the RRs by utility. Rather, the report recommends that the workpapers are refined with field-verified data such as temperature rise and efficiency.
SCG		TWH NTG Result	p. 6-9	NRR is 55% vs. WP at 58%. Only based on 6 vendors (total) and 2 for SCG.	Thank you for this input.
SCG		Cost Effectiveness		There was almost no discussion of cost effectiveness in this evaluation. Something to consider for future evaluations.	Thank you for this input.
SCG		Process Pump VFD EUL		EUL set (ex post) at 1/3 of host equipment (pump motor) EUL. This might be waived and the full EUL used if we consider that the pump motor will most likely be replaced with a similar sized pump motor on failure.	Thank you for this input. However, there is no CPUC evaluation policy or guidance that is consistent with this recommendation.

Submitted by	Section	Topic	Page	Comment	Evaluator Response
PG&E	Overarching	Report Content	NA	PG&E commends the evaluation team for providing a well-written draft report with the inclusion of appendices for IESR tables and Recommendations. Furthermore, PG&E appreciates that the evaluation team has included analyses to categorize and quantify the reasons for discrepancies between ex ante and ex post results. These are best practices for impact evaluations.	Thank you for this complimentary input on the report content.
PG&E	Cover	Repot Title		To aid future searchability of this report, could the evaluators rename the study to include keywords "PY2018", "impact evaluation" and "SMB?" A revised title could be, "PY2018 Small/Medium Commercial (SMB) Sector ESPI Impact Evaluation, Draft," or similar?	The evaluation team made this suggested change.
PG&E	Overarching	Ex-Ante Savings	NA	PG&E would like to replicate the ex ante savings values for the four measures identified in the report. Can you specify what measure codes or other identifying information was used to query the ex ante savings from the Cedars data to construct the ex ante savings for each measure?	Appendix C includes a listing of tracking system-based measure descriptions by IOU that were included within the scope of this evaluation. However, it is notable that common measure descriptions are sometimes mapped to more than one such sector. The data are further screened, as needed, to remove all residential records, custom records, lighting records, HVAC records and codes and standards records. The evaluation team will provide PG&E with a complete listing of the claim IDs that constitute the population frame for this evaluation more generally, including both the four measure groups included in the evaluation scope AND those of other measure groups that also fell under the small/medium commercial sector but were passed through.
PG&E	Overarching	Ex-Ante Savings	NA	Can the report clarify throughout, where market effects (ME) of five percentage points are included in net savings and NTG values?	We have clarified in the report in multiple places where ME is included or not. To summarize, ME is included in all net values presented in section 1, section 7 and the IESR appendix AA. However, the NTGR in chapter 6 is defined as one minus free ridership, and therefore does not include the ME adder.
PG&E	Executive Summary	Ex-Ante Savings	NA	The executive summary discusses savings from four measures while the IESR table (Appendix AA) shows 60-70% pass through savings for other measures. What are the other measures that are passed through? If these other measures are part of the SMB commercial impact evaluation, should there be a summary table in the executive summary that includes all the savings covered by the evaluation?	There are only 4 uncertain measures that were evaluated under this study. For these four measure, little to no savings values were passed thru (i.e., the pass thru is typically 0% or something very small. All other measures were 100% passed through. These measures are not part of a reporting group, and are indicated with a reporting group called "Pass Through" and will show 100% passed through. Therefore, when the PA total line is shown, it will often be in the 60-70% range because the four measures that were evaluated, only represent 30-40% of the ex ante savings and the other measures, which were passed through, represent the other 60-70%. These other non-evaluated measures were not in any way examined by this study, and include a large number of other measures, and therefore will not be identified in the report.

Submitted by	Section	Topic	Page	Comment	Evaluator Response
PG&E	Executive Summary	Pump VFD Measure Description	p. 1-4	Can the report be clarified to explain what "Pumps are mislabeled, including proper classification…" means? Does this refer to labeling on the pump itself or mis-identification in the ex ante claims data?	Report updated to clarify that this issue relates to the accuracy of tracking system-based measure descriptions and pump horsepower ratings.
PG&E	Executive Summary, and Section 5.1	Refrigeration Case LED EUL	p. 1-5	The workpaper used a measure application type of replace on burnout (ROB) with a CPUC approved EUL of 16 years. PA's are required to use the approved workpaper values when making ex ante claims. However, we agree the 16-year EUL is inconsistent with a refrigerated case EUL of 12 years, although that value may be low. How did the evaluators come up with a 4-year RUL? We note that usage of RUL=1/3 EUL for custom retrofit add-on measure application types is not appropriate because LED lighting was not added but replaced existing lighting. Therefore, the evaluators have liberty to determine an appropriate RUL. PG&E doesn't believe most customers would invest in retrofitting equipment that they believe is near end of life. Will the evaluators consider a more appropriate measure life somewhere between 4 and 16 years?	Application of an evaluation-based EUL of 4 years is both appropriate and consistent with CPUC evaluation guidance that relates measure life to host equipment remaining useful life.
PG&E	Executive Summary Section 1.4.4	TWH Ex-Ante Savings Values		The report states, "11 of the 25 evaluated projects applied incorrect per-unit savings values…" This is a deemed measure; we are required to use workpaper values. Can the evaluators clarify what is meant by incorrect savings values or re-word the finding?	We agree that deemed measures, including TWH, must conform with applicable workpapers. The quoted statement refers to the underlying DEER models referenced by the applicable workpapers. These prototype models result in different unit energy savings values as a function of facility type, climate zone, efficiency tier, and system size. In 11 of 25 cases, the UES value applied by the programs contradicted the DEER-recommended UES based on facility type, climate zone, efficiency tier, and system size. We have added this information in the report.
PG&E	Chapter 2 Intro and Overview Section 2.2 and Table 2-2	Studies Measure Groups		Could the report clarify what is an "ESPI measure group" and what is an "ESPI measure?" Is there a distinction between measures on the Uncertain Measure List and ESPI measures, or are those synonymous terms?	The terms ESPI measure group and ESPI measure are synonymous when used in the report. Both terms refer to ESPI uncertain measures that were assigned to the Small/Medium Commercial sector evaluation.
PG&E	Chapter 2 Intro and Overview Table 2-2 and Table 2-3	Studies Measure Groups		Tables 2-2 and 2-3 both have footnotes "*** ESPI measures selected for evaluation." Where does this selection occur? These tables include Water Heater Boiler and Water Heating Storage Water Heater Measures. Based on the final 2018 Uncertain Measures List (October 31, 2017), these two measures contributed 7.4% and 6.4% respectively to statewide total uncertainty. Why were these measures not selected for evaluation and who makes that determination?	The evaluation team made the decision to exclude these two measures from the scope of the evaluation. That decision was made at the workplan stage of the project in June of 2019. Refer to page 1-2 of the final workplan.

Submitted by	Section	Topic	Page	Comment	Evaluator Response
PG&E	Chapter 5 Gross Impact Evaluation Results	Pump VFD Savings	pp. 5-20 to 5-23	PG&E commends the evaluation team for the excellent Tables 5-15 and 5-16 showing site-level sample results and discrepancy classifications. This is best practice reporting. In cases where pump run hours were found to be < 500 hours/yr., it looks like the evaluators calculated the resulting savings and factored that into the final measure GRRs. Is that correct, or were these considered "ineligible" and zeroed out?	First, thank you for your appreciation of the evaluation team efforts. Second, where pump run hours were under 500 hours per year, evaluators calculated ex-post savings and did not zero-out savings on an eligibility basis.
PG&E	Chapter 5 Gross Impact Evaluation Results	TWH Zero Savers	p. 5-47	The report states, "Three of the 25 projects were deemed zero-savers: one project occurred at a facility that has since gone out of business, one project occurred at a facility that uses electricity for water heating, and one project occurred at a service address that had no evidence of recent TWH installation." The tankless WH measure is a midstream program intervention. During the data request process PG&E initially did not provide end-customer data for this measure because that information is not definitively known. Recipients of tankless WHs were not direct program participants because it's a midstream program. Itron persisted asking PG&E "to do the best we could..." and we cautioned Itron that the end-customer matching through shipping addresses for these measures would result in low matching rates and could not be considered 100% accurate to identify end-customers benefiting from a midstream intervention. How are the evaluators certain that they were looking at the correct customer sites to warrant zero savings assessments when they were warned that the data are not 100% accurate? Unless the evaluators can demonstrate with high confidence that the sites they visited received incentivized tankless WH, and something else happened such that the incentivized tankless WH were not installed at any other location, can these sites be removed from the sample?	The summary of the PG&E/evaluator data request process is accurate. PG&E did caution the evaluators of the uncertainty of the customer-matched data, and evaluators carefully cleaned and examined the data to identify the projects with the highest-confidence contact information. The low-confidence projects resulted in a very poor recruitment rate. To maximize the recruitment rate and quantity of evaluated projects as the March 1 bus stop loomed, evaluators focused recruitment efforts on high-confidence projects with good contact information. For all recruited facilities, evaluators pre-screened the customers to minimize unfruitful site visits. Such recruitment efforts were necessary due to the data gaps and inaccuracies from the midstream measure design. Nonetheless, evaluators were only able to conduct site visits at 25 of the target sample count of 36 facilities. These difficulties caused evaluators to recommend that the programs more comprehensively collect end-user information, not only for evaluation purposes but for basic, proof-of-install auditing purposes. Evaluation site visits therefore generally occurred for customers with credible contact information and verbal agreement to participate. Only one of the 25 evaluated projects appear to be affected by the comment's last question-- the site for which a TWH could not be found, which was addressed above in response to the SCG comment referencing p. 5-37. Regarding sample design, removing a project from the sample would bias the results. The sample is designed such that, for every zero-saver in the sample, there are likely many other zero-savers in the participant population represented by that individual project.
PG&E	Chapter 5 Gross Impact Evaluation Results	TWH Zero Savers	p. 5-47	During the draft comment period, PG&E asked Itron by email to provide details for a site that may have received a midstream program instantaneous gas WH, but the site had electric water heating. Itron declined to provide the site data on concerns of anonymity. PG&E appreciates promises made around survey anonymity, and we believe that commitment has been met since no survey responses have been shared. However, how can program processes be improved if we are unable to identify and investigate possible issues? PG&E is requesting site-identifying information again. Further, we are requesting site-identifying information for the other two PG&E zero-saver WHs so that we can investigate what happened to determine if program changes are warranted.	The evaluation team and CPUC are not comfortable providing site-identifying information to PG&E, as our team has promised those participants that their responses will remain anonymous, and we feel it is important to provide that assurance to willing study participants in order to obtain full disclosure and honesty during data collection. When we identify issues with an application in our sample, we provide this information in the report, as well as recommendations to help alleviate ongoing problems more broadly. In this case, we have identified the issues we've encountered in the hope that PG&E can better address these and other similar problems through a combination of process improvements and thorough verification. That is the purpose behind the provision of some of the discrepancy factors identified in Chapter 5 . In our opinion taking a forward-looking, proactive approach would be more productive than a backward looking investigation of lost opportunities.

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PG&E	Chapter 5 Gross Impact Evaluation Results	TWH Zero Savers	p. 5-47	The tankless WH heating measure is a midstream intervention. PG&E appreciates that this is mentioned in the Executive Summary, but no mention of this appears anywhere in the section 5.4 write-up. Could the evaluators edit this section to acknowledge the midstream intervention approach, the data limitations associated with identifying end-customers in midstream programs, how those limitations could impact evaluation results, and steps the evaluator took to mitigate those impacts?	Good suggestions, and we have made these points more clear in Section 5.
PG&E	Chapter 5 Gross Impact Evaluation Results	TWH Zero Savers	p. 5-48	The evaluators indicate they re-estimated savings in part by examining the delta T resulting from both inlet and outlet temperatures. What months were inlet water temperatures taken? Inlet water temperatures vary at least 15degF throughout the year (p20, CEC Water Heating Design Guide, 2012, https://ww2.energy.ca.gov/2013publications/CEC-500-2013-126/CEC-500-2013-126.pdf). In calculating savings, were spot measurements used, or was there an effort to estimate average annual inlet temperatures?	Evaluators considered annual average city water temperatures in the site-specific savings calculations. When spot-measured inlet temperatures differed materially from the range of typical city water temperatures for a given climate zone, evaluators defaulted to the annual average city water temperature.