FINAL IMPACT EVALUATION

Small/Medium Commercial Sector
Program Year 2019

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Submitted to:
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SECTION 1:
EXECUTIVE SUMMARY

1-1 NEED FOR THE STUDY

The overall goal of our study is to evaluate energy savings from selected technologies in the 2019 energy efficiency programs funded by investor-owned utility ratepayers and administered by energy efficiency program administrators[1] (PAs). Specifically, this study examines programs in the non-residential sector including small and medium commercial buildings and industrial and agricultural businesses. Our 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 our study address California Public Utilities Commission (CPUC) regulatory reporting requirements. Our results are also used to conclude whether or not energy efficiency programs are meeting savings goals or helping to meet the state's climate goals.

1-2 ENERGY EFFICIENCY TECHNOLOGIES STUDIED

Our study evaluated 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 Ozone Laundry** – addition of ozone[2] laundry equipment to laundry facilities, in order to reduce hot water use
- **Process Pumping Variable Frequency Drives (VFDs)** – installation of pump motor speed controls on pumps that are used to irrigate farm crops

[1] Program administrators include Pacific Gas and Electric, Southern Calififornia Edison, Southern California Gas Company and San Diego Gas and Electric.

[2] Ozone laundry equipment add ozone to the water supply of laundry machines, resulting in laundry cycles that are typically completed using less hot water, while also enhancing sanitation.

- **Agricultural Irrigation** – drip irrigation used in agriculture
- **Tankless Water Heaters** – installation of high efficiency instantaneous water heaters in commercial buildings

1-3 APPROACH

Our study conducted original research to verify the savings reported by the PAs and/or developed revised estimates of savings for each technology studied. Our study addresses both electric (kWh, kW) and gas (Therm) savings provided over the lifetime of the technology. The primary mechanism for collecting data included telephone surveys and "virtual visits[3]" which we conducted remotely among a sample of customers that installed at least one of the study technologies. The data we collected as part of these activities includes information on how the technology was installed, and how the technology affected the site's energy consumption.

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

We also examined how successful the PA 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."

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[3] Virtual visits make use of cellular phone applications to allow for verification of on-site conditions that go beyond voice communication. This includes transmittal of pictures and data and video calls completed during a walk-through of a given facility.

Our evaluated gross savings estimates differ from the PAs' reported savings estimates due to differences in the modeling approach and measured inputs and other assumptions being applied by our evaluation team. Furthermore, our evaluated net savings estimates include all such gross savings adjustments and net savings adjustments associated with measured free ridership. Our gross savings realization rate is the ratio of the evaluation gross savings to the PAs' 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% or 1.0 means the PA-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% 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 included several questions regarding the program's influence on the participant's decision to install the energy efficient equipment. The survey examined various factors related to the program and asked the participant what they would likely have done in the absence of the program.

1-4 RESULTS

The results of our 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. Table 1-1 presents Therm savings for gas saving technologies, and

Table 1-2 shows MWhs and MWs savings for electric technologies. The tables also provide the ratios of evaluated savings to the PAs' reported savings and the corresponding NTGRs.[4] Just one of the 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-to-low

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

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 (PA) and Evaluated Lifecycle Therm Savings, Realization Rates and NTGRS for Evaluated Gas Technologies

Technology	Evaluated Therm Savings			
	Reported	Evaluated	Realization Rate (Evaluated / Reported)	Net-to-Gross Ratio
Lifecycle Gross Savings				
Ozone Laundry Equipment	10,979,241	8,534,943	0.78	
Tankless Water Heaters	21,118,085	17,174,352	0.81	
Lifecycle Net Savings				
Ozone Laundry Equipment	7,136,507	6,774,782	0.95	0.74
Tankless Water Heaters	13,357,829	11,864,760	0.89	0.64

Table 1-2: Reported (PA) and Evaluated MWh and MW Lifecycle Savings, Realization Rates and NTGRS for Evaluated Electric Technologies

Technology	Evaluated MWh Savings			Evaluated MW Savings			
	Reported	Evaluated	Realization Rate (Evaluated / Reported)	Reported	Evaluated	Realization Rate (Evaluated / Reported)	Net-to-Gross Ratio
Lifecycle Gross Savings							
Agricultural Pump VFD	44,686	91,283	2.04	22.7	11.5	0.51	
Agricultural Drip Irrigation	118,668	38,030	0.32	94.2	17.0	0.18	
Lifecycle Net Savings							
Agricultural Pump VFD	29,046	31,774	1.09	14.7	4.1	0.28	0.30
Agricultural Drip Irrigation	65,279	23,892	0.37	51.8	10.7	0.21	0.58

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.

1-5 RECOMMENDATIONS

1-5-1 Ozone Laundry Equipment

- **The addition of ozone laundry equipment is generally an effective technology for reducing hot water used by laundry equipment, resulting in energy savings.** With ozone laundry equipment in place, laundry cycles are typically completed using less hot water, and the hot water temperature setpoint for the water heating system is lowered. Both factors combined contribute to a reduction in natural gas used to heat water, in a water heater or boiler that provides hot water to a given laundry facility. Furthermore, the ozone that is introduced into the water supply used by laundry equipment enhances sanitation, including the destruction of microorganisms, like bacteria and viruses, that can cause disease.
  - The equipment's dual effectiveness in combating climate change through energy savings and reducing the likelihood of contagious disease outbreaks makes this technology highly attractive as a program offering. We recommend that this technology not only continue to be offered by the programs, but that the PAs increase participation levels through additional marketing and outreach supporting uptake of ozone laundry equipment.
- **Out of a total sample size of 35 sites we sampled 1 San Diego Gas and Electric (SDG&E) project, with a program-based savings estimate that accounts for 37% of all reported savings across all PAs.** This participating business supplies linens and work uniforms and acquired ozone laundry equipment through the program.

  While this project had great potential to save energy using ozone laundry equipment, the customer did not substantially adjust the hot water use per laundry load or change the water temperature settings, which resulted in a gross savings realization rate for this project of just 5%. While the resulting downward effect on the overall realization rate reported in Table 1-1 above is substantial, the result is still decent at nearly 80% of the reported savings. However, the effect on realized SDG&E savings is much greater, resulting in a realization rate of just 36%.
  - We recommend that large-scale projects of this nature are better served through a program channel where site-level reported savings are adequately vetted through the program application process. This type of program is called a custom program. Using a custom channel instead of a deemed program approach would likely have produced a more reliable estimate of PA-reported savings

for this project. Custom program projects typically undergo a more rigorous verification of operating conditions that are in-turn incorporated within the project saving estimates.

- **Ozone laundry equipment installations are not always properly screened for eligibility requirements.** We found that two of our sample points, out of a total sample size of 35 sites, replaced existing ozone laundry equipment with new equipment. Such installations are not eligible for the program and do not save energy.

  - The program's application and review process should include verification steps that better screen projects against eligibility requirements and exclusions.

1-5-2 Agricultural Pump Variable Frequency Drives (VFDs)

- **We found that VFD controls installed through the programs are not being properly screened in many cases for eligibility criteria.** Out of a total sample size of 45 pumps, commonly observed reasons for failing eligibility requirements includes the installation of speed controls in the following cases:

  - 5 pumps run fewer than 1,000 hours per year
  - 2 pumps pump well water into a water storage reservoir or trucks
  - 12 pumps have settings that are at or near full load
  - 4 pumps previously ran uncontrolled.

  Many of the VFDs are installed on new pumps that irrigate orchards that have been planted in the last couple of years; these young trees require less water than mature trees and this results in low run hours, many below 500 hours per year.

  - The program's application and review process should include verification steps that better screen projects against eligibility requirements and exclusions.

- **In most cases, pump loads and run hours per year can be determined using interval billing data, such as hourly demand measurements for a given pump.** In fact, our evaluation applied interval billing data as a key model input used to determine VFD savings.

  - We recommend that the programs make use of interval billing data for characterizing pump operations, including use of those data to derive updated estimates of savings for the pump VFD measure, and as screening criteria for pump run hours.

- **Beside the potential to save energy, there are other common reasons that farmers will decide to install VFD controls on crop irrigation pumps.** Some pumps cannot continue to operate 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, we recommend that the appropriate baseline be determined as a function of pump type and size. Current program savings estimates assume a throttle valve flow control baseline, in which partially closed valves are used to control pump flow. However, this assumed baseline ignores the fact that VFD flow controls are commonly installed, even without the influences of program intervention. VFD flow controls may already be the most commonly installed approach for certain pump type and size combinations.

1-5-3 Agricultural Irrigation

- **Agricultural drip irrigation is no longer offered through Pacific Gas and Electric (PG&E) programs**. PG&E gradually altered the eligibility requirements to accommodate specific irrigation technologies and crop types for which low-pressure irrigation was not yet a standard practice. By sunsetting the final eligible technology—drip irrigation at farms growing field vegetables—PG&E has deemed low-pressure irrigation to be standard practice throughout northern California.
  - We recommend that the agricultural irrigation realization rates and NTGRs presented in this evaluation report should not be applied prospectively to other agricultural irrigation technologies. The drip irrigation installations were uniquely conducive to downstream distribution at scale. As a result, its gross and net performance does not serve as a reliable proxy for other agricultural equipment or replacements such as irrigation pump upgrades.
- **The PA 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 our evaluated savings relative to the PA reported savings. For example, 13 of the 19 evaluated drip irrigation projects considered some combination of the following critical parameters needed to calculate savings: 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 PAs' reported savings did not consider these factors, the savings values were inaccurate and generally overstated.
  - Should drip irrigation technologies reemerge, we recommend that future savings estimates claims should be derived using evaluation data and results. The PAs should leverage findings from

previous evaluations to refine model inputs and assumptions, correct errors and omissions, and otherwise improve the accuracy of reported savings for drip irrigation technologies. This will ensure better alignment between reported savings and evaluation-based savings results.

- **The PA reported savings may be significantly overstating how long the equipment will last following installation.** PG&E assumes the equipment will last 20 years based on the default value considered for agricultural irrigation pumps. The EUL should be based on the expected life of the program installed equipment, not the associated irrigation pump. In many cases, we would expect that to be a much shorter life, as little as 5 years.
    - While the evaluated drip irrigation measure is no longer offered by PG&E, we recommend for future measures that involve drip irrigation or similar upgrades that useful life estimates should reflect the expected life of the program-installed irrigation emitters, not the associated irrigation pump.

1-5-4 Tankless Water Heaters

- **We determined that 9 of the 51 evaluated projects either never saved energy or no longer save energy.** Three claimed projects occurred at facilities that have since permanently closed, and 6 projects were claimed at service addresses that had no evidence of recent tankless water heater installations. These projects resulted in zero savings and significantly reduced overall realized program savings.
    - We recommend that programs should 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. This appears to be most challenging to accomplish for installed equipment that are delivered by the programs through retail or other equipment supplier sources, in contrast with equipment that are installed directly by contractors, and should therefore be an area of focus for implementing this recommendation.
- **Twenty-nine of the 51 evaluated projects applied incorrect per-unit savings values or misclassified the type of facility in which the measure was installed**. Correcting these errors resulted in slightly lower estimated savings.
    - We recommend that the PAs redouble efforts to ensure that reported savings estimates are based on the correct application of per-unit savings values. We attribute these observed errors to the following: erroneous application of the wrong result, or mis-specification of the facility type, climate zone, water heater size, or efficiency tier.

- **We found that water heaters operated at different temperatures than assumed in the applicable workpapers, which negatively affected the savings estimates**. However, we also found that the installed water heaters were rated at higher efficiencies than assumed. Overall, the positive effects from increased efficiency outweighed the negative effects due to operating temperatures, resulting in an overall increase in savings.
  - We recommend that future workpaper revisions incorporate recent evaluation results when available. This will ensure better alignment between reported savings and evaluation-based savings.
- **For many of the tankless water heaters evaluated, program tracking data did not provide sufficient information.** For approximately 45% of projects in the population, we did not have sufficient participant contact data to verify water heater installations or evaluate savings. As a result, we expanded our evaluation recruitment pool and ultimately exceeded the target sample count. We are encouraged by the slight improvement in recent tracking data quality as compared to our previous experiences.
  - We recommend that the PAs require participating distributors and partnering contractors to collaboratively collect and submit basic information for each customer ultimately receiving the equipment or other program support. As noted above, this appears to be most challenging to accomplish for installed equipment that are delivered by the programs through retail or other equipment supplier sources, in contrast with equipment that are installed directly by contractors and should therefore be an area of focus for implementing this recommendation. This basic information is critical for the PAs, the CPUC, and its contractors to verify installations and maintain the integrity of ratepayer incentive dollars.

1-6 Contact Information

The ED Project Manager for this study was Ms. Mona Dzvova. Mr. Kris Bradley of Quantum Energy Analytics served as the manager for this evaluation.

Table 1-3: Contact Information

Firm	Lead	Contact Info
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SECTION 2:

INTRODUCTION AND OVERVIEW OF THE STUDY

This report documents the activities and results of the Nonresidential Small and Medium Commercial Sector Impact Evaluation of the 2019 California program administrators[5] (PAs) energy efficiency programs. The overall goal of this study is to perform an impact evaluation on specific nonresidential deemed measures[6] that were identified in the Efficiency Savings and Performance Incentive (ESPI) Uncertain Measure List for program year (PY) 2019.[7] The team we have assembled to complete this work consists of two lead firms – Quantum Energy Analytics and DNV GL – and includes core data collection activities performed by Tierra Resource Consultants.

This evaluation focuses on energy efficiency (EE) resource program savings – measured in net ex post lifecycle energy savings – realized by PA programs in PY2019. Our evaluation team collected and analyzed primary data from PY2019 participants to develop net ex post lifecycle savings estimates and to satisfy impact evaluation requirements for measures on the PY2019 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 we 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.

[5] Program administrators include Pacific Gas and Electric (PG&E), Southern Califirfornia Edison (SCE), Southern California Gas Company (SCG) and San Diego Gas and Electric (SDG&E).

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

[7] https://pda.energydataweb.com/api/view/2100/2019UncertainMeasuresListMemo_2018-10-31c.pdf

2-1 RESEARCH OBJECTIVES

The objective of this study is to perform a measure or measure-parameter impact evaluation – utilizing new primary evaluation data – in order to develop ex post gross and net savings estimates and inform future ex ante savings values for measures identified in the PY2019 ESPI decision. Attachment A of the PY2019 uncertain measure list provides an overview of the measure groups (i.e., ozone laundry equipment, tankless water heaters, 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:

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

The final 2019 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 PY2019. 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. Our evaluation team has determined which measures and measure-parameters are subject to ex post evaluation. This determination is based on several factors, which we detail throughout this report.

Table 2-1 lists the PY2019 small and medium commercial sector uncertain measure groups. Due to budgetary and time constraints, we did not evaluate all measure groups, as will be discussed in more detail below. We identify the in-scope evaluation activities using bolding in the table, and the "G" and "N" designations indicate gross and net impact evaluation scope, respectively.

Table 2-1: 2019 Uncertain Measure List and Parameters Relevant to the Small/Medium Commercial Sector

Measure Group	2019 Impact Evaluation Scope*	
Process Ozone Laundry	**G / N**	Installation Rate, Unit Energy Savings (UES), Realization Rate (RR), Expected Useful Life (EUL)
Process Pumping VFD	**G / N**	Installation Rate, UES, RR, EUL
Refrigeration Case LED Lighting	X	Installation Rate, UES, RR, EUL
Water Heating Tankless Water Heater	**G / N**	Installation Rate, UES, RR, EUL
Agricultural Irrigation	**G / N**	Installation Rate, UES, RR, EUL

Source: Hansen, R., 2018. 2019 Efficiency Savings and Performance Incentive (ESPI) Uncertain Measures List. October 31, 2018.

** "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. We have addressed these research questions by collecting new primary data from participant telephone surveys and interviews with knowledgeable industry experts, and by conducting secondary literature reviews and leveraging relevant data provided by the PAs. Our proposed research questions (and supporting primary deliverables) are:

1. **What is the installation rate?** We confirmed installations (verification) using telephone-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 and operating conditions, and use shapes to support the estimate of gross energy savings values and 8760 impact load shapes, where feasible.

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 of existing or replaced equipment and the 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 PY2019 ESPI measures that fall under the Small/Medium Commercial sector impact evaluation and identifies the two electric measures that were in scope for this evaluation. We selected these two measures because they comprise nearly all the electric savings among the 2019 Small/Medium Commercial uncertain measures. These measures include the process pumping VFD and agricultural irrigation measure groups.

Table 2-2: PY2019 Participation Summary – Expected Net Lifecycle Electric Savings (GWh)

PY2019 ESPI Small/Medium Commercial Measure Group	PY2019 Tracking System Records*	PY2019 Unique Applications by Measure Group**	Ex Ante Net Lifecycle GWh Savings***	Percent of Savings	PY2019 In-Scope ESPI**** Electric Measures
Process Ozone Laundry	-	-	-	-	-
Process Pumping VFD	380	337	31	32%	G / N
Refrigeration Case LED Lighting	11	7	1	1%	-
Water Heating Tankless Water Heater	2	2	0	0%	-
Agricultural Irrigation	55	55	65	67%	G / N
Total	**448**	**401**	**97**	**100%**	**-**

Sources: Hansen, R., 2018. Final 2019 Efficiency Savings and Performance Incentive (ESPI) Uncertain Measures List. October 31, 2018.

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 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 included in the net savings values.*

***** ESPI measures selected for evaluation. "G" and "N" designations indicate ESPI measures that are being selected for PY2019 evaluation, with "G" identifying gross impact evaluation scope and "N" indicating net impact evaluation scope.*

Similarly, Table 2-3 presents the PY2019 ESPI gas-focused measures, including expected gas savings and associated participation statistics. The two gas-focused measures that we selected for evaluation are the process ozone laundry and tankless water heater measures which we selected because they comprise nearly all of the 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: PY2019 Participation Summary – Expected Net Lifecycle Gas Savings (MMTherm)

PY2019 ESPI Small/Medium Commercial Measure Group	PY2019 Tracking System Records*	PY2019 Unique Applications by Measure Group**	Ex Ante Net Lifecycle MMThm Savings***	Percent of Savings	PY2019 In-Scope ESPI**** Gas Measures
Process Ozone Laundry	138	113	7	35%	G / N
Process Pumping VFD	-	-	-	-	-
Refrigeration Case LED Lighting	7	5	0	0%	-
Water Heating Tankless Water Heater	893	687	13	65%	G / N
Agricultural Irrigation	-	-	-	-	-
Total	**1,038**	**805**	**20**	**100%**	**-**

Sources: Hansen, R., 2018. Final 2019 Efficiency Savings and Performance Incentive (ESPI) Uncertain Measures List. October 31, 2018.

CEDARS, 2019. Confirmed Claims Dashboards for 2019 (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 included in the net savings values.*

**** *ESPI measures selected for evaluation. "G" and "N" designations indicate ESPI measures that are being selected for PY2019 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 we 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 we developed first year and lifecycle ex post savings for each measure.
- **Section 5** discusses the development of each of the gross impact parameters, such as eligibility considerations, pre-and post-retrofit irrigation approaches, 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 supporting material for the net-to-gross methodology.
- **Appendix B** presents the net impact participant telephone survey instrument.
- **Appendix C** presents the net impact vendor telephone survey instrument.
- **Appendix D** presents the gross impact survey instruments.
- **Appendix E** presents the ESPI measure mapping from measure name in the tracking data.
- **Appendix F** presents evaluator responses to comments received on the draft report.

SECTION 3:

DATA SOURCES

3-1 DATA SOURCES

Our 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. We obtained these data using a combination of secondary literature review and new primary data collection. We list each data source below and describe the specifics of each data source in greater detail throughout this subsection:

- Primary data sources:
  - Telephone interviews and related remote data collection supporting gross impact objectives
  - Participant telephone surveys supporting net impact objectives
  - Distributor telephone surveys for measures with midstream program delivery
- 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: Primary Data Sources and Ex Post Update for PY2019 ESPI Measures

	Primary Data Sources		Ex Post Update	
2019 ESPI Measure	NTG Phone Surveys	Gross Impact Interviews / Remote Data Collection	NTG Results	Gross Impact Results
Ozone Laundry	X	X	X	X
Process Pumping VFD	X	X	X	X
Agricultural Irrigation	X	X	X	X
Tankless Water Heater	X	X	X	X

3-1-1 Program Tracking and CIS Billing Data

Our evaluation team downloaded program tracking and CIS billing data from a centralized server; each PA uploads that data following CPUC requests to do so. We 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 2019 ESPI measures, understand the portfolio-level savings attributable to those rebated measures, and inform the sampling plan for ex post evaluation.

We also used the CIS billing data in support of billing analysis for the Agricultural Irrigation measure installations in our sample, and we also used both AMI and CIS data in support of gross impact model calibration for the pump VFD and ozone laundry measures.

3-1-2 Gross Impact Interviews / Remote Data Collection

For this evaluation, we collected verification data using telephone interviews and various remote data collection approaches for all four evaluated measures. The purpose of these efforts was to gather installation and operational characteristics, and data relevant to specific parameters that support the estimation of impacts. Table 3-2 provides the details of the data that we collected and used to support our evaluation.

Table 3-2: Summary of Primary Site-Specific Gross Impact Data Collection Efforts – Small Commercial Impact Evaluation

Parameter	Ag Irrigation	Ozone Laundry	Pumping VFD	Tankless Water Heater
Installation and Operation Characteristics	Premise Characteristics: Where relevant our data collection staff recorded the building type. Equipment Nameplate: Our staff also recorded information obtained from each nameplate. Where feasible we obtained a photograph of each nameplate. Operating Characteristics: Our staff collected the operating and set-point schedules. Where possible, we obtained the schedules by direct observation of a programmable thermostat or energy management system. Where we were unable to directly observe the schedules, then we queried facility personnel for the schedules. We obtained equipment use schedule, as well as relevant set points and seasonality, if applicable. We also asked the site contact for the list of holidays observed at the facility and any other seasonal fluctuations in operation or production.			
Specific Parameters of Interest	Pump control sequences, crop type, pre-installation crop and irrigation method.	Equipment capacity, usage profiles for laundry operations, inlet water and hot water setpoint temperatures.	Pumping part-load profiles, well depth, pump capacity, head, seasonality-based variability in loads. The gross impact approach also featured use of AMI data to inform pump part-load data, in addition to participant-focused self-report data collection.	Building type, loads served, hot water setpoints, occupancy schedule, units served, eligibility, rated efficiency, and inlet and discharge water temperatures.
Industry Sources	Crop water requirements and irrigation end-use water discharge rates.	Inlet water temperature, prototypical laundry cycle descriptions and details, laundry water use models, laundry equipment specifications.	Motor efficiency, pump load factor default, pump performance curves.	We leveraged embedded load profiles within prototype DEER models by climate zone and facility type.
Billing Data	A dedicated billing meter supports billing analysis for the Ag measures.	Utility gas AMI or billing data for model calibration.	AMI/ dedicated billing meter for model calibration.	N/A

Ozone Laundry

The ozone laundry measures offered by PG&E, SCG and SDG&E in PY2019 accounts for nearly 7 million net lifecycle ex ante Therm savings, which represents 7% of the small/medium commercial sector savings overall. These claims consist of 138 tracking system records. For each PA one or two large projects contribute a relatively large proportion of the savings claims, with the remainder of the savings claims concentrated among nursing home participants. Tracking system-based measure descriptions also indicate the laundry capacity of each facility, consisting of the total pounds of linen capacity across all facility laundry machines. All of the measure records are tracked as being add-on equipment (AOE) applications. All EUL values are set to 10 years in the PA tracking records.

We assessed each sampled project for installation/operability, operating schedule, operating conditions, pre- and post-installation laundry cycle stages and associated fill levels and temperatures, parameters derived using targeted industry interview and literature review data sources, eligibility, baseline, EUL determination and GRR and savings derivation. As described in the subsequent sampling section, the impact evaluation assessed a sample of 35 facilities where participants installed ozone laundry machines in PY2019.

Field data collection included discussions with ozone laundry equipment suppliers and facility maintenance and laundry personnel regarding usage patterns, laundry cycles per day, hot water setpoints, hot water use throughout each laundry cycle, water heating equipment type, make, model and efficiency, laundry machine capacity, type, number, make and model, and other factors needed for modeling laundry water use. We obtained these data on a retrospective basis, inclusive of both the pre- and post-installation conditions, based on data collection spanning November 2020 through February 2021. We made follow-up calls where warranted. Assigned field engineers also obtained any available laundry logs, as well as a host of data and information surrounding 2021 operations relative to normal operations.

We used a combination of telephone interviews and remotely collected data to support key parameters required for accurate modeling of laundry pre- and post-installation hot water usage and related Therm impacts. Information that we collected includes:

- **The schedule of operation for laundry loads – seasonal (if variable), daily by day of the week (if variable)**
- **What loads are met, and how those loads are best characterized and quantified (i.e., pounds of laundry washed and dried per week)**
- **Make and model information for the installed ozone laundry and laundry machine equipment, and rated capacity (in pounds of linens washed)**
- **Water heating system type, capacity and efficiency**

- **Comparisons between pre- and post-installation laundry operations and washing machine water temperature and volume per load**
- **Confirmed utility gas meter and gas uses**

Our evaluation team also conducted a literature review to determine whether or not laundry equipment is governed by appliance standards. The relevant laundry equipment is not governed by efficiency standards, and other health and safety standards do not impact the selection of ozone laundry machines. We did learn, however, during the course of the evaluation that air quality management district requirements may impact ozone laundry equipment selection in some cases. The use of ozone laundry equipment is strictly optional, and as long as the pre-installation condition does not include the presence of ozone laundry equipment, then the appropriate baseline is laundry operations in the absence of ozone laundry equipment.

Process Pumping VFD

The pumping VFD measures included in the PY2019 savings claims constitute 32% of the net lifecycle electric savings among all small/medium commercial ESPI measures and 12% of the small/medium commercial sector savings overall. Most records, 98%, have measure descriptions that indicate they are agricultural pumps used in both booster pump and well pumping applications. The remaining records are glycol pumps used in process pumping applications. The measure descriptions describe the pump capacity in horsepower. All the PG&E tracking data claims are reported as being AOE applications. SCE reported that most records are AOE with a smaller number of records being new construction (NC). The only SDG&E record is reported as being NC. During evaluation data collection, our field staff independently determined the application type, as this has important implications for the evaluation baseline determination, the EUL derivation, and the appropriate evaluation approach to apply.

We assessed each sampled project for installation/operability, operating schedule, operating conditions, and conducted secondary literature review, targeted interviews, eligibility screening, baseline assessment, EUL determination and GRR and savings derivation. In determining the gross savings estimates we modeled the energy use of the pumps in the sample using AMI/CIS billing data to calibrate to observed post-installation usage with the VFD in place. We then modeled energy use for the baseline condition with throttle valve controls in place, and in-turn used the two resulting model-based results to estimate savings. The impact evaluation assessed a sample of 45 pumps installed in PY2019.

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. We obtained these data on a retrospective basis, both before and following VFD installation, based on data collection spanning September 2020 through February 2021. Our evaluation team obtained AMI records for a period of nearly three years, ending in September or October of 2020, with follow up data obtained for some records through December 2020. The affected pump typically has a dedicated utility meter in the field, and therefore AMI data provides sufficiently granular kW data; additional short-term measurement was not needed. In cases where the pump did not have a dedicated meter, we attempted to isolate the pump usage by removing any other known loads on the meter. Our field engineers also obtained any available trend data from the site contact or other sources, such as pump run hours, cumulative kWh since installation and even water volume pumped throughout the year.

Our evaluation team used telephone interviews to collect key parameters required for accurate modeling of pump usage. We collected the following information using our telephone survey:

- **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**

Agricultural Irrigation

The agricultural irrigation measure had appeared on prior uncertain measure lists and was evaluated in the PY2013-15, PY2017, and PY2018 ESPI cycles. This measure has evolved since prior cycles and, per the applicable PG&E workpaper (PGECOAGR111 Revision 6[8]), 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.

Additionally, the agricultural irrigation measure in PY2019 only allowed upgrades from sprinkler nozzle irrigation to drip irrigation. Prior cycles had allowed low-pressure nozzles or "micronozzles" as high-efficiency replacements, but those other measure options have since been sunset, as reflected in the PG&E workpaper active in PY2019. At the time of this writing, the agricultural sprinkler-to-drip irrigation measure is now sunset for all installations and crop classifications.

Our gross impact evaluation for PY2019 supports the March 2021 Bus Stop by leveraging evaluation methods used in PY13-18: consisting of a billing analysis of electric consumption and/or AMI data, incorporating participant survey data in support of a regression-based modeling effort. We obtained monthly and AMI utility data for the population of PY2019 participants from PG&E.

Based on recruitment dispositions in prior evaluation cycles for this measure group, we designed an evaluation sample of 22 to represent the 55 sprinkler-to-drip projects completed in PY2019; however, due to some instances of non-response or refusal, evaluators attempted to recruit all high- and medium-impact projects in the population, resulting in a total of 19 evaluated projects.

We employed a "virtual verification" approach for collecting key parameters to normalize pre- and post-project utility data for appropriate comparison, including:

- **Installation status using videoconference and/or photos**

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

- **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**

As the utility meter for the affected pump is often isolated in the irrigated field, AMI data provided sufficiently granular kW data; additional trended data or other performance 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% thermal efficiency, and tier two is ≥ 90% thermal efficiency.

The commercial tankless water heater (TWH) measure contributes 65% of PY2019 gas savings among all ESPI measures falling within the small/medium commercial sector and was previously studied in the PY2018 ESPI evaluation cycle. We revised the PY2019 approach to assess each sampled project virtually for installation/operability, eligibility, gross impact realization rate (GRR), and net-to-gross ratio (NTGR) through project file reviews and virtual data collection using videoconference whenever possible. As described in the subsequent sampling section, the impact evaluation was originally designed to assess a sample of 38 projects completed in PY2019. Evaluators surpassed the sample target by completing virtual verifications among 51 projects.

During each virtual verification, our 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**
- **Spot-read inlet and discharge water temperatures**
- **Presence of a hot water storage tank, size in gallons**

We leveraged data collection 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.

We used the temperature readings, along with the verified TWH size and nameplate efficiency as bulleted above, to recreate the unit energy savings (UES) originating from DEER prototype models. By comparing the DEER modeling assumptions with virtual-verified data, our analyst team calculated evaluated UES (Therm per kBtu/h installed) and subsequent evaluated savings.

3-1-3 Participant Phone Surveys

We also conducted telephone surveys to support the Net-to-Gross (NTG)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.

Our staff conducted 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 NTG and net savings values. We asked a standard battery of NTG questions of all telephone survey respondents.

A subset of the telephone interviews involved a single contact who was responsible for a large portion of the (weighted) program savings across multiple sites. A corporate decision maker installing ozone laundry equipment 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.

3-1-4 IOU Workpapers and DEER

Our 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.

Lifecycle savings are calculated by multiplying the annual unit energy savings by the effective useful life of the measure. Where feasible, we 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 sampled measure.

3-1-5 Industry Sources

Industry sources were used by our evaluation team 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 we used to establish robust methods for estimating savings include some of the following examples:

- **Use of DEER methods, augmented for site-specific conditions, to derive savings estimates**
- **Use of manufacturer equipment specifications to establish parameters**

- **Use of theoretical irrigation requirements by crop type and climate**
- **Use of literature and interviews with industry experts to establish laundry wash cycle characteristics and models**

3-2 SAMPLE DESIGN AND DATA COLLECTION

3-2-1 Gross and Net Impact Sample Design

Sampling across measure groups shares a common approach, involving data collection for a sample of points, and conducting measurement and verification (M&V) and NTGR estimation for that representative sample following data collection.

We used M&V activities to derive independent estimates of ex post gross 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.

We estimated NTGRs using established calculations/procedures for each representative sample point. The resulting sample-based NTGR estimates were used to derive independent estimates of evaluation-based net impacts, which we in-turn used to inform ESPI deliverables and possibly expected NTGR parameter updates, as well as to inform improvements that can be made to the programs themselves.

In general, where measure populations by strata were sufficient in size and good contract information was available, a sample was pulled for gross impact participant recruitment and subsequent impact evaluation, where insufficient a census was performed.

In general, for NTG sampling, a census was performed.

Ozone Laundry

The process ozone laundry measure group is an important contributor to natural gas savings within the measures included in this evaluation, contributing 35% of gas savings. The measure is delivered using downstream incentive programs. Furthermore, we note the following important observations:

- SCG and SDG&E contribute the bulk of the gas savings in the process ozone laundry measure group, at 46% and 42%, respectively, with the remaining 11% contributed by PG&E. The sample frame consists of just over 100 sites/applications, and the allocation by utility is 60%, 21% and 19% for SCG, SDG&E and PG&E, respectively.
  - **Implication**: we sampled all three utilities, but with the largest allocation of sample points going to SCG, followed by a moderate allocation to SDG&E and finally a small allocation to PG&E.
- Just six of the applications in the process ozone laundry measure group account for 42% of the measure groups' total gas savings claim.
  - **Implication**: For each utility we created certainty stratum so that data collection can be prioritized for this sub-sample of the program population. This was especially important for us to prioritize for SDG&E where just two applications account for 77% of the savings claim total for that PA.
- Program eligibility for the process ozone laundry measure is limited to just a handful of business types – one being nursing homes, which statewide accounts for a majority of the total applications in the program in PY2019.
  - **Implication**: we stratified each PA sample on nursing homes businesses and all other businesses, in order to ensure a representative mix of businesses in the sample, with a focus on obtaining nursing home sample points across the PAs.

Table 3-3 presents a summary of information surrounding the process ozone laundry measure group, and the resulting M&V sample design, along with the number of completed sites.

Table 3-3: Process Ozone Laundry Measure Group Gross Impact Sample Design and Completed Sample Points

Process Ozone Laundry Measure Strata	PY2019 Tracking Population		Sample Design and Data Collection Achieved (Sites)		Achieved Data Collection (% of Population)	
	Sites*	Ex Ante Net Lifecycle Savings (MTherms)**	Target	Completed Sites*	Sites	Therms
PG&E						
Certainty	1	0.13	1	1	100%	100%
Nursing Homes and Other Businesses	20	0.67	6	6	30%	29%
Subtotal	**21**	**0.79**	**7**	**7**	**33%**	**40%**
SCG						
Certainty	1	0.53	1	0	0%	0%
Nursing Homes	62	2.54	15	17	27%	25%
Other Businesses	5	0.25	1	0	0%	0%
Subtotal	**68**	**3.32**	**17**	**17**	**25%**	**19%**
SDG&E						
Certainty	2	2.33	2	2	100%	100%
Nursing Homes	14	0.49	5	7	50%	57%
Other Businesses	8	0.21	4	2	25%	31%
Subtotal	**24**	**3.03**	**11**	**11**	**46%**	**88%**
Total						
PG&E, SCG and SDG&E Total	**113**	**7.14**	**35**	**35**	**31%**	**51%**

Source: CEDARS, 2019. Confirmed Claims Dashboards for 2019 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

** Count of sites with records of non-zero gas savings.*

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

It is notable that the net impact sample design is the same as the gross impact sample design, and we were generally able to obtain both net and gross impact data for a nested sample of sites, with several exceptions. However, it is also true that for some telephone survey respondents a single decision maker provided a single set of responses supporting NTG objectives for multiple sites in the resulting gross impact sample and population. This was especially true for one SCG participant, where a single respondent accounted for 36 sites in the sample and 36 sites in the population. Table 3-4 presents the population and resulting net impact completes, presented in terms of both sites and decision makers.

Table 3-4: Process Ozone Laundry Measure Group Net Impact Sample Design and Completed Sample Points

Process Ozone Laundry Measure Strata	PY2019 Tracking Population		Sample Design and Data Collection Achieved		Achieved Data Collection (% of Population)	
	Sites* And (Decision Makers)	Ex Ante Net Lifecycle Savings (MTherms)**	Targeted Sites	Completed Sites*And (Decision Makers)	Sites And (Decision Makers)	Therms
PG&E						
Certainty	1 (1)	0.13	1	1 (1)	100% (100%)	100%
Nursing Homes and Other Businesses	20 (13)	0.67	6	3 (3)	15% (23%)	14%
Subtotal	**21 (14)**	**0.79**	**7**	**4 (4)**	19% **(28%)**	**28%**
SCG						
Certainty	1 (1)	0.53	1	1 (1)	100% (100%)	100%
Nursing Homes	62 (22)	2.54	15	43 (6)	69% (27%)	71%
Other Businesses	5 (5)	0.25	1	2 (2)	40% (40%)	22%
Subtotal	**68 (28)**	**3.32**	**17**	**46 (9)**	**68% (32%)**	**72%**
SDG&E						
Certainty	2 (2)	2.33	2	1 (1)	50% (50%)	74%
Nursing Homes	14 (13)	0.49	5	5 (4)	36% (31%)	28%
Other Businesses	8 (5)	0.21	4	2 (2)	25% (40%)	38%
Subtotal	**24 (20)**	**3.03**	**11**	**8 (7)**	**33% (35%)**	**64%**
Total						
PG&E, SCG and SDG&E Total	**113 (62)**	**7.14**	**35**	**58 (20)**	51% **(31%)**	**64%**

Source: CEDARS, 2019. Confirmed Claims Dashboards for 2019 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* *Count of sites with records of non-zero gas savings.*

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

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 32% 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 79% and 21%, respectively, and SDG&E contributes just a small minority of savings.**
  - Implication: We only sampled among PG&E and SCE **applications and we transferred evaluation results to SDG&E savings where feasible.**
- **Following the sample pull, our evaluation team created additional stratification within the design as follows:**
  - The process pumping VFD measure group consists largely of VFDs installed in agricultural pumping applications – consisting of a mix of booster pumps used for irrigation (36% of tracking system records and 22% of savings) and well pumps used to draw water to the surface (63% of tracking system records and 72% of savings). A small minority of applications involve glycol pumps used in industrial process applications.
  - Implication: Our evaluation approach featured a data collection strategy designed to yield an appropriate mix of booster and well pumps.
- **PG&E and SCE applications feature several repeat customers that participate on more than one occasion.**
  - Implication: We pulled sample among a population of farms by collapsing across records and applications that span a given farm. This ensured efficient recruitment for M&V efforts and coordination with our NTGR team, and ensured that a given decision maker was not overly burdened.

Table 3-5 presents a summary of information surrounding the process pumping VFD measure group, and the resulting M&V sample design along with the number of completed tracking system records. It is notable that each tracking system record usually represents a single pump, and we were able to successfully collect M&V evaluation data for 45 pumps, with a target of 50 records. We somewhat exceeded the overall PG&E targeted number of completes, but were short of targets for SCE due to sample frame size limitations, contract information data quality issues and participant non-response.

Table 3-5: Process Pumping VFD Measure Group Gross Impact Sample Design and Completed M&V Points

Process Pumping VFD Measure Grouping	PY2019 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						
Well	205	17.8	19	21	10%	10%
Booster	111	4.8	13	12	11%	12%
Glycol	6	1.8	0	0	0%	0%
Subtotal	**322**	**24.4**	**32**	**33**	**10%**	**9%**
SCE						
Well	31	4.5	10	7	23%	15%
Booster	26	2.0	8	5	19%	23%
Subtotal	**57**	**6.4**	**18**	**12**	**21%**	**18%**
SDG&E						
Subtotal	**1**	**0.2**	**0**	**0**	**0%**	**0%**
PG&E and SCE Total						
Total	**380**	**31.1**	**50**	**45**	**12%**	**11%**

Source: CEDARS, 2019. Confirmed Claims Dashboards for 2019 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* *Count of records with non-zero electric savings.*

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

It is notable that the net impact sample design is the same as the gross impact sample design, but for the net evaluation it is more meaningful to examine the number of completed NTG interviews with a given farmer. Farmers are typically the decision makers who elect to acquire VFD flow controls and their decision making normally does not vary substantially from pump-to-pump.

Table 3-6 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 among farmers. Where possible we conducted NTG interviews within the sample of M&V completes. In addition, we conducted additional NTG interviews with a census of points in the population, and thereby achieved additional NTG completes to supplement the nested M&V/NTG sample. Across both PAs we targeted NTG completes with 40 farmers but obtained 59 completes.

Table 3-6: Process Pumping VFD Measure Group Net Impact Sample Design and Completed Surveys

Process Pumping VFD Strata	PY2019 Tracking Population		Sample Design and Data Collection (Farmers)		Achieved Data Collection (% of Population)	
	Farmers*	Ex Ante Net Lifecycle Savings (GWh)**	Target	Actual	% Farms	% GWh
PG&E						
Well Pumps	133	17.8	14	34	26%	20%
Booster Pumps	73	4.8	10	21	29%	22%
Glycol Pumps	5	1.8	0	---	---	---
Subtotal	**196**	**24.4**	**24**	**48*****	**24%**	**19%**
SCE						
Subtotal	**50**	**6.4**	**16**	**11**	**22%**	**33%**
SDG&E						
Subtotal	**1**	**0.2**	**0**	**0**	**---**	**---**
PG&E and SCE Total						
Total	**247**	**31.1**	**40**	**59**	**24%**	**22%**

Source: CEDARS, 2019. Confirmed Claims Dashboards for 2019 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* *Count of farms with records of non-zero electric savings.*

** *The 0.05 market effects adder is included in the net savings values.*

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

Agricultural Irrigation

The agricultural irrigation measure group included in this evaluation contributes 67% of electric savings and no gas savings. Please note that we have interpreted the agricultural irrigation measure group to include only the sprinkler-to-drip replacement measure. For this 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 PY2019.**
  - 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 M&V and NTG samples consisted only of PG&E projects.
- **The agricultural irrigation measure program delivery is bifurcated by sector: commercial participants are classified as upstream delivery, while agricultural participants are classified as downstream. Workpaper references and unit energy savings for kWh and kW are uniform across all sectors and delivery methods.**
  - Implication: We believe the distinction by sector is an eccentricity of the PG&E tracking data, as participants classified as commercial generally appear to be farms that have been classified as agricultural in prior cycles of evaluation. Since the unit energy savings are uniform between commercial and agricultural customers, we did not stratify the sample by sector or delivery method.
- **The agricultural irrigation measure program delivery is via downstream provision of deemed participating customer rebates.**
  - Implication: We did not segment the sample design by delivery method. Reasonable customer contact information was available in the program tracking data and sufficed for the purposes of M&V and NTG recruitment efforts. Our evaluation team used all available means to reach selected participant sample points.

The PY2019 sample frame consists of 55 unique applications, all of which are PG&E customers with measures classified as "sprinkler-to-drip irrigation" among field vegetables. Table 3-7 illustrates how we stratified the sample frame among four total strata to ensure the most economical design possible.

Table 3-7: Agricultural Irrigation Measure Group Gross Impact Sample Design and Completed M&V Points

Agricultural Irrigation Measure Grouping	PY2019 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	4	21.7	4	4	100%	100%
Stratum 2	8	20.4	8	7	88%	89%
Stratum 3	32	21.1	10	8	25%	29%
Stratum 4 – Small Savers	11	2.1	0	0	0%	0%
Total	**55**	**65.3**	**22**	**19**	**29%**	**71%**

Source: CEDARS, 2019. Confirmed Claims Dashboards for 2019 (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.*

*** 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 relatively conservative coefficient of variation of 1.0, due to high variability in site-specific results in prior cycles.

As shown in the table, we achieved the Stratum 1 target but fell slightly short of the Strata 2 and 3 targets. These strata included three customers that refused participation in the study. As a result, we assessed 19 projects, three less than the original target of 22 projects. The 19 projects comprise 71% of PY2019 GWh savings for the agricultural irrigation measure.

These 19 projects comprised only 2 unique decision makers. Therefore, we only completely 2 unique NTG surveys.

Tankless Water Heating

The tankless water heater measure group contributes 65% of PY2019 natural gas 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 PY2019.**
  - Implication: the full population of applications/projects with gas savings 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 63% and 37%, respectively.**
  - Implication: The sample design segments by PA, to ensure sufficient representation from each PA in the evaluation sample.
- **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. Despite a more challenging recruitment effort than traditional impact evaluations, we ultimately assessed 51 projects for gross savings evaluation, as compared to the target of 38.

The tankless water heater measure had appeared on the 2017 and 2018 uncertain measure lists and was evaluated in the PY2018 ESPI cycle. 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 3-8 confirmed sufficient representation of large and small water heaters.

Table 3-8: Tankless Water Heater Measure Group Gross Impact Sample Design and Completed M&V Points

Tankless Water Heater Measure Grouping by PA	PY2019 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 3 (Large Savers)	12	2.7	4	0	0%	0%
Stratum 2	39	2.8	6	7	18%	13%
Stratum 1	163	2.7	6	12	7%	6%
Stratum 0 (Excluded)	57	0.2	0	0	0%	0%
PG&E Subtotal	271	8.5	16	19	7%	6%
SCG						
Stratum 3 (Large Savers)	46	1.0	6	4	9%	11%
Stratum 2***	241	2.7	10	14	6%	6%
Stratum 1	127	1.2	6	14	11%	11%
Stratum 0 (Excluded)	2	0.0	0	0	0%	0%
SCG Subtotal	416	4.9	22	32	8%	8%
Total	**687**	**13.4**	**38**	**51**	**7%**	**7%**

Source: CEDARS, 2019. Confirmed Claims Dashboards for 2019 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* *Count of applications with records of non-zero gas savings.*

** *The 0.05 market effects adder is included in the net savings values.*

*** *As described in the PY2019 Data Collection and Sampling Plan, the majority of SCG participants in PY2019 had identical savings claims at approximately 11,200 lifecycle net Therms per project. We therefore grouped all such projects into a single stratum.*

PY2019 featured 687 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. Four savings strata were used within each PA segment. The lowest-saving stratum (stratum 0) was omitted from the sample, as it constituted less than one percent of the lifetime Therm savings within each segment. Based on tankless water heater evaluation results in the PY2018 cycle, evaluators assumed a coefficient of variation (COV) of 0.5 in the sample design.

Table 3-8 indicates that evaluators exceeded the target sample count of sampled projects. As in the PY2018 evaluation, recruitment of PY2019 TWH participants proved 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. In anticipation of these recruitment challenges, the evaluation team expanded the recruitment pool, particularly within the strata with relatively low project counts (e.g., PG&E 3, PG&E 2, SCG 3). In the end, we achieved and exceeded the target counts for all but the two high-saver strata: PG&E 3 and SCG 3.

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. Program influence is therefore evident among participating distributors, of which 17 participated in the PG&E and SCG programs in PY2019. The evaluation team conducted professional interviews among 7 distributors representing 84% of PY2019 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

Tankless Water Heater Program Administrator	PY2019 Tracking Population		Completed Distributor Interviews		
	Distributor Counts	Ex Ante Net Lifecycle Savings (MMThm)*	Counts	% Applications	% MMThm
PG&E	6	18.0	5	89%	90%
SCG	11	6.1	2	79%	74%
Total	**17**	**24.1**	**7**	**82%**	**84%**

Source: CEDARS, 2019. Confirmed Claims Dashboards for 2019 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

** The 0.05 market effects adder is 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

To complement the distributors' perspectives on program influence, we also conducted NTG surveys among end-users receiving the discounted TWHs in PY2019. The purpose of the end-user interviews was to quantify the influence of the program and its rebates on end-user decision-making by collecting information on the following:

- Likelihood of installing a high-efficiency TWH without program incentives
- Importance of the contractors' recommendation to install the high-efficiency TWH
- Awareness of program participation
- Awareness of embedded incentives potentially discounting the TWH cost

- **Importance of those incentives in the decision to install the high-efficiency TWH**
- **Influence of other non-program factors on TWH installation and timing**

Ultimately, the evaluation team completed NTG surveys with 25 unique decision makers that installed high-efficiency TWHs in PY2019, which comprised 93 different applications. Our initial target was identical to the gross sample target (38 end-users); however, we encountered challenges in identifying and reaching the end-user decision-maker. In many cases, the facility representative most knowledgeable about the system itself (i.e., the TWH characteristics addressed in the gross survey) was different from the decision-maker. As a result, evaluators attempted NTG surveys among all PY2019 end-users with sufficient contact information, resulting in a total of 25 decision maker surveys corresponding to 93 unique applications, as detailed in Table 3-10.

Table 3-10: Tankless Water Heater Measure Group Completed Net Surveys

Tankless Water Heater Measure Grouping by PA	PY2019 Tracking Population		Achieved Data Collection (% of Stratum Total)		
	Applications*	Ex Ante Net Lifecycle Savings (MMThm)**	Actual	% Applications	% MMThm
PG&E					
Stratum 3 (Large Savers)	12	2.7	1	8%	11%
Stratum 2	39	2.8	2	5%	5%
Stratum 1	163	2.7	9	6%	3%
Stratum 0 (Excluded)	57	0.2	0	0%	0%
PG&E Subtotal	271	8.5	12	4%	6%
SCG					
Stratum 3 (Large Savers)	46	1.0	2	4%	5%
Stratum 2	241	2.7	67	28%	28%
Stratum 1	127	1.2	12	9%	9%
Stratum 0 (Excluded)	2	0.0	0	0%	0%
SCG Subtotal	416	4.9	81	19%	19%
Total	**687**	**13.4**	**93**	**14%**	**11%**

Source: CEDARS, 2019. Confirmed Claims Dashboards for 2019 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

** Count of applications with records of non-zero gas savings.*

*** The 0.05 market effects adder is included in the net savings values.*

SECTION 4:

GROSS IMPACT EVALUATION METHODOLOGY

This section provides an overview of the methods we used to estimate the gross savings for each of the evaluated PY2019 ESPI measures.

4-1 Ozone Laundry 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 ozone laundry measures, and to contribute method and parameter findings in support of future ex ante workpaper revisions. Ozone laundry equipment are optional add-ons to laundry facilities that introduce ozone to the feedwater serving laundry machines. The presence of ozone in the wash cycle allows sanitation of linens using lower hot water temperature settings and less hot water during the wash cycle. This in-turn leads to reduction in natural gas use at the boiler or hot water heater that serves a given laundry facility.

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

Table 4-1: Ozone Laundry Measure Codes and Tracking Data-Based Ex Ante Savings Values

Code	PA	Measure Description	UES Therms	Unit
B85	PG&E	Ozone Laundry	39.3	PROC-LBS
540361	SCG	Ozone Laundry	39.3	PROC-LBS
402421	SDG&E	Ozone Laundry	39.3	PROC-LBS

Ex ante claims are based upon workpapers, and our evaluation team checked whether or not tracking data-based claims were properly reported for all ozone laundry measures. We verified unit-energy savings (UES) claims in all instances examined, which we found to be properly set equal to 39.3 Therms per pound of laundry machine linen capacity.

It is notable that ozone laundry equipment program eligibility is restricted to certain businesses types, which varies somewhat across utility workpapers, but the superset of eligible businesses includes hotel/motels, health care facilities, nursing homes, correctional facilities and fitness centers. Our review of the tracking data-based business type variables suggests that some SCG and SDG&E facilities may not be eligible. This includes government facilities, commercial laundry businesses, linen supply companies, a party rental store and a charity, among others. However, our evaluation-based gross impacts were not impacted in any way based on potential business type ineligibility.

4-1-1 Laundry Modeling Description

We created an Excel-based gross impact modeling tool to estimate natural gas savings for all but one point in the sample. This tool also incorporates a publicly available model for estimating hot and cold water consumption for a laundry load that is specified by the user. This Excel-based tool (wewatercharts US 111008rinsave.xls) was obtained from the website of a leading laundry machine manufacturing company.[9] The user of the water consumption model specifies a laundry machine make and model, the pounds of linens washed, the type of linens being washed, the various stages of the wash cycle, and for each stage of the wash cycle the relevant temperature setting and fill level.

For one point in the sample we instead applied a billing analysis, using pounds of laundry washed per month as an normalizing variable to explain month-to-month variation in natural gas use. The natural gas use at this particular facility is dominated by laundry machine hot water loads, so other end uses did not impact the ability of the resulting model to properly resolve this relationship between laundry machine load and gas consumption.

9 https://www.milnor.com/tkb/HFW5.x/FLS/Milnor/wewatercharts%20US%20111008rinsesave.xls

Table 4-2 presents the water usage model inputs for a prototypical wash cycle and a washing machine with a 60-pound linen capacity, representing the baseline condition. We specified this same baseline wash cycle for all points in the sample where the model was applied, but with appropriate adjustments for the laundry machine make and model. This baseline wash cycle was obtained from an ozone laundry machine supplier that is very active in the program, who in-turn obtained this information from a chemical supplier to laundry facilities. We further confirmed this baseline wash cycle based on wash cycle information obtained from the leading supplier of chemicals to laundry facilities. The two wash cycle sources differed in some ways but both yielded similar hot water consumption estimates using the water use tool noted above. This wash cycle reflects appropriate wash stages for heavily soiled linens. We typically set additional model parameters to a load size that is 80% of full capacity, unless site-specific load size was available, and a mix of poly-cotton linens. The result is a baseline characterized by wash cycle stages that frequently use hot water, and an estimate of hot water use of 49.3 gallons per wash load for a machine with a 60-pound linen capacity.

Table 4-2: Industry-Based Baseline Wash Cycle Hot Water Use by Stage

Operation	Level	Water Level (Inches)	Fill Water Temperature Setting	Hot Water Consumption (Gallons)
Initially Absorbed Water	None	0	Hot/Cold Split	5.0
Flush	High	10	Hot/Cold Split	5.3
Flush	High	10	Hot	10.5
Suds	Low	8	Hot	9.0
Bleach	Low	8	Hot	9.0
Rinse	High	10	Hot	10.5
Rinse	Low	8	Cold	0.0
Extract	None	NA	NA	0.0
Total				**49.3**

We also obtained a similar prototypical wash cycle for laundry machines, assuming ozone laundry equipment are present, from the same ozone laundry equipment supplier. The supplier considers this to be proprietary information and so we cannot present that information in a format similar to Table 4-2 above. However, the result is a wash cycle characterized by frequent cold water use for most wash stages, and a considerably reduced hot water use estimate per wash cycle.

The remainder of our model estimates baseline gas use and post-installation gas use, given hot water use per wash cycle results discussed above. Additional model inputs for both the baseline and post-installation condition includes the following: hot water setpoint temperature, tap water (cold) temperature, enthalpy conditions for the hot and cold conditions, laundry wash cycles per day, laundry days per week, laundry weeks per year, laundry machine capacity in pounds of laundry (and other clothes washer specifications), an assumed 80% washer capacity use estimate (in the absence of participant reports), the number of washing machines in a given facility, the assumed boiler or water heater efficiency (80%), and several conversion constants.

For both the post-installation and baseline cases, our model utilizes the above data as follows:

$$PUWHE = \frac{8.34 \times (Enthalpy_{hot} - Enthalpy_{cold})}{100{,}000 \times WHE}$$

$$WHGPY = LLPY \times HWGPL$$

$$WHTPY = WHGPY \times PUWHE$$

Where:

$PUWHE$ is the per-unit water heater energy (Therms per gallon of hot water)
8.34 is the density of water (Lbs/gallon)
$Enthalpy_{hot}$ is the enthalpy of hot water (Btu/lbm)
$Enthalpy_{cold}$ is the enthalpy of cold water (Btu/lbm)
100,000 is a Btu to Therm conversion factor

WHE is the water heater efficiency

$WHGPY$ is the annual hot water load for laundry

$LLPY$ is the number of laundry loads per year

$HWGPL$ is the gallons of hot water per laundry cycle

$WHTPY$ is the water heater Therms per year

We then set the resulting ex post Therm savings equal to the difference in water heater Therms per year between the baseline model and the post-installation model.

Our evaluation models for each site in the sample were supported by the data requirements noted above. We obtained inputs from a mix of sources, including participants self-reports, ozone machine supplier self-reports, secondary sources, industry experts, equipment specification sheets and engineering judgement (where needed). In Table 4-3 we present the sources supporting each parameter. Where feasible we obtained data from more than one source in an effort to validate the primary sources used. In this table primary sources are identified using a P and secondary sources using an S, where relevant.

Table 4-3: Data Sources Used for Gross Impact Model Parameters and Inputs

Model Parameter/Input	Participant Self-Reports	Ozone Machine Supplier Self-Reports	Secondary Sources	Industry Experts	Equipment Specification Sheets	Tracking Data	Engineering Judgement
Hot water setpoint temperature	S	P	S	S			
Tap water (cold)temperature			P				
Water enthalpy curves			P				
Laundry wash cycles per day	P	S					
Laundry days per week	P	S					
Laundry weeks per year	P	S					
Laundry machine capacity	S	P				S	
Laundry machine utilization factor	P	S		S			
Linen type washed	S	P	S	S			
Number of laundry machines	P	S				S	
Boiler or hot water heater efficiency			P		S		S

4-1-2 Effective Useful Life Estimation

Our evaluation team accepts the workpaper-based EUL estimate of 10 years, which in-turn is based on DEER. 10 years was also found to be populated in tracking data for each record we examined. While our evaluation team accepts that ozone laundry equipment are an optional add-on, we do not believe that the clothes washer remaining useful life is a factor that should be considered in determining ozone equipment EUL. That is, should a laundry machine fail, that has no implications for the ongoing functionality of the ozone system, which is frequently the logic applied for add-on measures that result in reduced evaluation- or tracking-based EULs. Instead, participating customers would be expected to replace the existing laundry machine when needed and continue to reap the energy saving benefits of ozone equipment.

4-2 PROCESS PUMPING VFD MEASURES

The primary objective of our 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. The majority of PY2019 savings claims for the process pumping VFD measure are associated with agricultural pumps, with a minority of glycol pumps serving industrial processes. The evaluation team focused exclusively on the agricultural pumping applications – specifically pumps used to irrigate fields/crops – both booster pumps and well pumps.

In Table 4-4 we display the claimed measures and their ex ante unit energy savings.

Table 4-4: Process Pumping VFD Measure Codes and Tracking Data-Based Ex Ante Savings Values

Code	IOU	Measure Description	UES kW	UES kWh	Unit
IR006	PGE	Variable Frequency Drive on Agricultural Well Pumps (<=300hp)	0.121	256.60	Rated HP
IR007	PGE	Variable Frequency Drive on Agricultural Booster Pumps (<=150hp)	0.122	226.65	Rated HP
IR012	PGE	AGR Well Pumps (LTE 75HP) VFD - Enhanced Specifications	0.120	284.00	Rated HP
IR013	PGE	Booster Pumps (LTE 75HP) VFD - Enhanced Specifications, Retrofit and New Construction	0.1	237.00	Rated HP
IR014	PGE	Well Pumps (GT 75HP TO LTE 600HP) VFD - Enhanced Specifications, Retrofit and New Construction	0.177	276.00	Rated HP
IR015	PGE	Booster Pumps (GT 75HP TO LTE 150HP) VFD - Enhanced Specifications, Retrofit and New Construction	0.11	257.00	Rated HP
MA6	PGE	Glycol Pump VFD- 7.5HP	0	16,935	Each
MA7	PGE	Glycol Pump VFD- 10HP	0	22,580	Each
MAA	PGE	Glycol Pump VFD- 25HP	0	55,097	Each
PR-12484	SCE	Variable Frequency Drive on Agricultural Booster Pumps (<=150hp)	0.122	226.65	Rated HP
PR-12484	SCE	Variable Frequency Drive on Agricultural Well Pumps (<=300hp)	0.121	256.60	Rated HP

Code	IOU	Measure Description	UES kW	UES kWh	Unit
PR-12484	SCE	VFD on Agricultural Well Pumps (<=300hp) Pump	0.121	256.60	Rated HP
PR-12497	SCE	Variable Frequency Drive on Agricultural Well Pumps (<=300hp)	0.121	256.60	Rated HP
PR-12497	SCE	Variable Frequency Drive on Agricultural Booster Pumps (<=150hp)	0.122	226.65	Rated HP
PR-12497	SCE	VFD on Agricultural Booster Pumps (<=150hp) Pump	0.122	226.65	Rated HP
PR-18922	SCE	Variable Frequency Drive on Agricultural Well Pumps (<=300hp) NEW Express only	0.121	256.60	Rated HP
PR-18922	SCE	VFD on Ag Well Pumps (<=300hp) NEW Express Pump	0.121	256.60	Rated HP
PR-18923	SCE	Variable Frequency Drive on Agricultural Booster Pumps (<=150hp) NEW Express only	0.122	226.65	Rated HP
PR-18923	SCE	VFD on Ag Booster Pumps (<=150hp) NEW Express Pump	0.122	226.65	Rated HP
463779	SDGE	VFD on New Agricultural Well Pumps for 300 HP and below	0.121	256.60	Rated HP

Ex ante claims are based on the utility workpapers, and we checked whether the tracking data-based claims were properly reported for all agricultural pump VFD measures. We verified the Unit-energy savings (UES) claims for all measure codes and the only discrepancy was PG&E measure code IR014. The evaluation team 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

Our 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,[10] and is downloadable from their website under TRM spreadsheet number 401.[11]

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

[11] https://www.cmua.org/energy-efficiency-technical-reference-manual

Our Evaluation team adapted the Excel-based tool from the CMUA TRM 401 calculator, which models the 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. The VFD adjusts the pump motor speed (and flow) with reduction in load, whereas with the throttle valve controls the motor continues to spin at a constant speed. The throttle valve instead adjusts flow by incrementally closing a control valve on the discharge side of the pump, thus constricting the flow through an increase in friction. The reduction in power input for the VFD drops off more dramatically under lower and lower part-load conditions when compared with the throttle valve controls. 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 we set the affinity law exponent 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.[12] 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.

Table 4-5 is a table featured in the evaluation tool and is based on an example sample point to illustrate the impact of a VFD on pump load relative to the baseline throttle valve controls and the associated impacts – as a function of pump part-load operating conditions and the frequency of each load condition. For this example, the pump is rated at 100 hp.

[12] 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 4-5: Evaluation-Based BIN/Impact Model Example for Process Pumping VFD Measures

Annual Hours of Operation:						1,603
Pump kW Bin	Average AMI Loads w/ VFD	AMI Hours	Percent of Full Load Speed	Baseline w/o VFD kW	kW Differential	Energy Savings kWh
52	48.14	95.5	87%	57.98	9.84	940
48	47.42	63.5	87%	57.72	10.29	653
44	40.88	88.0	83%	55.29	14.40	1,267
40	38.25	411.8	82%	54.35	16.10	6,629
36	34.95	87.5	79%	53.21	18.27	1,598
32	29.69	394.7	73%	51.49	21.79	8,601
28	24.63	201.3	67%	49.82	25.19	5,070
24	21.28	110.5	62%	48.66	27.38	3,026
20	19.48	150.0	60%	48.01	28.53	4,279
16	-	-	-	-	-	-
12	-	-	-	-	-	-
8	-	-	-	-	-	-
4	-	-	-	-	-	-
TOTALS					**172**	**32,064**

In this table we see that the model breaks up the pump load into 13 bins; from 52 kW, the max seen in the AMI data, to 0 kW, in increments of 4 kW. This pump using AMI data on a dedicated meter allows us to model the actual pump usage after the VFD, therefore we do not have to estimate pump consumption, but can use actual recorded values. The energy efficient VFD case is modeled with the understanding that the 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 a VFD will use just 24% of full input power at 60% VFD speed, while the throttle valve will use 60% of full input power for that same load category. Out of a total of 1,603 hours of operation for this pump, 9% of loads fall around this load bin, resulting in a kW load reduction of 28.53 for a full hour of operation and 4,279 kWh of savings for all of the hours having that load combined (roughly 150 hours at that load) – which illustrates the savings of a VFD relative to a throttle valve baseline.

For summer peak demand savings we use operating load-based savings from this same table coupled with actual usage during the DEER defined peak periods for individual climate zones.[13]

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, we used those, but when unavailable we used default values based on workpapers, secondary sources and engineering estimates. For example, percent of maximum motor load at maximum pump load is assumed to be 80% in the absence of better data, based upon engineering judgement for irrigation pumping systems. Also, we apply a default value for the motor efficiency rating of 94% based on efficiency values listed within the US DOE Advanced Manufacturing Office's Premium Efficiency Motor Selection and Application Guide[14]. The VFD efficiency is always assumed to be 97% based upon guidance from Water Management Technical Note No. 1, September 2014.[15]

The primary evaluation, tracking, billing and AMI data, in conjunction with data from various secondary sources supports our evaluation models for each site in the sample. In general, we analyzed the intermediary data in support of the derivation of model inputs and model calibration parameters.

The most important input contributing to each of our models was the AMI data supporting a post-VFD installation kW load distribution and frequency. Having AMI data for each pump allows for an actual annual kWh load profile for the post-VFD installation case. Furthermore, the AMI data provided observed operating kW loads during the DEER-defined Peak hours. We found that AMI and CIS data were particularly useful in instances where the utility meter was dedicated to the program pump, which

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

[14] 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

[15] 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

was frequently the case, and provided the evaluation team with great confidence in the resulting impact estimates for all such pumps.

Our evaluation team interviewed farmers or pump operators to understand a number of key pumping system inputs, 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.

In addition to collecting operating parameters, we used the phone surveys to identify projects that do not save energy or are deemed ineligible based on program criteria.

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 or water truck, 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.

4-2-2 Effective Useful Life Estimation

For each sample point we asked a battery of questions concerning the VFD installation, such as, whether the VFD was installed on an existing pump, if the pump was also replaced, or if both the pump and VFD were new. Adding a VFD to an existing pump or a new pump has important implications for the EUL determination. When the farmer adds the VFD to an already existing pump, the EUL is set equal to the remaining useful life of the existing pump (which is one-third of a new pump EUL) in order to account for the fact that that VFD operations may cease at the time of pump replacement. This is long-standing CPUC policy 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,[16] 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).[17]

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

- **PG&E EULs are 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 all 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. Our impact evaluation supports the March 2021 Bus Stop with both gross and net results, using telephone interviews, virtual verification, and analysis of utility consumption data.

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

[17] www.deeresources.com › DEER2014-EUL-table-update_2014-02-05

Our PY2019 evaluation of the agricultural irrigation measure group addressed sprinkler-to-drip irrigation conversions, as described in the following paragraphs.

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). Our general approach for estimating ex post gross savings first considers all available data. As discussed, our 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, we relied on pre-project utility bills, when available. However, as some participating farms featured conversions in crop type at the time of the installation, a fair comparison of pre- and post-project utility meter data required that we normalize by the amount of water delivered after the conversion.

We employed two methods for normalization, depending on the availability, quality, and comparability of pre/post utility consumption data. Regardless of the site-level approach we applied in order to generate gross ex post savings values, data collection activities remained consistent for each site. For every project, we administered an engineering telephone survey to collect information needed to ensure fair pre/post comparison of relevant parameters. Relevant parameters/details that we gathered can be found in the following section while a breakdown of all/additional parameters can be found in the Appendices.

Next, we describe each of the two evaluation methods applied, in order of preference.

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

Our 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 from billing data. 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, we 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.[18] By normalizing the required acre-feet in pre- and post-intervention cases we were able to ensure a fair comparison between pre- and post-intervention electric consumption.[19]

2. Analysis of project impacts from discharge pressure reduction

When utility consumption data was incomplete or incomparable between pre/post cases, we 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.

[18] Our 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.

[19] Our 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

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 requirements, and irrigation operating hours.

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 our team, and we used that information 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% or greater were required for program eligibility. OPE has been typically estimated by PAs between 45-55% based on field studies.

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

Our evaluation team obtained key parameters that were used in the equations discussed above from both primary and secondary data sources, 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.

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 (TWH) measures. Our impact evaluation supports the March 2021 Bus Stop with both gross and net results, using telephone and remote-based metering and verification and telephone interviews with market actors.

Our study group includes commercial TWH replacements as rebated by PG&E and SCG. The TWH measure accounts for 65% of the sector's expected net lifecycle natural gas savings among ESPI measures in PY2019 and 12% of the small/medium commercial sector savings overall.

We virtually verified TWH installation and operation at 51 sampled facilities that received PA-rebated TWHs in 2019. During each virtual verification, our 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). We also collected information on remaining useful life and operating condition of the preexisting water heater(s). Finally, our field engineers requested that the site contact read out the digital or analog temperature display or gauge to determine 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, our evaluation engineers leveraged the default water usage profiles embedded within 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 (Therms)

$size$ = 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 4-6, below, provides a distribution of PY2019 savings by size classification.

UES = Unit energy savings as modeled by DEER simulations among prototype buildings by climate zone, adjusted by our 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 4-6, below, provides a distribution of PY2019 savings by efficiency tier.

CZ = Climate zone of the facility receiving the rebated TWH

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

Table 4-6 illustrates the distribution of reported savings by size and efficiency classifications.

Table 4-6: Tankless Water Heater PY2019 Savings Distribution by Size, UEF Categories

Tankless Water Heater Type by Program Administrator	PY2019 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%	141	229	2.07
Instantaneous Domestic Water Heater, > 200 kBTUh, > 85% TE	29	48	1.03
Instantaneous Domestic Water Heater - Condensing, > 200 kBTUh, > 90% TE	101	195	5.36
PG&E Subtotal	271	472	8.46
SCG**			
Tankless Water Heater <=200 MBtu/hr (Small / Medium), Tier 2 (>=0.87 UEF)	325	327	3.83
TanklessWaterHeaters-Large(>200MBtuh)-Tier1(>=80%TE)	2	2	0.00
TanklessWaterHeaters-Large(>200MBtuh)-Tier2(>=90%TE)	89	92	1.07
SCG Subtotal	416	421	4.90
Total	**687**	**893**	**13.36**

Source: CEDARS, 2019. Confirmed Claims Dashboards for 2019 (Cost Effectiveness Output). California Energy Data and Reporting System. Online at cedars.sound-data.com.

* *Count of applications with records of non-zero gas savings.*

** *SCG lists an additional measure, "Small Tankless Water Heater, Tier 2 (UEF>=0.87), High Draw"; all 8 records are zero savers.*

*** *The 0.05 market effects adder is included in the net savings values.*

Our evaluators sought to collect sufficient information to inform savings parameters for the size/UEF tiers featured in Table 4-6. Since a single project might include multiple TWHs among different size/UEF tiers, we 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 several variables defined in the equation above. As a result, we were unable to quantify UES alternatives from the 51-project sample, as the sites spanned 9 different facility classifications and 8 different climate zones.

Nonetheless, our evaluation team independently quantified parameter results based on the 51-project sample: installation rate, domestic hot water (DHW) temperature increase, and uniform energy factor. We then delineated parameter results by equipment size or efficiency tier, when relevant. In Section 5 we examine results for individual impact parameters, along with the resulting gross realization rates.

SECTION 5:

GROSS IMPACT EVALUATION RESULTS

In this section we compare and contrast ex ante and ex post gross impact results, and present discrepancy factors and model-based parameters that contribute to each result. Our intent 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. We also make a point to share information derived by the ex post evaluation that can be used to potentially update workpaper estimates and thereby improve alignment between ex post and ex ante gross impact results, and lessen the gap between the two approaches on a going forward basis, where warranted.

5-1 PROCESS OZONE LAUNDRY MEASURES

As discussed in Chapter 3 and 4, we completed gross impact evaluation sampling, data collection and analysis for ozone laundry equipment installations. The results we present in this section are segmented by PA (PG&E, SCG and SDG&E) at the claim-level – that is, individual tracking system records that represent each claim. Our results represent the as-found condition as determined using telephone interviews and "virtual visits" which we conducted remotely among a sample of customers that installed ozone laundry equipment at a given facility.

It is important to note that the mean gross impact realization rate results we present in this section are sample-based weighted averages, using the ratio of summed ex post savings divided by summed ex ante savings for a given PA segment. This differs sharply from mean results and weighting applied in Section 7 (Evaluation Results), where population-level weights are applied to derive the gross impact results presented by measure group alone.

5-1-1 First Year and Lifecyle Gross Impact Results

In this section we present first year and lifecycle gross impact results for a sample of evaluated projects. It is notable, across all PAs, that all ex post EULs in the sample are identical to ex ante EULs, and therefore all of our lifecycle estimated GRRs are identical to each derived first year GRR. For this reason, we exclude any redundant discussion of lifecycle GRRs within the ozone laundry subsection of this chapter. In this section we also present a list of discrepancy factors that collectively influence the savings results in a meaningful way, leading to both relatively high or low ex post evaluation results. This includes information on the number of wash cycles per day per machine, the reduction in hot water temperature settings with ozone laundry equipment in place, percent of hot water reduction with ozone laundry equipment in place, or replacement of existing ozone laundry machines that were previously in place.

The ex ante savings claims for ozone laundry equipment vary claim-by-claim as a function of the total dry-weight linen capacity of all of the laundry machines that are connected to the new ozone system. Ex ante claims are based upon workpaper-based approaches involving analysis of a database of previous custom and new construction ozone laundry projects; we were able to reproduce ex ante savings estimates from intermediate parameters that were derived from this database. Furthermore, we were able to verify, across all PAs, proper application of unit energy savings from the relevant workpaper to the tracking system.

In Table 5-1 we present our first year and lifecycle gross impact results for PG&E measurement and verification (M&V) sample points. In Table 5-2 we present the key discrepancy factors that help to explain relatively high or relatively low gross impact realization rates in the PG&E gross impact results.

Table 5-1: First Year and Lifecycle Ex Post Gross Impact Results for Ozone Laundry Sample Points – PG&E

Sample Point Identifier	Ex Post	Ex Ante	Results	Ex Post	Ex Ante	Results
	First Year Gross Savings (Therms)	First Year Gross Savings Claim (Therms)	First Year Savings Realization Rate	Lifecycle Gross Savings (Therms)	Lifecycle Gross Savings Claim (Therms)	Lifecycle Savings Realization Rate
PGE_OzL_1	2,586	4,716	0.55	25,861	47,160	0.55
PGE_OzL_2	5,135	4,716	1.09	51,348	47,160	1.09
PGE_OzL_3	8,262	5,895	1.40	82,617	58,950	1.40
PGE_OzL_4	4,505	4,716	0.96	45,052	47,160	0.96
PGE_OzL_5	6,546	4,716	1.39	65,456	47,160	1.39
PGE_OzL_6	6,642	4,716	1.41	66,421	47,160	1.41
PGE_OzL_7	0	19,650	0.00	0	196,500	0.00
Total	**33,676**	**49,125**	**0.69**	**336,755**	**491,250**	**0.69**

Table 5-2: Discrepancy Factors for Ozone Laundry Sample Points – PG&E

Sample Point Identifier	Gross Realization Rate*	Replaced Existing Ozone Equipment	Number of Wash Cycles per Day per Machine > 16	Number of Wash Cycles per Day per Machine < 11	Hot Water Temperature Setting Reduction < 40 (Deg F)	Percent Hot Water Reduction < 80%
		Downward	Upward	Downward	Downward	Downward
PGE_OzL_1	0.55			1	1	
PGE_OzL_2	1.09					
PGE_OzL_3	1.40		1			
PGE_OzL_4	0.96					
PGE_OzL_5	1.39		1			
PGE_OzL_6	1.41		1			
PGE_OzL_7	0.00	1		1	1	1
Total	**0.69**	**1**	**3**	**2**	**2**	**1**

** Discrepancy factors can have a downward or upward effect on the Gross Realization Rate as labeled under each discrepancy factor heading.*

PG&E ex post gross first year annual impact results per ozone laundry sample point range from zero to 8,262 Therms, with gross impact realization rates (GRRs) ranging from 0.00 to 1.41, and yields our sample-based weighted mean GRR of 0.69. Some highlights concerning discrepancy factor findings includes the following:

- **One sample points out of a total sample size of 7 ozone laundry machines does not save energy.**
  - The replaced ozone laundry equipment has equivalent functionality to the newly installed ozone laundry equipment, resulting in no savings being realized by the grid. CPUC policy does not allow programs to install like-for-like energy efficiency replacements.
  - It is notable that the program standards exclude eligibility for replacing ozone laundry equipment. ***The program eligibility screening should be strengthened to exclude all such projects from participation.***
  - This project had a relatively large sample-based weight due to the fact that the ex ante claim was roughly 4 times as large as the other 6 projects that we sampled. If not for this one sample point, the sample-weighted mean realization rate for PG&E would have exceeded 1.0, but was instead 0.69.
- **Variation among the sample in the number of wash cycles per day per machine is another key factor that we found to drive ex post GRRs relatively high or relatively low in the PG&E sample.**

In Table 5-3 we present our first year and lifecycle gross impact results for SCG measurement and verification (M&V) sample points. In Table 5-4 we present the key discrepancy factors that help to explain relatively high or relatively low gross impact realization rates in the SCG gross impact results.

Table 5-3: First Year and Lifecycle Ex Post Gross Impact Results for Ozone Laundry Sample Points – SCG

Sample Point Identifier	Ex Post	Ex Ante	Results	Ex Post	Ex Ante	Results
	First Year Gross Savings (Therms)	First Year Gross Savings Claim (Therms)	First Year Savings Realization Rate	Lifecycle Gross Savings Therms)	Lifecycle Gross Savings Claim (Therms)	Lifecycle Savings Realization Rate
SCG_OzL_1	9,094	10,808	0.84	90,937	108,075	0.84
SCG_OzL_2	5,729	6,288	0.91	57,287	62,880	0.91
SCG_OzL_3	8,116	6,485	1.25	81,157	64,845	1.25
SCG_OzL_4	5,715	6,288	0.91	57,147	62,880	0.91
SCG_Ozl_5	5,410	6,485	0.83	54,105	64,845	0.83
SCG_OzL_6	5,092	4,323	1.18	50,922	43,230	1.18
SCG_OzL_7	5,938	5,895	1.01	59,379	58,950	1.01
SCG_OzL_8	7,235	7,074	1.02	72,354	70,740	1.02
SCG_OzL_9	5,733	4,323	1.33	57,331	43,230	1.33
SCG_OzL_10	7,462	6,485	1.15	74,623	64,845	1.15
SCG_OzL_11	11,237	8,253	1.36	112,373	82,530	1.36
SCG_OzL_12	5,686	4,323	1.32	56,855	43,230	1.32
SCG_OzL_13	8,645	4,520	1.91	86,450	45,195	1.91
SCG_OzL_14	3,805	3,930	0.97	38,053	39,300	0.97
SCG_OzL_15	4,502	4,716	0.95	45,020	47,160	0.95
SCG_OzL_16	5,643	4,127	1.37	56,426	41,265	1.37
SCG_OzL_17	4,507	4,520	1.00	45,072	45,195	1.00
Total	**109,549**	**98,840**	**1.11**	**1,095,493**	**988,395**	**1.11**

Table 5-4: Discrepancy Factors for Ozone Laundry Sample Points – SCG

Sample Point Identifier	Gross Realization Rate*	Replaced Existing Ozone Equipment	Number of Wash Cycles per Day per Machine > 16	Number of Wash Cycles per Day per Machine < 11	Hot Water Temperature Setting Reduction < 40 (Deg F)	Percent Hot Water Reduction < 80%
		Downward	Upward	Downward	Downward	Downward
SCG_OzL_1	0.84					
SCG_OzL_2	0.91					
SCG_OzL_3	1.25		1			
SCG_OzL_4	0.91					
SCG_Ozl_5	0.83		1			
SCG_OzL_6	1.18					
SCG_OzL_7	1.01					
SCG_OzL_8	1.02					
SCG_OzL_9	1.33		1			
SCG_OzL_10	1.15					
SCG_OzL_11	1.36		1			
SCG_OzL_12	1.32					
SCG_OzL_13	1.91		1			
SCG_OzL_14	0.97					
SCG_OzL_15	0.95					
SCG_OzL_16	1.37					
SCG_OzL_17	1.00					
Total	**1.11**	**0**	**5**	**0**	**0**	**0**

** Discrepancy factors can have a downward or upward effect on the Gross Realization Rate as labeled under each discrepancy factor heading.*

SCG ex post gross first year annual impact results per ozone laundry sample point range from 3,930 to 10,808 Therms, with gross impact realization rates (GRRs) ranging from 0.83 to 1.91, and yields our sample-based weighted mean GRR of 1.11. Some highlights concerning discrepancy factor findings includes the following:

- **Variation among the sample in the number of wash cycles per day per machine is the key factor that we found to drive ex post GRRs for SCG. This shows a clear correlation between a high number of wash cycles and higher GRRs.**
  - We can see this trend for sample IDs SCG_OzL_3, 9, 11 and 13. For ID SCG_OzL_5 there are other counteracting factors that lead to a lower, but still respectable GRR of 0.83. The other key factor for this ID is that the claimed total washing machine capacity in pounds of linens was 165, while the evaluation verified just two machines with a 55-pound capacity each.
  - For SCG_OzL_16, with a GRR of 1.37, the wash cycles per day are at the threshold of 16 for the discrepancy factor shown, which is still explanatory of the high GRR which is also impacted by a relatively high water temperature reduction of 50 degrees Fahrenheit.

In Table 5-5 we present our first year and lifecycle gross impact results for SDG&E measurement and verification (M&V) sample points. In Table 5-6 we present the key discrepancy factors that help to explain relatively high or relatively low gross impact realization rates in the SDG&E gross impact results.

Table 5-5: First Year and Lifecycle Ex Post Gross Impact Results for Ozone Laundry Sample Points – SDG&E

	Ex Post	Ex Ante	Results	Ex Post	Ex Ante	Results
Sample Point Identifier	First Year Gross Savings (Therms)	First Year Gross Savings Claim (Therms)	First Year Savings Realization Rate	Lifecycle Gross Savings Therms)	Lifecycle Gross Savings Claim (Therms)	Lifecycle Savings Realization Rate
SDGE_OzL_1	60,740	92,748	0.65	607,404	927,480	0.65
SDGE_OzL_2	11,451	10,021	1.14	114,514	100,215	1.14
SDGE_OzL_3	0	4,716	0.00	0	47,160	0.00
SDGE_OzL_4	4,878	4,716	1.03	48,781	47,160	1.03
SDGE_OzL_5	3,272	7,664	0.43	32,716	76,635	0.43
SDGE_OzL_6	15,046	10,414	1.44	150,460	104,145	1.44
SDGE_OzL_7	7,449	5,305	1.40	74,487	53,055	1.40
SDGE_OzL_8	1,984	4,323	0.46	19,835	43,230	0.46
SDGE_OzL_9	2,514	3,930	0.64	25,137	39,300	0.64
SDGE_OzL_10	1,611	2,161	0.75	16,105	21,615	0.75
SDGE_OzL_11	13,792	265,275	0.05	137,915	2,652,750	0.05
Total	**122,736**	**411,274**	**0.30**	**1,227,356**	**4,112,745**	**0.30**

Table 5-6: Discrepancy Factors for Ozone Laundry Sample Points – SDG&E

Sample Point Identifier	Gross Realization Rate*	Replaced Existing Ozone Equipment	Number of Wash Cycles per Day per Machine > 16	Number of Wash Cycles per Day per Machine < 11	Hot Water Temperature Setting Reduction < 40 (Deg F)	Percent Hot Water Reduction < 80%
		Downward	Upward	Downward	Downward	Downward
SDGE_OzL_1	0.65					1
SDGE_OzL_2	1.14		1			
SDGE_OzL_3	0.00	1			1	1
SDGE_OzL_4	1.03					
SDGE_OzL_5	0.43			1		
SDGE_OzL_6	1.44		1			
SDGE_OzL_7	1.40					
SDGE_OzL_8	0.46			1	1	
SDGE_OzL_9	0.64			1		
SDGE_OzL_10	0.75			1		
SDGE_OzL_11	0.05				1	
Total	**0.30**	**1**	**2**	**4**	**3**	**2**

** Discrepancy factors can have a downward or upward effect on the Gross Realization Rate as labeled under each discrepancy factor heading.*

SDG&E ex post gross first year annual impact results per ozone laundry sample point range from zero to 60,740 Therms, with gross impact realization rates (GRRs) ranging from 0.00 to 1.44, and yields our sample-based weighted mean GRR of 0.30. Some highlights concerning discrepancy factor findings includes the following:

- **One sample point out of a total sample size of 11 ozone laundry machines had very low ex post savings, with a realization rate of just 0.05. If not for this one sample point the GRR would have been 0.75 instead of 0.30.**
  - While this project had great potential to save energy using ozone laundry equipment, the customer did not substantially adjust the hot water use per laundry load or change the water temperature settings.
  - *We recommend that large-scale projects of this nature are better served through a custom program channel where site-level reported savings are adequately vetted through the program application*

process. Using a custom channel instead of a deemed program approach would likely have produced a more reliable estimate of PA-reported savings for this project. Custom program projects typically undergo a more rigorous verification of operating conditions that are in-turn incorporated within the project saving estimates.

- *We also recommend that eligibility criteria be included with the ozone laundry offering to ensure both an adequate reduction in hot water usage per laundry cycle and a reduction in hot water temperature settings.*
- It is also notable that this business does not appear to be eligible to participate. This participating business supplies linens and work uniforms. The relevant SDG&E workpaper only allows participation in fitness, nursing home, correctional and hotel/motel facilities.

- **One sample points out of a total sample size of 11 ozone laundry machines does not save energy.**
  - The replaced ozone laundry equipment has equivalent functionality to the newly installed ozone laundry equipment, resulting in no savings being realized by the grid. CPUC policy does not allow programs to install like-for-like energy efficiency replacements.
  - It is notable that the program standards exclude eligibility for replacing ozone laundry equipment. *The program eligibility screening should be strengthened to exclude all such projects from participation.*
  - However, this project had a relatively small sample-based weight and therefore only had a minor impact on the resulting sample-based mean resulting GRR.
- **For one sample point the percent reduction in hot water use per laundry cycle led directly to a relatively low realization rate of 0.65, while one other point that we already discussed above was also affected by this discrepancy factor due to like-for-like replacement.**
- **For one sample point a hot water temperature setting reduction of just 20 degrees Fahrenheit was one of two factors leading to a relatively low realization rate, in conjunction with a low number of wash cycles per day.**
  - Two other points were affected by a relatively low hot water temperature setting reduction, but those are the two projects with the lowest realization rates that were already discussed above.
- **Variation among the sample in the number of wash cycles per day per machine is another key factor that we found drives ex post GRRs relatively high or relatively low in the SDG&E sample.**

- It is notable that the above commentary surrounding the percent reduction in hot water use, the number of laundry cycles per day and the reduction in hot water temperature settings generally brought down the resulting realization rate for SDG&E. ***We recommend that the programs strengthen program requirements in these areas to ensure adequate savings for all participating projects.***

5-1-2 Ozone Laundry Model-Based Parameters and Results

Based on the ex post impact modeling performed we are able to assemble model inputs by sample point and unit energy savings estimates that might contribute in some way to workpaper updates in the future. Table 5-7, Table 5-8, and Table 5-9 present model-based parameters and unit energy savings results for PG&E, SCG and SDG&E sample points, respectively. The tables include the business type, total laundry machine capacity, number of laundry machines, total wash cycles per day, the baseline hot water use per pound of linens washed, the percent of hot water reduction, and the water temperature setting reduction. We selected these parameters on the basis that they would be most useful to any future workpaper updates, and, in fact, several of these factors do currently contribute to workpaper-based savings estimates. Also shown are unit energy savings values expressed in a way that parallels ex ante workpaper values that are applied to the tracking data (expressed per pound of laundry machine capacity).

In support of any future workpaper updates for ozone laundry measures, ***it is recommended that the utility workpaper team mines this data source and applies findings where feasible and, as noted above, modify program requirements to ensure all projects deliver adequate program savings.*** *Furthermore, our evaluation team has assembled a model for estimating ozone laundry equipment savings, and in doing so has amassed industry knowledge, tools and experience that can be shared with the workpaper team in order to hopefully improve the accuracy of resulting workpaper-based savings estimates and better align PA and evaluation results.* While some of the parameters included are meant to be generally informative, the potential usefulness of some of the parameters is as follows:

- **The business type is useful in terms of measuring program conformance with program business type eligibility criteria.**
  - Interestingly, these eligibility criteria are found to vary across PA workpapers, but the universe of eligible businesses includes hotel/motel, health facilities, nursing homes, correctional facilities and fitness centers.

  - Within the sample exceptions to this include a commercial laundry, a party rental store, a linen and work apparel supplier and lodging facilities (that are not hotel/motels).
  - In fact, we even observed business type exceptions to the eligible business list using business type variables available in the program tracking system.
  - *We recommend that the program either better screen businesses for eligibility based on business type, or if warranted, expand the availability of businesses that can participate.*
  - *We also recommend better alignment among the PA workpapers in terms of businesses that are eligible and a consensus on why.*
- **The baseline hot water use factor, percent hot water reduction and water temperature setting reduction variables are all critical parameters that are useful for accurate savings estimation.**
  - These factors were derived or obtained by our evaluation team, and can inform ex ante workpaper parameter values.

Table 5-7: Ex Post Model-Based Parameters and Results for Ozone Laundry Sample Points – PG&E

Sample Point Identifier	Business Type	Total Washer Capacity*	Number of Laundry Machines	Total Wash Cycles per Day	Baseline Hot Water Use Factor**	Percent Hot Water Reduction	Water Temperature Setting Reduction (Deg F)	Ex Post First Year Gross Per-Unit Savings***
PGE_OzL_1	Hotel/Motel	120	2	18	1.1	82%	20	21.6
PGE_OzL_2	Nursing Home	120	2	32	1.1	82%	40	42.8
PGE_OzL_3	Post-Hospital Acute Care	150	3	51	1.2	81%	40	55.1
PGE_OzL_4	Skilled Nursing Facility	120	2	24	0.9	100%	40	37.5
PGE_OzL_5	Nursing Home	120	2	34	1.0	100%	40	54.5
PGE_OzL_6	Skilled nursing facility	120	2	36	1.0	82%	50	55.4
PGE_OzL_7	Hotel/Motel	560	4	19	0.2	0%	0	0.0
Average******		**187**	**2**	**31**	**0.9**	**75%**	**33**	**25.7**
Ex Ante Metric								**39.3**

** Pounds of dry-weight linens.*

*** Gallons per pound of linens washed.*

**** Therms per pound of laundry machine capacity.*

***** Weighted average using total washer capacity for the per-unit savings value, but otherwise a straight average for other parameters.*

Table 5-8: Ex Post Model-Based Parameters and Results for Ozone Laundry Sample Points – SCG

Sample Point Identifier	Business Type	Total Washer Capacity*	Number of Laundry Machines	Total Wash Cycles per Day	Baseline Hot Water Use Factor**	Percent Hot Water Reduction	Water Temperature Setting Reduction (Deg F)	Ex Post First Year Gross Per-Unit Savings***
SCG_OzL_1	Nursing Home	275	5	54	1.1	82%	45	33.1
SCG_OzL_2	Nursing Home	165	3	36	1.1	82%	40	34.7
SCG_OzL_3	Nursing Home	165	3	51	1.1	82%	40	49.2
SCG_OzL_4	Nursing Home	160	3	36	1.1	82%	40	35.7
SCG_Ozl_5	Nursing Home	110	2	34	1.1	82%	40	49.2
SCG_OzL_6	Nursing Home	110	2	32	1.1	82%	40	46.3
SCG_OzL_7	Nursing Home	150	2	28	1.1	83%	40	39.6
SCG_OzL_8	Nursing Home	180	3	45	1.0	82%	40	40.2
SCG_OzL_9	Nursing Home	110	2	36	1.1	82%	40	52.1
SCG_OzL_10	Nursing Home	165	3	42	1.1	82%	50	45.2
SCG_OzL_11	Nursing Home	210	3	51	1.2	83%	50	53.5
SCG_OzL_12	Nursing Home	110	2	32	1.1	82%	50	51.7
SCG_OzL_13	Nursing Home	120	2	51	1.0	82%	45	72.0
SCG_OzL_14	Nursing Home	100	2	24	1.2	81%	50	38.1
SCG_OzL_15	Nursing Home	120	2	28	1.0	82%	40	37.5
SCG_OzL_16	Nursing Home	105	2	32	1.2	81%	50	53.7
SCG_OzL_17	Nursing Home	114	3	30	1.3	81%	45	39.5
Average****		**145**	**3**	**38**	**1.1**	**82%**	**44**	**44.4**
Ex Ante Metric								**39.3**

** Pounds of dry-weight linens.*

*** Gallons per pound of linens washed.*

**** Therms per pound of laundry machine capacity.*

***** Weighted average using total washer capacity for the per-unit savings value, but otherwise a straight average for other parameters.*

Table 5-9: Ex Post Model-Based Parameters and Results for Ozone Laundry Sample Points – SDG&E

Sample Point Identifier	Business Type	Total Washer Capacity*	Number of Laundry Machines	Total Wash Cycles per Day	Baseline Hot Water Use Factor**	Percent Hot Water Reduction	Water Temperature Setting Reduction (Deg F)	Ex Post First Year Gross Per-Unit Savings***
SDGE_OzL_1	Commercial Laundry	2,360	13	160	0.8	32%	50	26.0
SDGE_OzL_2	Post Acute Rehabilitation	255	3	54	1.0	83%	40	44.9
SDGE_OzL_3	Skilled Nursing Facility	120	2	28	0.2	0%	0	0.0
SDGE_OzL_4	Skilled Nursing Facility	120	2	30	1.0	82%	40	40.7
SDGE_OzL_5	Rental Store	185	2	19	1.0	83%	50	17.7
SDGE_OzL_6	Post-Acute Care Facility	265	3	60	1.0	83%	50	56.8
SDGE_OzL_7	Treatment Center	135	3	45	1.3	81%	50	55.2
SDGE_OzL_8	Lodging	110	2	16	1.1	82%	20	18.0
SDGE_OzL_9	Retirement Community	100	2	16	1.2	81%	40	25.1
SDGE_OzL_10	Lodging	55	1	10	1.1	82%	40	29.3
SDGE_OzL_11	Linen and Work Apparel Supplier	6,875	9	250	UTD*****	UTD*****	0	2.0
Average****		**962**	**4**	**63**	**1.0**	**69%**	**35**	**11.6**
Ex Ante Metric								**39.3**

** Pounds of dry-weight linens.*

*** Gallons per pound of linens washed.*

**** Therms per pound of laundry machine capacity.*

***** Weighted average using total washer capacity for the per-unit savings value, but otherwise a straight average for other parameters.*

****** Unable to determine.*

5-2 PROCESS PUMPING VFD MEASURES

As discussed in Chapter 3 and 4, our evaluation team completed gross impact evaluation sampling and analysis for agricultural irrigation pump VFDs. All of the PG&E claims associated with industrial glycol pumps were excluded from the sample design. We segmented the results featured in this section by PA (PG&E and SCE) and the pump type (well versus booster pumps). We also excluded the SDG&E claim from sampling since there was only one record, and it makes up a small percentage of the overall savings. The results presented in this section represent the as-found condition determined during the phone survey. There were a total of 34 pumps evaluated in PG&E, of those, it was determined that 15 of them were booster pumps, and 19 were well pumps. Three of these pumps were misclassified in the tracking data. Two claimed to be booster pumps, but we were able to confirm that they were well pumps. The ten SCE pumps are comprised of 7 booster pumps and 3 well pumps, and were all correctly classified in the tracking data.

The horsepower (HP) was verified at the time of the phone survey, and was corrected for 4 pumps resulting in a slightly higher overall HP. All of the pumps that had updated HP are located in PG&E service territory with the largest change from a pump that was claimed to be 125 HP but the pump was verified to be 60 HP.

It is important to note that the results presented in this section reflect the as found pump type and horsepower. Also, the mean gross impact realization rate results by PA and pump type are sample-based weighted averages, using the ratio of summed ex post savings divided by summed ex ante savings for a given PA segment. This differs 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 measure group (strata) level, without differentiation by PA or pump type.

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 the horsepower claimed. Ex ante claims are based on a workpaper-based approach involving database analysis of previous custom and new construction agricultural pump VFD projects. Our evaluation team was able to verify proper application of energy savings per unit of horsepower from each relevant workpaper, except for PG&E measure code IR014.

5-2-1 First Year Gross Impact Results

In Table 5-10 we present first year gross impact results for PG&E well pump M&V sample points and Table 5-11 lists 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 an observed coincidence factor of less than 0.50. In addition, the table shows the GRR and whether the factor causes a decrease (Dn) or increase (Up) in the energy savings.

Table 5-10: First Year Ex Post Gross Impact Results for Well Pump Sample Points – PG&E

Sample Point Identifier	Ex Post First Year Gross Impact Savings (kWh)	Ex Ante First Year Gross Impact Claim (kWh)	Results First Year Gross Impact Realization Rate	Ex Post First Year Gross Impact Savings (kW)	Ex Ante First Year Gross Peak Demand Claim (kW)	Results First Year Gross Impact Realization Rate
PGE_Well_1	6,966	32,075	0.22	1.01	15.09	0.07
PGE_Well_2	80,654	38,490	2.10	26.82	18.11	1.48
PGE_Well_3a	128,154	82,800	1.55	4.65	53.10	0.09
PGE_Well_3b	85,436	55,200	1.55	3.10	35.40	0.09
PGE_Well_4a	42,137	38,490	1.09	1.43	18.11	0.08
PGE_Well_4b	5,075	19,245	0.26	0.02	9.05	0.00
PGE_Well_5a	7,748	32,075	0.24	2.22	15.09	0.15
PGE_Well_5b	696	15,396	0.05	0.61	7.24	0.08
PGE_Well_6	0	64,150	0.00	0.00	30.18	0.00
PGE_Well_7	3,994	7,698	0.52	0.00	3.62	0.00
PGE_Well_8	16,728	38,490	0.43	0.00	18.11	0.00
PGE_Well_9	7,879	7,698	1.02	0.00	3.62	0.00
PGE_Well_10a	60,963	82,800	0.74	0.00	53.10	0.00
PGE_Well_10b	50,802	69,000	0.74	0.00	44.25	0.00
PGE_Well_11	33,128	19,245	1.72	8.36	9.05	0.92
PGE_Well_12	24,460	38,490	0.64	14.29	18.11	0.79
PGE_Well_13	47,296	55,200	0.86	6.74	35.40	0.19
PGE_Well_14	32,064	25,660	1.25	20.71	12.07	1.72
PGE_Well_15	-2,778	51,320	-0.05	0.00	24.14	0.00
Total	**631,400**	**773,522**	**0.82**	**90**	**423**	**0.21**

Table 5-11: Discrepancy Factors* for Well Pump Sample Points – PG&E

Sample Point Identifier	First Year Gross Impact Realization Rate	Pump Run Hours > 1500	Pump Run Hours < 500	Pump Speed Typically 90-100%	Pump Speed is Relatively Low	Farmer Prefers Using District Water	Farmer Also Irrigates with a Different Pump	Pump Peak Coinc. Factor < 50%	Pump is a Booster but Claim is a Well	Applied Mean Modeled Result from Sample	Applied Result from Other Point at Same Farm	Other**
		Up	Dn	Dn	Up	Dn	Dn	Dn	-	-	-	-
PGE_Well_1	0.22			1				1				
PGE_Well_2	2.10	1			1							
PGE_Well_3a	1.55	1						1				
PGE_Well_3b	1.55										1	
PGE_Well_4a	1.09				1			1				1
PGE_Well_4b	0.26			1				1				
PGE_Well_5a	0.24			1				1				
PGE_Well_5b	0.05	1		1								
PGE_Well_6	0.00											1
PGE_Well_7	0.52		1		1			1				
PGE_Well_8	0.43		1		1		1	1				
PGE_Well_9	1.02							1				
PGE_Well_10a	0.74	1					1	1				
PGE_Well_10b	0.74	1					1	1				
PGE_Well_11	1.72	1			1							
PGE_Well_12	0.64			1								
PGE_Well_13	0.86									1		1
PGE_Well_14	1.25	1			1							
PGE_Well_15	-0.05			1				1				
Total	**0.82**	**7**	**2**	**6**	**6**	**0**	**3**	**11**	**0**	**1**	**1**	**3**

** Discrepancy factors can have a downward or upward effect on the Gross Realization Rate as labeled under discrepancy factor headings.*
*** Other: Pump is a Well but Claim is a Booster, Farmer uses Pump to Fill Reservoir or Truck, Farmer has PV which Reduces Grid Impact.*

PG&E ex post gross first year annual impact results per well pump sample point range from -2,778 to 128,154 kWh, with gross impact realization rates (GRRs) ranging from -0.05 to 2.10 and yielding a sample-based weighted mean GRR of 0.82. Ex post gross first year peak demand results per point are also presented and range from zero to 26.82 kW, with realization rates ranging from 0.00 to 1.72, and yielding a sample-based weighted mean GRR of 0.21. Highlights to point out include the following:

- **Two sample points out of a total sample size of 19 well pumps do not save energy.**
  - One well pump was being used to fill an water truck and so the energy savings was set to zero. VFDs used for filling reservoirs or water trucks are not eligible for program incentives. For this type of application the system pressure is low and the program requires pressurized systems, such as drip irrigation lines, as outlined in the program application materials.[20] Systems such as these are detrimental to the pump affinity law exponent for a VFD, as discussed in Section 4.2.
  - In addition, one pump operates at a high load whenever in operation, so no savings are realized from the VFD. In fact, the pump runs at such high loads that with the VFD consumption there is an overall increase in energy use due to the efficiency of the VFD.
- **Additionally, 7 well pumps do not save peak demand; the pumps were not observed to operate at the time of coincident peak, as defined by DEER.[21]**
- **Other factors having a meaningful downward effect on some of the GRRs include pumps running fewer than 500 hours per year, and multiple pumps serving a given field (especially where well pumps are used as a backup for irrigating fields when district water is unavailable).**
  - It is notable that program standards exclude pump eligibility if pump run hours are below 1,000 hours per year. Yet six points in the ex post sample have annual hours of runtime below 1000 hours with two pumps below 500 hours per year. Many of the claims with low pump hours are caused by the pumps irrigating orchards with trees that have 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.
  - It is also notable that pumps that operate high speed/loads and flow should not be eligible for program VFD incentives. We see 6 sample points that typically operate at more than 89% of full speed most of the time. ***The program eligibility requirements should be strengthened to exclude all such pumps from participation. The current language is too open for 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.***

[20] https://www.PG&E.com/PG&E_global/common/pdfs/save-energy-money/business-solutions-and-rebates/product-rebates/business-rebate-catalog.pdf; page 4

[21] See Chapter 4 for details on DEER Peak definition.

- **Increased GRRs are the product of pumps operating more than 1,500 hours per year and from pumps running at relatively low speeds.**
  - There are seven pumps that operate more than 1,500 hours per year. Increasing the number of hours these VFDs run provides more opportunity for the pumps to save energy, but increased hours do not guarantee higher energy savings. If the pump is running at higher speeds, adding a VFD will not result in substantial savings, but if the motor runs at lower speeds the savings will increase with more hours.
  - In addition, there are 6 pumps that operate at relatively low speeds, which results in high savings. These pumps save more energy since they spend most of their time operating at a lower speeds, drawing less energy compared to throttle valve controls. Due to the Affinity laws, the lower the speed the higher the savings.
- **Models were developed for 17 of the 19 well pumps evaluated.**
- **For the other two 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.**
  - Mean results were applied to sample point identifiers for well pumps 3b and 13.
  - It is notable that this mean excludes well pump 6 where the savings were set to zero due to eligibility considerations, as outlined above.
  - The rationale for excluding that point from the mean result is that well pumps 3b and 13 were both eligible for participation.

Of the 19 pumps, only 8 had an annual energy GRR greater than 0.75, and 7 pumps had an annual energy GRR less than 0.50. For demand savings, the GRR was less than 0.20 for all but four pumps. *As noted above, program eligibility requirements and screening should be enhanced to improve this result, and especially to exclude the projects that do not save energy, as well as those that save very little energy for the reasons outlined in this discussion.*

In Table 5-12 we present first year gross impact results for SCE well pump M&V sample points and

Table 5-13 includes a listing of discrepancy factors that collectively influence the savings results in a meaningful way.

Table 5-12: First Year Ex Post Gross Impact Results for Well Pump Sample Points – SCE

Sample Point Identifier	Ex Post	Ex Ante	Results	Ex Post	Ex Ante	Results
	First Year Gross Impact Savings (kWh)	First Year Gross Impact Claim (kWh)	First Year Gross Impact Realization Rate	First Year Gross Impact Savings (kW)	First Year Gross Peak Demand Claim (kW)	First Year Gross Impact Realization Rate
SCE_Well_1	25,913	25,660	1.01	9.04	12.07	0.75
SCE_Well_2	35,735	51,320	0.70	5.16	24.14	0.21
SCE_Well_3	36,624	64,150	0.57	0.00	30.18	0.00
Total	**98,273**	**141,130**	**0.70**	**14**	**66**	**0.21**

Table 5-13: Discrepancy Factors* for Well Pump Sample Points – SCE

Sample Point Identifier	First Year Gross Impact Realization Rate	Pump Run Hours > 1500	Pump Run Hours < 500	Pump Speed Typically 90-100%	Pump Speed is Relatively Low	Farmer Prefers Using District Water	Farmer Also Irrigates with a Different Pump	Pump Peak Coinc. Factor < 50%	Pump is a Booster but Claim is a Well	Applied Mean Modeled Result from Sample	Applied Result from Other Point at Same Farm	Other**
		Up	Dn	Dn	Up	Dn	Dn	Dn	-	-	-	-
SCE_Well_1	1.01							1				1
SCE_Well_2	0.70									1		
SCE_Well_3	0.57	1		1			1	1				
Total	**0.70**	**1**	**0**	**1**	**0**	**0**	**1**	**2**	**0**	**1**	**0**	**1**

** Discrepancy factors can have a downward or upward effect on the Gross Realization Rate as labeled under discrepancy factor headings.*

*** Other: Farmer uses Flood Irrigation.*

SCE ex post gross first year annual impact results per well pump sample point range from 25,913 to 36,624 kWh, with gross impact realization rates (GRRs) ranging from 0.57 to 1.01 and yielding a sample-based weighted mean GRR of 0.70. We also present ex post gross first year peak demand results per point, ranging from zero to 9.04 kW, with realization rates ranging from 0.00 to 0.75, and yielding a sample-based weighted mean GRR of 0.21. In addition to the findings from each sample point, it is important to note that for SCE we had difficulty getting participants to complete our survey. Of the 57 records in the population our field staff were only able to get 3 SCE well pump surveys completed. The field staff reported that there was a difficulty in getting ahold of the contact, but they also reported that some farmers were too busy, citing that it was harvest season and to contact them next year. With so few respondents it is difficult to glean many overarching issues, but below we have described some of the reasons for discrepancy in further detail.

- **SCE_Well_1 was fairly consistent with the ex ante estimates for savings. There were no major discrepancies for the energy savings.**
  - Our evaluation team did find a peak coincidence factor less than 0.5 resulting in a lower-than-expected demand savings. This coincidence factor is based on the operation of the pump during the DEER defined peak demand period.[22]
- **For SCE_Well_2, it was not possible to isolate loads in the AMI data for irrigation from those used to fill two reservoirs, so we applied a mean savings per horsepower based on the other two projects in the SCE well pump sample.**
  - Since filling a reservoir is not eligible, we initially sought to remove those hours, but were unable to accomplish that objective. In order to still award savings for the remaining hours, that are eligible, we decided to apply a mean savings per horsepower for this pump.
- **Among the SCE well pump sample, SCE_Well_3 is the largest saver but also features the lowest realization rate, so it is the largest driver of the resulting energy savings GRR for SCE well pumps.**
  - It is also notable that the pump does not operate at substantially reduced speeds. We see that the sample point typically operates more than 89% of full speed, resulting in less energy savings, even after taking into account annual operating hours that exceed 1,500. ***The program eligibility requirements should be strengthened to exclude pumps from participation that operate near full load.***

None of the three pumps in the sample have annual energy GRRs below 0.50. As noted above, with so few surveys completed it is difficult to make overarching program recommendations based on eligibility requirements. ***But we conclude that additional customer information should be collected to make***

[22] See Chapter 4 for details on DEER Peak definition.

contacting the customers easier, and further information should be collected by the program to demonstrate that projects are eligible.

We note that the mean peak demand GRR of just 0.21 is driven by two very low performing pumps – one not contributing any savings to the peak and one having a GRR of just 0.21.

In Table 5-14 we present first year gross impact results for PG&E booster pump M&V sample points and Table 5-15 includes a listing of discrepancy factors that collectively influence the savings results in a meaningful way.

Table 5-14: First Year Ex Post Gross Impact Results for Booster Pump Sample Points – PG&E

Sample Point Identifier	Ex Post First Year Gross Impact Savings (kWh)	Ex Ante First Year Gross Impact Claim (kWh)	Results First Year Gross Impact Realization Rate	Ex Post First Year Gross Impact Savings (kW)	Ex Ante First Year Gross Peak Demand Claim (kW)	Results First Year Gross Impact Realization Rate
PGE_Booster_1a	8,565	25,700	0.33	0.00	10.80	0.00
PGE_Booster_1b	8,565	25,700	0.33	0.00	10.80	0.00
PGE_Booster_2	1,997	3,849	0.52	0.00	1.81	0.00
PGE_Booster_3a	5,364	5,666	0.95	0.65	3.05	0.21
PGE_Booster_3b	10,728	11,333	0.95	1.31	6.10	0.21
PGE_Booster_4	36,669	22,665	1.62	3.15	12.20	0.26
PGE_Booster_5a	5,123	13,599	0.38	0.00	7.32	0.00
PGE_Booster_5b	10,672	28,331	0.38	0.00	15.25	0.00
PGE_Booster_6	32,183	33,998	0.95	3.92	18.30	0.21
PGE_Booster_7	10,489	11,333	0.93	0.00	6.10	0.00
PGE_Booster_8	13,884	14,200	0.98	0.00	6.00	0.00
PGE_Booster_9	997	5,666	0.18	0.17	3.05	0.05
PGE_Booster_10a	18,428	22,665	0.81	0.00	12.20	0.00
PGE_Booster_10b	18,428	22,665	0.81	0.00	12.20	0.00
PGE_Booster_11	70,012	28,331	2.47	21.52	15.25	1.41
Total	**252,103**	**275,701**	**0.91**	**30.72**	**140.43**	**0.22**

Table 5-15: Discrepancy Factors* for Booster Pump Sample Points – PG&E

Sample Point Identifier	First Year Gross Impact Realization Rate	Pump Run Hours > 1500	Pump Run Hours < 500	Pump Speed Typically 90-100%	Pump Speed is Relatively Low	Farmer Prefers Using District Water	Farmer Also Irrigates with a Different Pump	Pump Peak Coinc. Factor < 50%	Pump is a Booster but Claim is a Well	Applied Mean Modeled Result from Sample	Applied Result from Other Point at Same Farm	Other
		Up	Dn	Dn	Up	Dn	Dn	Dn	-	-	-	-
PGE_Booster_1a	0.33	1		1			1	1				
PGE_Booster_1b	0.33	1		1			1	1				
PGE_Booster_2	0.52		1		1			1	1			
PGE_Booster_3a	0.95									1		
PGE_Booster_3b	0.95									1		
PGE_Booster_4	1.62	1					1	1				
PGE_Booster_5a	0.38		1		1			1				
PGE_Booster_5b	0.38										1	
PGE_Booster_6	0.95									1		
PGE_Booster_7	0.93							1				
PGE_Booster_8	0.98							1	1			
PGE_Booster_9	0.18			1				1				
PGE_Booster_10a	0.81					1	1	1				
PGE_Booster_10b	0.81							1			1	
PGE_Booster_11	2.47	1			1	1						
Total		**4**	**2**	**3**	**3**	**2**	**4**	**10**	**2**	**3**	**2**	**0**

* *Discrepancy factors can have a downward or upward effect on the Gross Realization Rate as labeled under discrepancy factor headings.*

PG&E ex post gross first year annual impact results per booster pump sample point range from 997 to 70,012 kWh, with gross impact realization rates (GRRs) ranging from 0.18 to 2.47 and yielding a sample-based weighted mean GRR of 0.91. We also present ex post gross first year peak demand results per sample point, ranging from 0 kW to 21.52 kW, with realization rates ranging from 0 to 0.26, 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:

- **PGE_Booster_11 has an annual energy GRR of 2.47 due to run hours exceeding 1,500 and the pump running at a relatively low speed.**
  - Both reasons for discrepancy cause a higher-than-expected energy savings and a high GRR.
- **Additionally, 9 booster pumps do not save peak demand; the pumps were not observed to operate at the time of coincident peak, as defined by DEER.[23]**
- **Models were developed for 10 of the booster pumps, and for the remaining 5 points either a GRR result was applied from other pumps on the same farm or a sample-based mean savings per horsepower estimate was applied. These mean saving metrics for energy (kWh/HP) and demand (kW/HP), were derived from the 10 modeled points noted above. The sample mean was applied to booster pumps 3a, 3b and 6.**

The evaluation results show that on a GRR basis that PG&E booster pumps perform much closer to expectations and claims than do well pumps. One important difference we note is that the PG&E booster pump sample did not include any ineligible pumps.

In Table 5-16 we present first year gross impact results for SCE booster pump M&V sample points, and in Table 5-17 we present a listing of discrepancy factors that collectively influence the savings results in a meaningful way.

[23] See Chapter 4 for details on DEER Peak definition.

Table 5-16: First Year Ex Post Gross Impact Results for Booster Pump Sample Points – SCE

Sample Point Identifier	Ex Post	Ex Ante	Results	Ex Post	Ex Ante	Results
	First Year Gross Impact Savings (kWh)	First Year Gross Impact Claim (kWh)	First Year Gross Impact Realization Rate	First Year Gross Impact Savings (kW)	First Year Gross Peak Demand Claim (kW)	First Year Gross Impact Realization Rate
SCE_Booster_1	0	9,066	0.00	0.00	4.88	0.00
SCE_Booster_2	9,285	13,599	0.68	0.69	7.32	0.09
SCE_Booster_3	2,564	9,066	0.28	10.07	4.88	2.06
SCE_Booster_4a	15,245	16,999	0.90	2.16	9.15	0.24
SCE_Booster_4b	7,848	16,999	0.46	0.88	9.15	0.10
SCE_Booster_4c	7,848	16,999	0.46	0.88	9.15	0.10
SCE_Booster_4d	30,040	16,999	1.77	4.72	9.15	0.52
Total	**72,829**	**99,726**	**0.73**	**19.39**	**53.68**	**0.36**

Table 5-17: Discrepancy Factors* for Booster Pump Sample Points – SCE

Sample Point Identifier	First Year Gross Impact Realization Rate	Pump Run Hours > 1500	Pump Run Hours < 500	Pump Speed Typically 90-100%	Pump Speed is Relatively Low	Farmer Prefers Using District Water	Farmer Also Irrigates with a Different Pump	Pump Peak Coinc. Factor < 50%	Pump is a Booster but Claim is a Well	Applied Mean Modeled Result from Sample	Applied Result from Other Point at Same Farm	Other**
		Up	Dn	Dn	Up	Dn	Dn	Dn	-	-	-	-
SCE_Booster_1	0.00						1					1
SCE_Booster_2	0.68				1			1				
SCE_Booster_3	0.28		1		1		1					
SCE_Booster_4a	0.90										1	
SCE_Booster_4b	0.46	1		1								
SCE_Booster_4c	0.46	1		1								
SCE_Booster_4d	1.77	1										
Total		**3**	**1**	**2**	**2**	**0**	**2**	**1**	**0**	**0**	**1**	**1**

** Discrepancy factors can have a downward or upward effect on the Gross Realization Rate as labeled under discrepancy factor headings.*

*** Other: Farmer uses Flood Irrigation.*

SCE ex post gross first year annual impact results per booster pump sample point range from 0 kWh to 30,040 kWh, with gross impact realization rates (GRRs) ranging from 0 to 1.77 and yielding a sample-based weighted mean GRR of 0.73. We also present ex post gross first year peak demand results per point, ranging from 0 kW to 10.07 kW, with realization rates ranging from 0 to 2.06, and yielding a sample-based weighted mean GRR of 0.36. 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:

- **One sample point out of a total sample size of 7 booster pumps does not save energy.**
  - For ID SCE_Booster_1 our field staff determined that the farmer uses flood irrigation. As discussed in section 4, there are no energy savings associated with flood irrigation, therefore the energy savings is set to zero.
- **Models were developed for 6 of the 7 booster pumps evaluated, and for the remaining point a mean GRR result was applied from other pumps on the same farm.**

The evaluation results show that on a GRR basis that SCE booster pumps perform similarly to SCE well pumps.

5-2-2 Effective Useful Life Evaluation Results

In Table 5-18 and Table 5-19 we present effective useful life (EUL) results for the PG&E and SCE well pump sample points, respectively. In Table 5-20 and Table 5-21 we present effective useful life (EUL) results for the PG&E and SCE booster pump sample points, respectively. These tables compare our evaluation team's ex post EULs to the ex ante EUL assignments.

In general, the 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. For these retrofit add-on pumps the EUL is set equal to 1/3 of the EUL of a new agricultural pump. The EUL is dependent on the pump type being a booster or well pump and if it is a centrifugal, submersible, or vertical turbine pump; refer to Section 4.2.2 for more details on the values applied by the evaluation team.

The EULs determined by our team are different from the ex ante EULs for most of the sample points, and is only consistent with new pumps in SCE, which are both 10 years. PG&E assignments are relatively conservative at 3.3 years for each record in the sample, while SCE assignments are greater, consisting of a mix of assignments of 10 and 6.67. It appears that ex post EUL estimates are greater on average than both PG&E assignments and 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. *We recommended that the PAs more carefully and accurately apply EUL to tracking system measure claims, consistent with CPUC policy.*

Table 5-18: Ex Post EUL Results for Well Pump Sample Points – PG&E

Sample Point Identifier	Ex Post Effective Useful Life	Ex Ante Effective Useful Life
PGE_Well_1	2.27	3.30
PGE_Well_2	10.00	3.30
PGE_Well_3a	10.00	3.30
PGE_Well_3b	UNK	3.30
PGE_Well_4a	10.00	3.30
PGE_Well_4b	10.00	3.30
PGE_Well_5a	2.27	3.30
PGE_Well_5b	10.00	3.30
PGE_Well_6	UNK	3.30
PGE_Well_7	10.00	3.30
PGE_Well_8	10.00	3.30
PGE_Well_9	2.27	3.30
PGE_Well_10a	10.00	3.30
PGE_Well_10b	10.00	3.30
PGE_Well_11	10.00	3.30
PGE_Well_12	2.27	3.30
PGE_Well_13	10.00	3.30
PGE_Well_14	10.00	3.30
PGE_Well_15	4.23	3.30
Average	**7.84**	**3.30**

Table 5-19: Ex Post EUL Results for Well Pump Sample Points – SCE

Sample Point Identifier	Ex Post Effective Useful Life	Ex Ante Effective Useful Life
SCE_Well_1	10.00	10.00
SCE_Well_2	10.00	6.67
SCE_Well_3	10.00	6.67
Average	**10.00**	**7.78**

Table 5-20: Ex Post EUL Results for Booster Pump Sample Points – PG&E

Sample Point Identifier	Ex Post Effective Useful Life	Ex Ante Effective Useful Life
PGE_Booster_1a	10.00	3.30
PGE_Booster_1b	10.00	3.30
PGE_Booster_2	10.00	3.30
PGE_Booster_3a	4.23	3.30
PGE_Booster_3b	10.00	3.30
PGE_Booster_4	4.23	3.30
PGE_Booster_5a	10.00	3.30
PGE_Booster_5b	10.00	3.30
PGE_Booster_6	10.00	3.30
PGE_Booster_7	10.00	3.30
PGE_Booster_8	3.10	3.30
PGE_Booster_9	10.00	3.30
PGE_Booster_10a	10.00	3.30
PGE_Booster_10b	10.00	3.30
PGE_Booster_11	10.00	3.30
Average	**8.68**	**3.30**

Table 5-21: Ex Post EUL Results for Booster Pump Sample Points – SCE

Sample Point Identifier	Ex Post Effective Useful Life	Ex Ante Effective Useful Life
SCE_Booster_1	10.00	6.67
SCE_Booster_2	10.00	10.00
SCE_Booster_3	4.23	6.67
SCE_Booster_4a	10.00	6.67
SCE_Booster_4b	10.00	6.67
SCE_Booster_4c	10.00	6.67
SCE_Booster_4d	10.00	6.67
Average	**9.18**	**7.15**

5-2-3 Lifecycle Gross Impact Results

In Table 5-22 and Table 5-23 we present lifecycle gross impact results for the PG&E and SCE well pump on-site sample points, respectively. In Table 5-24 and Table 5-25 we 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 2.34 for PG&E well pumps, 0.96 for SCE well pumps, 2.40 for PG&E booster pumps, and 1.00 for SCE booster pumps. Peak demand (kW) lifecycle realization rates are 0.55 for PG&E well pumps, 0.29 for SCE well pumps, 0.62 for PG&E booster pumps and 0.36 for SCE booster pumps. Our adjustments to gross first year savings estimates using EUL estimates leads to substantially increased lifecycle realization rates for PG&E and SCE relative to first year realization rates discussed above. This is based on EUL differences discussed above in Section 5-2-2. Otherwise, the same discrepancy factors we discussed in Section 5-2-1remain in effect.

Table 5-22: Lifecycle Ex Post Gross Impact Results for Well Pump Sample Points – PG&E

Sample Point Identifier	Ex Post	Ex Ante	Results	Ex Post	Ex Ante	Results
	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	15,812	105,848	0.15	2.29	49.79	0.05
PGE_Well_2	806,536	127,017	6.35	268.25	59.75	4.49
PGE_Well_3a	1,281,536	273,240	4.69	46.51	175.23	0.27
PGE_Well_3b	854,357	182,160	4.69	31.01	116.82	0.27
PGE_Well_4a	421,374	127,017	3.32	14.33	59.75	0.24
PGE_Well_4b	50,745	63,509	0.80	0.17	29.87	0.01
PGE_Well_5a	17,588	105,848	0.17	5.05	49.79	0.10
PGE_Well_5b	6,957	50,807	0.14	6.06	23.90	0.25
PGE_Well_6	0	211,695	0.00	0.00	99.58	0.00
PGE_Well_7	39,939	25,403	1.57	0.00	11.95	0.00
PGE_Well_8	167,279	127,017	1.32	0.00	59.75	0.00
PGE_Well_9	17,886	25,403	0.70	0.00	11.95	0.00
PGE_Well_10a	609,626	273,240	2.23	0.00	175.23	0.00
PGE_Well_10b	508,022	227,700	2.23	0.00	146.03	0.00
PGE_Well_11	331,285	63,509	5.22	83.58	29.87	2.80
PGE_Well_12	55,524	127,017	0.44	32.44	59.75	0.54
PGE_Well_13	472,959	182,160	2.60	67.38	116.82	0.58
PGE_Well_14	320,636	84,678	3.79	207.06	39.83	5.20
PGE_Well_15	-11,752	169,356	-0.07	0.00	79.66	0.00
Total	**5,966,310**	**2,552,623**	**2.34**	**764**	**1,395**	**0.55**

Table 5-23: Lifecycle Ex Post Gross Impact Results for Well Pump Sample Points – SCE

Sample Point Identifier	Ex Post	Ex Ante	Results	Ex Post	Ex Ante	Results
	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	259,129	256,600	1.01	90.37	120.70	0.75
SCE_Well_2	357,355	342,304	1.04	51.64	161.01	0.32
SCE_Well_3	366,242	427,881	0.86	0.00	201.27	0.00
Total	**982,726**	**1,026,785**	**0.96**	**142**	**483**	**0.29**

Table 5-24: Lifecycle Ex Post Gross Impact Results for Booster Pump Sample Points – PG&E

Sample Point Identifier	Ex Post	Ex Ante	Results	Ex Post	Ex Ante	Results
	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_1a	85,647	84,810	1.01	0.00	35.64	0.00
PGE_Booster_1b	85,647	84,810	1.01	0.00	35.64	0.00
PGE_Booster_2	19,970	12,702	1.57	0.00	5.97	0.00
PGE_Booster_3a	22,689	18,699	1.21	2.76	10.07	0.27
PGE_Booster_3b	107,278	37,397	2.87	13.07	20.13	0.65
PGE_Booster_4	155,109	74,795	2.07	13.34	40.26	0.33
PGE_Booster_5a	51,227	44,877	1.14	0.00	24.16	0.00
PGE_Booster_5b	106,722	93,493	1.14	0.00	50.33	0.00
PGE_Booster_6	321,834	112,192	2.87	39.22	60.39	0.65
PGE_Booster_7	104,889	37,397	2.80	0.00	20.13	0.00
PGE_Booster_8	43,039	46,860	0.92	0.00	19.80	0.00
PGE_Booster_9	9,970	18,699	0.53	1.67	10.07	0.17
PGE_Booster_10a	184,281	74,795	2.46	0.00	40.26	0.00
PGE_Booster_10b	184,281	74,795	2.46	0.00	40.26	0.00
PGE_Booster_11	700,122	93,493	7.49	215.17	50.33	4.28
Total	**2,182,706**	**909,812**	**2.40**	**285**	**463**	**0.62**

Table 5-25: Lifecycle Ex Post Gross Impact Results for Booster Pump Sample Points – SCE

Sample Point Identifier	Ex Post	Ex Ante	Results	Ex Post	Ex Ante	Results
	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	0	60,470	0.00	0.00	32.55	0.00
SCE_Booster_2	92,853	135,990	0.68	6.87	73.20	0.09
SCE_Booster_3	10,844	60,470	0.18	42.61	32.55	1.31
SCE_Booster_4a	152,451	113,382	1.34	21.58	61.03	0.35
SCE_Booster_4b	78,477	113,382	0.69	8.79	61.03	0.14
SCE_Booster_4c	78,477	113,382	0.69	8.79	61.03	0.14
SCE_Booster_4d	300,398	113,382	2.65	47.16	61.03	0.77
Total	**713,499**	**710,457**	**1.00**	**136**	**382**	**0.36**

5-2-4 Pump VFD Model-Based Parameters and Results

We have assembled model inputs by sample point and unit energy savings estimates that might contribute to workpaper updates. In Table 5-26 and Table 5-27 we present model-based parameters and unit energy savings results for well pump sample points, for the PG&E and SCE samples, respectively. In Table 5-28 and Table 5-29 we 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, 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 parameters 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% 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 5-26: Ex Post Model-Based Parameters and Results for Well Pump Sample Points – PG&E

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	125	Tomatoes / Corn	NA	84	940	56	0.01
PGE_Well_2	150	Cherries	2	295	1,904	538	0.18
PGE_Well_3a	300	Lettuce/Broccoli/Peas	NA	170	2,828	427	0.02
PGE_Well_3b	200	UNK	UNK	UNK	UNK	427	0.02
PGE_Well_4a	150	Almond	1	300	1,090	281	0.01
PGE_Well_4b	75	Almond	2	50	939	68	0.00
PGE_Well_5a	125	Wine Grapes	2	200	680	62	0.02
PGE_Well_5b	60	Wine Grapes	2	100	2,041	12	0.01
PGE_Well_6	250	NA	NA	NA	UNK	0	0.00
PGE_Well_7	30	Almonds	2	18	490	133	0.00
PGE_Well_8	150	Almond, Pistachio	1	85	483	112	0.00
PGE_Well_9	30	Grapes	35	23	1,040	263	0.00
PGE_Well_10a	300	Tomatoes / Garlic	NA	600	1,645	203	0.00
PGE_Well_10b	250	Tomatoes / Garlic	NA	600	1,645	203	0.00
PGE_Well_11	75	Olives	1	80	2,613	442	0.11
PGE_Well_12	150	Strawberries/Lettuce	NA	155	1,414	163	0.10

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_13	200	Almonds/Cherries	4	201	NA	236	0.03
PGE_Well_14	100	Plum/Almonds	2	75	1,603	321	0.21
PGE_Well_15	200	Sunflower/Tomato/ Wheat	NA	100	712	-14	0.00
Weighted Average*			**3**	**215**	**1,173**	**216**	**0.03**
Predominant Ex Ante Metrics						**257**	**0.12**

** Weighted average uses pump horsepower as a weight.*

Table 5-27: Ex Post Model-Based Parameters and Results for Well Pump Sample Points – SCE

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_Well_1	100	Cuties/Almonds/ Walnuts	15	92	1,319	259	0.09
SCE_Well_2	200	Avocados/Lemons/ Trees/Plants/ Household Water	NA	241	3,431	179	0.03
SCE_Well_3	250	Alfalfa, Grass Hay	NA	300	3,245	146	0.00
Weighted Average*			**3**	**262**	**2,962**	**179**	**0.03**
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 Booster Pump Sample Points – PG&E

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_1a	100	Almonds	5	616	2,437	86	0.00
PGE_Booster_1b	100	Almonds	5	616	2,437	86	0.00
PGE_Booster_2	15	Almonds	2	18	490	133	0.00
PGE_Booster_3a	25	Almond Trees	10	200	NA	215	0.03
PGE_Booster_3b	50	Almond Trees	10	200	NA	215	0.03
PGE_Booster_4	100	Pistachios	6	145	2,030	367	0.03
PGE_Booster_5a	60	Almond Trees	2	50	332	85	0.00
PGE_Booster_5b	125	Almond/Walnut Trees	2	155	NA	85	0.00
PGE_Booster_6	150	Almonds	3	200	NA	215	0.03
PGE_Booster_7	50	Almonds	3	100	1,126	210	0.00
PGE_Booster_8	50	Grapes	1	40	1,404	278	0.00
PGE_Booster_9	25	Almonds	2	35	671	40	0.01
PGE_Booster_10a	100	Tomatoes/Carrots/ Onions	Annual	210	731	184	0.00
PGE_Booster_10b	100	Tomatoes/Carrots/ Onions	Annual	210	680	184	0.00
PGE_Booster_11	125	Corn/Tomatoes	Annual	249	2,063	215	0.17
Weighted Average*			**4**	**244**	**1,072**	**215**	**0.03**
Predominant Ex Ante Metrics						**227**	**0.12**

* *Weighted average uses pump horsepower as a weight.*

Table 5-29: Ex Post Model-Based Parameters and Results for Booster Pump Sample Points – SCE

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	40	Wheat / Corn	3	400	NA	0	0.00
SCE_Booster_2	60	Almonds	2	NA	858	155	0.01
SCE_Booster_3	40	Tangerines/Avocados	5	250	192	64	0.25
SCE_Booster_4a	75	Citrus	5	300	NA	203	0.03
SCE_Booster_4b	75	Citrus	5	300	2,919	105	0.01
SCE_Booster_4c	75	Citrus	5	300	2,919	105	0.01
SCE_Booster_4d	75	Citrus	5	300	3,346	401	0.06
Weighted Average*			**4**	**305**	**1,700**	**166**	**0.04**
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.

We note upfront that PG&E no longer offers the agricultural drip irrigation measure. The measure has undergone several iterations since we first began evaluating it in the PY2013 ESPI cycle. Recently, PG&E restricted the measure's eligibility criteria to exclude deciduous crops and vineyards, for which low-pressure irrigation was deemed standard practice. By sunsetting the final eligible crop type—field vegetables—PG&E has demonstrated that low-pressure irrigation has generally become standard practice in northern California. We nonetheless have contextualized results in Sections 5 through 7, and conclusions/recommendations in Section 8, to be useful if a similar irrigation measure should reemerge.

Installation Rate

The installation rate is defined as the ratio of affected acreage served by the installed equipment, as virtually verified by our evaluation team, versus the affected acreage reported by the program administrator (PA). We estimated the installation rate for each site based on data we gathered for each sample point (farm). As part of the virtual verifications, we sought to identify and assess the quantity and operability of all equipment installed as well as the acreage of plot served by the irrigation system.

From the PY2019 evaluation sample of 19 projects, we determined **an installation rate of 35.1%.**[24]

The key measure count identified during our virtual visits is the acreage served by the rebated irrigation system currently installed and in working condition. We used a combination of interview questions, virtual inspection, and review of project invoices to confirm the acreage served. The installation rate was calculated directly from this measurement. Additionally, when possible, we 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 our team

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

The resulting 35.1% installation rate is primarily due to significant discrepancies in reported acreage among 14 projects at several farms under the same ownership. We confirmed that all installed drip systems are properly functioning (i.e., no installed drip systems were failed, removed, or in storage).

[24] As discussed below, the evaluators determined that two sampled projects were ineligible because they did not meet the discharge pressure eligibility threshold required by the workpaper. These two projects are nonetheless included in the installation rate, as the rebated equipment was properly installed and functioning.

Nonetheless, we found that the tracked installation quantity exceeded the actual installation quantity by nearly a factor of four among these 14 projects in total. The representative of the participating farm could not provide an explanation for the significant discrepancy.

Table 5-30 we break down the installation rate by the categories defined above.

Table 5-30: Disposition of ESPI Micro-Nozzle and Drip Irrigation Verification

Measure	Sites	Received Rate	Failure Rate	Storage Rate	Removal Rate	Installation Rate
Drip Irrigation	19	35.1%	0.0%	0.0%	0.0%	35.1%

Pumping Discharge Pressure

A key variable affecting our estimated sprinkler replacement savings is the reduction in discharge pressure experienced by the irrigation pump. We 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. We recorded pre/post discharge pressure estimates during virtual visits, including the post-project value via virtual gauge reading when possible. However, due to the timing of the study, not all affected irrigation pumps were operating at the time of the virtual visits.

We calculated the weighted average discharge pressure reduction for eligible sites to **be 39.8 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

Our team requested interval utility data for all 55 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[25] of 0.34. This value aligns closely with results from prior evaluation cycles of this measure—for example, the PY2015 evaluation resulted in an average CF of 0.37.

We also calculated the coincidence factor using PG&E's new peak period definition that goes into effect for agricultural customers in March 2021[26]. Aggregate analysis of the interval data showed a weighted average coincidence factor of 0.22.

Site-Specific Results

Table 5-31 presents ex post and ex ante first-year gross saving results for the 19 projects sampled for evaluation, and the resulting GRRs for both annual energy and peak demand savings. Program-level GRRs and analysis of key contributors are presented in subsequent sections.

Table 5-31: Site-Specific Agricultural Drip Irrigation Evaluation Results – PG&E

Evaluation ID	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
AG3001	3	776,150	54,712	0.07	616.02	3.06	0.00
AG3002	3	449,825	54,007	0.12	357.02	3.56	0.01
AG3003	3	380,950	220,543	0.58	302.35	163.04	0.54
AG3004	3	365,275	54,007	0.15	289.91	3.56	0.01
AG3005	2	327,750	246,387	0.75	260.13	330.88	1.27
AG3006	2	274,075	59,654	0.22	217.53	3.16	0.01
AG3007	2	250,800	52,948	0.21	199.06	3.49	0.02
AG3008	2	241,775	53,654	0.22	191.89	3.09	0.02
AG3009	2	223,250	54,007	0.24	177.19	3.56	0.02
AG3011	2	191,425	49,418	0.26	151.93	3.26	0.02

[25] Based on PG&E's peak period in 2019, which is defined as 12:00 p.m. to 6:00 p.m., effective June through September.

[26] Defined as 5:00 p.m. to 8:00 p.m., effective 365 days per year. https://www.pge.com/en_US/small-medium-business/your-account/rates-and-rate-options/time-of-use-rates.page

Evaluation ID	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
AG3012	2	146,775	23,365	0.16	116.49	62.63	0.54
AG3015	1	92,625	0	0.00	73.52	0.00	0.00
AG3018	1	77,425	54,359	0.70	61.45	3.22	0.05
AG3019	1	74,100	19,466	0.26	58.81	12.66	0.22
AG3021	1	74,100	57,075	0.77	58.81	43.23	0.74
AG3022	1	73,150	-497	-0.01	58.06	-0.94	-0.02
AG3025	1	71,250	55,418	0.78	56.55	3.37	0.06
AG3029	1	61,750	54,712	0.89	49.01	3.15	0.06
AG3034	1	38,950	0	0.00	30.91	0.00	0.00
Total		**4,191,400**	**1,163,233**	**0.28**	**3,327**	**648**	**0.19**

Gross First Year Realization Rates

Our 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 5-32 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 shown. The first year kWh GRR is 32% with a corresponding relative precision of 23% at the 90% confidence interval and the kW GRR is 18% with a corresponding relative precision of 27% at the 90% confidence interval. Below we examine the reasons behind the low GRRs and unexpectedly poor precision estimates.

Table 5-32: PG&E First Year Gross kWh and kW Realization Rates for Sprinkler-to-Drip Measures

PA	First Year Gross kWh Savings				First Year Gross kW Savings			
	Ex Ante Savings	Ex Post Savings	GRR	RP	Ex Ante Savings	Ex Post Savings	GRR	RP
PG&E	5,933,415	1,901,489	32%	23%	4,709	849	18%	27%

In the PY2019 data collection and sampling plan, we targeted results within ±14% relative precision at the 90% confidence interval. Despite the 19-project sample accounting for 71% of PY2019 ex ante kWh savings, our results demonstrate a relative precision of ±32% (kWh) and ±27% (kW) due to very 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, our evaluation results show *absolute* precisions of 7% (kWh) and 5% (kW).[27]

The ex post impacts and ex ante claims are products of several unique parameters that are generated in each 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 affect the overall realization rate results.

- **We identified differences in affected acreage in 12 projects causing a 52% reduction in kWh GRR.**
- **We determined for 9 projects that claimed savings exceeded the irrigation pump's annual billed usage, further reducing the kWh GRR by 10%.**
- **We found that 2 of the projects were ineligible[28] for program participation and therefore set the savings to zero, driving the GRR down by 3%.**

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27 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%.

28 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 system operating pressure eligibility requirements were not met for these two projects due to the prexisitng use of furrow irrigation (i.e., 0 psi discharge pressure).

The key discrepancies and their relative contribution to the overall program-level kWh GRR are illustrated in Table 5-33.

Table 5-33: Key Discrepancy Categories and Contributions to Overall kWh GRR – Sprinkler-to-Drip

Discrepancy Category	# Instances	kWh	Impact on GRR
Difference in affected field acreage	12	-2,274,814	-52%
Reported savings greater than annual billed usage	9	-433,797	-10%
Difference in irrigation hours of operation	3	-119,971	-3%
Ineligible measure	2	-131,575	-3%
Difference in pump discharge pressure reduction	2	-12,828	0%
Difference in irrigation pump hp	1	-16,698	0%
Total	29	-2,989,683	-68%

Gross Lifecycle Realization Rates

Table 5-34 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 precision is also presented for each impact category.

Based on interviews with participating farmers on the age and condition of preexisting irrigation emitter systems (e.g., nozzles, sprayers), we found that the preexisting systems were replaced for various reasons—e.g., water savings, energy savings, monetary savings —but never due to equipment failure or end-of-life. We also 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. Interestingly, the PG&E workpaper references an EUL of 20 years based on a default EUL for agricultural pumps, not for the emitters themselves. Our surveys of participating farmers showed that the irrigation emitters were generally replaced approximately every five years; however, this estimate is supported by only three unique respondents, as several farmers could not provide any information on pre-existing emitter age. Due to low survey respondent count, evaluators instead referenced the workpaper's recommended EUL of 20 years, and the first-year and lifecycle GRRs are therefore identical.

Table 5-34: PG&E Lifecycle Gross kWh and kW Realization Rates for Sprinkler-to-Drip Measures

PA	Lifecycle Gross kWh Savings				Lifecycle Gross kW Savings			
	Ex Ante	Ex Post	GRR	RP	Ex Ante	Ex Post	GRR	RP
PG&E	118,668,310	38,029,784	32%	23%	94,185	16,989	18%	27%

5-4 TANKLESS WATER HEATERS

Below we discuss the detailed approach for estimating each individual impact parameter, including the tankless water heater (TWH) 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 first-year and lifecycle GRRs.

Installation Rate

For the TWH measure, we define installation rate as the ratio of evaluator-verified TWH size in kBtu/h to the TWH size as reported by the program administrator (PA). We quantified installation rate for each of the 51 assessed sites based on data gathered during virtual visits. Our evaluation engineers worked with knowledgeable facility staff to confirm the installation, operability, and nameplate characteristics of each rebated TWH via videoconference and/or photos.

Our evaluation team conducted virtual inspections of installations at 51 participating facilities and determined **a TWH installation rate (ISR) of 81.5%.** The 19% reduction in installed kBtu/h was driven by observed differences at 12 of the 51 projects:

- **We found that in 9 of the 51 projects there were no savings.**
  - Three projects occurred at facilities that have permanently closed. Evaluators confirmed that such closures were not temporary due to the pandemic or for other seasonal reasons.
  - Six projects occurred at service addresses that had no evidence of recent TWH installation.
- **Three of the 51 facilities had TWH systems installed in 2019, but the installed size slightly differed from the PA-reported TWH capacity.**

Based on the reasons above, the 81.5% ISR is disaggregated in Table 5-35.

Table 5-35: Disposition of Tankless Water Heater Verification

Measure	Sites	Received Rate	Failure Rate	Storage Rate	Removal or Closure Rate	Installation Rate
Tankless Water Heater	51	88.3%	0.0%	0.0%	6.8%	81.5%

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. This assumes that wastewater does not recirculate to the TWH but is subsequently discarded via sewer.

From our 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).

Our evaluation team sought to calculate the average DHW inlet and outlet temperatures and corresponding temperature increase through remote spot readings of the TWH display and/or temperature gauges. These spot readings, weighted by TWH size, show an **average DHW outlet temperature of 138.5°F**, slightly higher than the 135°F reflected in DEER models. As illustrated in Table 5-36 below, evaluators observed slightly higher outlet temperatures for large TWHs relative to smaller units.

Our analysis of TWH inlet temperatures showed higher water temperatures than reflected within DEER models. For 5 projects, we identified closed-loop DHW systems that relied on storage tanks, thereby contradicting the workpaper assumptions and reducing the TWH's DHW load and subsequent savings.

Closed-loop systems were more prevalent for large TWHs as illustrated by the much higher inlet water temperatures shown in Table 5-36. Overall, we estimated a **weighted average inlet DHW temperature of 73.0°F**.

Comparing average outlet and inlet DHW temperatures, we estimated a **weighted average DHW temperature increase of 65.5°F**. Table 5-36 also presents differences in average DHW temperatures by TWH size. Please note that we were unable to take DHW temperature measurements at 9 zero-saver sites.

Table 5-36: Observed DHW Temperatures by Tankless Water Heater Size

TWH Size Classification	Sample Count	Weighted Average DHW Inlet Temperature (°F)*	Weighted Average DHW Outlet Temperature (°F)	Weighted Average DHW Temperature Increase (°F)
Large (≥ 200 kBtu/h)	15	79.5	140.9	61.4
Small (< 200 kBtu/h)	27	63.6	135.1	71.5
Total	**42**	**73.0**	**138.5**	**65.5**

** If closed-loop systems are excluded, inlet temperatures decrease to 62.0°F (large), 62.2°F (small), and 62.1°F (overall). Temperature increases (rightmost column) would subsequently rise to 78.8°F (large), 72.9°F (small), and 76.4°F (overall).*

Uniform Energy Factor

Another variable affecting TWH savings is the rated efficiency of the installed system. As shown in Table 5-37 program administrators classify rebated TWHs into two efficiency tiers. Tier 1 reflects efficiency thresholds greater than 80% thermal efficiency or 0.81 UEF (SCG) or 85% thermal efficiency (PG&E). Tier 2 reflects efficiency thresholds greater than 90% thermal efficiency or 0.87 UEF (SCG) or 90% thermal efficiency (PG&E).

Our evaluation team assessed all measure records in the sample of 51 projects to quantify evaluated UEFs among the size and efficiency tiers considered by program administrators. During each virtual visit, our field engineers determined the system's rated efficiency (in thermal efficiency, EF, or UEF units) from nameplate inspection. We subsequently converted these efficiencies into UEF format for comparison among tiers. Results of the UEF analysis are provided in Table 5-37. Please note that for 9 zero-saver projects we were unable to confirm UEF.

Table 5-37: Uniform Energy Factors by Tankless Water Heater Size and Efficiency Tier

TWH Size and UEF Tier Classification	Sites	Weighted Average UEF of Installed System
Large (≥ 200 kBtu/h) – Tier 1	1	0.850
Large (≥ 200 kBtu/h) – Tier 2	14	0.952
Small (< 200 kBtu/h) – Tier 1	0	No Data
Small (< 200 kBtu/h) – Tier 2	27	0.934
Total	**42**	**0.940**

The evaluation sample contained nearly all Tier 2 TWH installations, except for one project involving a large Tier 1 TWH. As a result, we were unable to estimate UEF values for Tier 1 small systems. Using installed TWH size as the weighting variable, we calculated **weighted average UEFs of 0.952 for large Tier 2 TWHs and 0.934 for small Tier 2 TWHs**. Each of these values exceeds the workpapers' UEF assumptions of 0.90 (PG&E and SCG) or 0.87 (SCG), and thereby increased the resulting evaluated savings relative to PA-reported estimates.

Site-Specific Results

Table 5-38 illustrates key characteristics and results of the 51 projects that we sampled for evaluation. In subsequent sections we present program-level GRRs and an analysis of key contributors to GRR results. Please note that the savings and GRRs presented in Table 5-38 are unweighted and therefore differ from the overall results presented later in this section.

Table 5-38: 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
WH3048	PGE	2	400	3,268	1,383	0.42
WH3026	PGE	2	798	6,535	9,803	1.50
WH3038	PGE	2	1,000	4,871	0	0.00
WH3051	PGE	2	2,000	3,267	0	0.00
WH3049	PGE	2	1,370	3,268	1,239	0.38

Evaluation ID	PA	Stratum	Total Size Installed (kBtu/h)	Ex Ante First-Year Savings (Therm)	Ex Post First-Year Savings (Therm)	GRR
WH3040	PGE	2	1,600	4,840	4,432	0.92
WH3050	PGE	2	1,000	3,268	939	0.29
WH3104	PGE	1	199	1,550	1,115	0.72
WH3166	PGE	1	200	720	968	1.34
WH3056	PGE	1	398	2,751	0	0.00
WH3146	PGE	1	200	923	1,162	1.26
WH3163	PGE	1	199	740	963	1.30
WH3101	PGE	1	1,501	1,635	608	0.37
WH3112	PGE	1	800	1,385	1,703	1.23
WH3147	PGE	1	200	920	0	0.00
WH3211	PGE	1	796	468	0	0.00
WH3201	PGE	1	199	486	776	1.60
WH3204	PGE	1	400	484	812	1.68
WH3207	PGE	1	500	484	284	0.59
WH3277	SCG	3	500	3,182	4,940	1.55
WH3276	SCG	3	500	3,182	4,940	1.55
WH3303	SCG	3	796	1,060	0	0.00
WH3304	SCG	3	500	1,060	0	0.00
WH3463	SCG	2	200	864	1,138	1.32
WH3392	SCG	2	200	864	1,005	1.16
WH3436	SCG	2	200	864	1,041	1.21
WH3457	SCG	2	200	864	1,134	1.31
WH3431	SCG	2	200	864	951	1.10
WH3462	SCG	2	200	864	1,134	1.31
WH3435	SCG	2	200	864	894	1.04
WH3346	SCG	2	200	864	1,041	1.21
WH3403	SCG	2	200	864	1,041	1.21
WH3401	SCG	2	200	864	894	1.04
WH3372	SCG	2	200	864	1,005	1.16
WH3354	SCG	2	200	864	1,005	1.16
WH3459	SCG	2	200	864	1,138	1.32
WH3461	SCG	2	200	864	1,138	1.32
WH3661	SCG	1	199	530	855	1.61
WH3684	SCG	1	199	530	631	1.19
WH3597	SCG	1	251	860	0	0.00

Evaluation ID	PA	Stratum	Total Size Installed (kBtu/h)	Ex Ante First-Year Savings (Therm)	Ex Post First-Year Savings (Therm)	GRR
WH3582	SCG	1	250	860	687	0.80
WH3673	SCG	1	160	530	631	1.19
WH3596	SCG	1	199	860	687	0.80
WH3645	SCG	1	199	532	0	0.00
WH3652	SCG	1	150	530	631	1.19
WH3677	SCG	1	199	530	631	1.19
WH3631	SCG	1	251	648	1,134	1.75
WH3654	SCG	1	160	530	631	1.19
WH3574	SCG	1	199	860	687	0.80
WH3590	SCG	1	300	860	687	0.80
WH3580	SCG	1	250	860	687	0.80
Total			**20,659**	**71,954**	**59,210**	**0.82**

Gross First Year Realization Rates

Our 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 5-39 below presents the population-level, first-year gross Therm realization rates for the tankless water heater measures along with the aggregate ex ante and ex post first year Therm savings. We also present the corresponding relative precision for each evaluation-based estimate. The first year Therm GRR is 81% with a corresponding relative precision of 20% at the 90% confidence interval. Further below we examine the reasons behind the GRR and precision results derived.

We observed a significant difference in GRR results by program administrator. The SCG GRR exceeded PG&E's by 49%, primarily due to a higher prevalence of zero-savers among the PG&E sample. We determined that 5 of the 19 sampled PG&E projects do not save energy, compared with 4 of the 32 sampled SCG projects.

Table 5-39: First Year Gross Therm Realization Rate by Program Administrator for Tankless Water Heater Measures

PA	First Year Gross Therm Savings			
	Ex Ante Savings	Ex Post Savings	GRR	RP at 90% Confidence
PG&E	678,886	433,519	64%	37%
SCG	377,018	425,198	113%	12%
Total	**1,055,904**	**858,717**	**81%**	**20%**

Our evaluation team experienced challenges in recruiting customers for participation in the study, particularly within strata with a limited count of high-saver projects. To compensate for the unmet sample counts in such strata, we assessed more projects in medium- and low-saver strata, ultimately assessing 51 participating facilities. The unmet sample targets in high-saving strata, in addition to high variation among site-specific results, contributed to slightly poorer relative precision than the target ±15%. The relative precision of PG&E's GRR is poorer than SCG's due to a higher prevalence of zero-saver PG&E projects in the sample.

Overall, our evaluation results show that TWH projects realize 81% of reported savings. Our evaluation team identified the following key contributors to the 19% reduction in evaluated savings:

- **As discussed previously in the context of installation rate, we identified 9 zero-saver projects due to business closure or non-install.**
  - Three additional projects installed systems with slightly different in size than reported by the program, marginally increasing the GRR.
  - Overall, differences in installation rate reduced the GRR by 27%.
- **Differences in DHW temperature increase, as detailed earlier in this section, reduced the GRR by 11% overall.**
  - The five 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 32%.**

- We found that all installed systems exceeded the minimum efficiency thresholds set forth by TWH workpapers and reflected in ex ante unit energy savings.

- **We identified inconsistencies between workpaper-recommended UES and those reflected within the reported ex ante savings claims.**
  - In some cases, the project was classified as "commercial" but should have been classified more specifically (e.g., "hotel," "restaurant," "office").
  - Overall, differences between tracked and DEER-recommended UES led to a 8% reduction in GRR.

A comprehensive analysis of discrepancy reasons, frequencies, and relative contributions to program-level Therm GRR is illustrated in Table 5-40.

Table 5-40: Discrepancy Categories and Contributions to Overall Therm GRR – Tankless Water Heater Measure

Discrepancy Category	Negative		Positive	
	Frequency	RR Impact	RR Impact	Frequency
Difference in temperature rise	12	-14%	3%	22
Difference in water heater efficiency	0	0%	32%	41
Difference in installed quantity	1	-2%	5%	2
Difference in water heater type	1	-4%	0%	0
Difference in building type	4	-3%	0%	1
Tracking UES does not match workpaper	20	-1%	0%	9
Residual differences or interactivity	19	-8%	1%	21
Facility closure	3	-7%	0%	0
Measure never installed	6	-20%	0%	0
Total	**66**	**-60%**	**41%**	**96**

Gross Lifecycle Realization Rates

Table 5-41 presents the population-level gross lifecycle Therm realization rates for the evaluated tankless water heater measures, along with the aggregate ex ante and ex post lifecycle Therm savings. The corresponding relative precision estimates are also presented.

While we were interviewing participating customers on the age and condition of preexisting water heaters, we found that the preexisting systems were generally functioning. Of the 51-project sample (ignoring 9 zero-savers), evaluators identified 6 instances of new construction and one instance of equipment failure. Otherwise, preexisting water heater age varied considerably between 10 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. Therefore, the lifecycle GRRs and RPs are identical to the first-year GRRs and RPs.

Table 5-41: Lifecycle Gross Therm Realization Rate by Program Administrator for Tankless Water Heater Measure

PA	Lifecycle Gross Therm Savings			
	Ex Ante Savings	Ex Post Savings	GRR	RP at 90% Confidence
PG&E	13,577,725	8,670,388	64%	37%
SCG	7,540,360	8,503,964	113%	12%
Total	**21,118,085**	**17,174,352**	**81%**	**20%**

SECTION 6:

NET-TO-GROSS ANALYSIS

For this evaluation, we relied on telephone surveys of participating customers and distributors to acquire information about the influence of the program on the purchase and installation of program rebated measures. The questions asked of interviewees gathered information that allowed our evaluation team to estimate participant free-ridership to support the development of net-to-gross ratios (NTGRs) and net savings values. Below we discuss the methodology used to develop the NTGR and the results of that analysis.

6-1 BACKGROUND

The net impact methodology involves a two-step process:

- First, we estimate a net-of-free-ridership ratio for sampled projects we evaluate through analysis of surveys and/or professional in-depth interviews.
- Second, we develop a net-of-free ridership estimate for the population by extrapolating from the sampled projects to the entire population sample frame.[29]

Over the last several evaluation cycles, Net-to-Gross (NTG) analysis for Nonresidential programs used a standardized Self-Report Approach (SRA)[30] that is based on the results of self-report telephone surveys with program participants and has been in place since the 2006-2008 evaluation cycle. This PY2019 evaluation continues the use of this standard SRA framework with updates developed during PY2018, through a collaborative process by team members from both the Group A and Group D evaluations. The

[29] 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.

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

net-to-gross scoring methodology used since PY2018 has an expanded framework to address both downstream and midstream programs.

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 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 we are assessing the unique contribution of the program to the energy efficiency project's implementation. Rather than focusing only on the respondents rating of the program's importance, we ask respondents 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. The method uses a 0 to 10 scoring system for key questions used to estimate the NTGR, rather than using fixed categories with assigned weights.

6-2 NTG Approach for Downstream Programs

The SRA methodology for downstream programs consists of an average of three components, termed program attribution indices (PAI) and referred to as PAI-2, PAI-3, PAI-N6. Note that the evaluation team dropped the PAI-1 score in the PY2017 evaluation and subsequently added the PAI-N6 score in the PY2018 evaluation.[31] We score these indices from participant survey responses about the decision to install a program measure.

- **Score PAI-2** 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 the customer 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. If respondents say they had already made their decision to install the specific program qualifying measure before they

[31] For a detailed discussion on the reasoning for replacing this index, please refer to the PY2018 report: http://www.calmac.org/publications/2018_Nonresidential_ESPI_Deemed_Lighting_Impact_Evaluation_-_Final_Report_and_Appendices.pdf

learned their project was eligible for program rebates, then we reduce the program influence score by half.

- **PAI-2 Question Bank**

N2	*Did your organization make the decision to install the new energy efficient equipment before after, or at the same time as you became aware that rebates were available through the PROGRAM?*
N41	*How many of the ten points would you give to the importance of the PROGRAM in your decision?*
N42	*and how many points would you give to all of these other non-program factors?*

- **PAI-2 Score**

$$\textbf{\textit{if}}\ N2 = Before$$

$$\textbf{\textit{then}}\ PAI2 = \frac{N41}{2}$$

$$\textbf{\textit{else}}\ PAI2 = N41$$

- **Score PAI-3** 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).

- **PAI-3 Question Bank**

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 equipment that you did for this project regardless of when you would have installed it?*

- **PAI-3 Score**

$$PAI3 = 10 - N5$$

- **Score PAI-N6** captures a more specific action the respondent would have taken if the program had not been available. The action taken by the respondent gives an indication of the level of influence the program has on the customer. For instance, if the customer indicates that without the program, they would have installed equipment of lower efficiency or quantity, this indicates that the program has a degree of influence on energy savings. If, however, the customer indicates that without the program they would have kept their previous equipment, this indicates that the program has completely influenced energy savings. If the respondent indicates that without the program, they would have repaired the existing equipment, then PAI-N6 is set to missing, and the overall net-to-gross ratio is the average of PAI-2 and PAI-3. This is because the resulting efficiency of the repaired equipment is unknown, therefore we excluded this response from the analysis.

PAI-N6 Question Bank

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* *2 Install standard efficiency equipment or whatever is 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_____________)* *88 Don't know* *99 Refused*
N6a How many fewer units would you have installed? (It is okay to take an answer such as ...HALF...or 10 percent fewer ... etc.)

PAI-N6 Score

Criteria	*PAI-N6 Score*	*Score Rationale*
$\textbf{if } N6 = 1$	$\textbf{then } PAIN6 = 10 * \%\, units\ installed\ due\ to\ program\ (N6a)$	*If the customer would have installed fewer units without the program, we score them with partial credit as being a net participant,*

		proportional to the percentage of fewer units they would have installed
$\boldsymbol{if}\ N6 = 2\ OR\ N6 = 4$	$\boldsymbol{then}\ PAIN6 = 10$	*If the customer would have done nothing or installed equipment of baseline efficiency, we score them as a net participant*
$\boldsymbol{if}\ N6 = 3$	$\boldsymbol{then}\ PAIN6 = 7.5$	*If the customer would have installed more efficient equipment than code, but less than what they installed under the program, they get partial credit as being a net participant. We give a score of PAI_N6 = 7.5 based on evaluator judgement, as no specifics about what the customer would have installed are known.*
$\boldsymbol{if}\ N6 = 5$	$\boldsymbol{then}\ PAIN6 = 0$	*If the customer would have taken the same action as under the program, we score them as a free rider*
$\boldsymbol{if}\ N6 = 6$	$\boldsymbol{then}\ PAIN6\ is\ missing$	*If the customer would have repaired the existing equipment, the resulting efficiency of the repaired equipment is unknown. Therefore, the PAI_N6 score is set to missing and not used.*
$\boldsymbol{if}\ N6 = 77$	*We review the response and provide a score based on judgment, frequently a 0 or 1*	*If the customer provides another response, we review that response, and develop a score based on that response.*

When there are missing data or 'don't knows' to critical elements of each score, then we do not use that PAI score. As long as there are at least two valid PAI scores, then the overall NTGR is set equal to the average of these valid scores, divided by ten. If we can only obtain one or no valid PAI scores, then the NTGR is set to missing.

When we are able to survey a robust sample of customers, we apply our sample NTGRs to the full population of participants. However, for PG&E's Ozone Laundry and Agricultural Irrigation measures, we were only able to sample a small number of customers. Because of this, we did not apply the results from our surveyed sample to the rest of the population. Instead, we only used the ex post NTGRs for the surveyed sample and we used the ex ante NTGRs for the remaining population of participants that were not surveyed. Some of the customers we surveyed had a number of rebated applications. When this was the case, we applied the NTG result for that customer to all of their applications if, during the interview, we verified the decision-making process was the same.

Table 6-1 summarizes the sample for the PG&E Ozone Laundry and Agricultural Irrigation measures. Although the number of customer surveys is small, for the Agricultural Irrigation measure, it corresponds to a large number of applications and a large portion of the lifecycle savings. Nonetheless, regardless of the large amount of savings captured, the sample size is too small to have a representative estimate for the population. For PG&E Ozone Laundry, we interviewed four participants which correspond to 4 applications and represents 28% of savings. However, for Agricultural Irrigation, we interviewed two participants which correspond to 19 applications and represents 70% of savings.

Table 6-1: Sample Sizes for PG&E Ozone Laundry and Agricultural Irrigation

Measure	Responses	Applications	Life Cycle Gross Savings		% of Lifecycle Savings Surveyed
	n	#	Sample	Pop.	
Ozone Laundry	4	4	337,980	1,222,230	27.7%
Ag Irrigation	2	19	82,811,500	118,668,310	69.8%

6-3 Overview of NTG Approach for Midstream Programs

Downstream programs focus on delivering incentives directly to end-use customers. However, some programs target market actors 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. For midstream programs, we utilize both end-use customer surveys and vendor surveys in calculating NTGRs whenever possible.

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 that we use in the evaluation:

- **Programs that work through vendors and collect customer contact data, and where the end-user could be aware of the program (Midstream A).**
- **Programs that work entirely with vendors, but do not collect customer contact data, and where the end-user may not be aware of the program (Midstream B).**

For this evaluation, the Midstream approach as described for the Tankless Water Heaters programs applies to programs delivered through distributors that meaningfully change how they stock, promote and price program-qualified energy efficient equipment as a result of their participation in the program.

6-3-1 Midstream NTG Protocol

The evaluation of Midstream A programs involves data collection with both customers and vendors. As with Downstream programs, evaluators query customers about 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. Assessing the influence of the program on vendors involves conducting in-depth interviews with participating vendors. Evaluators need to determine if the vendor changed their practices in a way that ultimately influenced the customer's buying decision. For this evaluation, we interviewed participating distributors and asked them how the program influenced their stocking, pricing and promotion practices, and alternatively, how they would behave in the absence of the program.

In contrast, the evaluation of Midstream B programs involves data collection only with vendors. For Midstream B programs that work exclusively with vendors and do not collect customer information, telephone or web surveys with end-use customers are not feasible. Therefore, for Midstream B programs, the NTGR metric is solely based on responses from the vendor surveys.

6-4 NTG APPROACH FOR NONRESIDENTIAL MIDSTREAM SMALL/MEDIUM COMMERCIAL PROGRAMS

For this evaluation, Tankless Water Heaters are the only measure belonging to a Midstream program, where we utilize method A, and develop both customer and distributor-based estimates of program influence. In order to develop an overall estimate of the NTGR, we combine the results of the customer and distributor analyses. In cases where there are customer surveys completed that are associated with a specific distributor, we combine the customer and distributor-based estimates into a single NTGR metric, as discussed in more detail below.

6-4-1 Customer Component

For the **Customer** component, we used the standard NTG framework[32], where we conducted participating customer surveys, and used this information to calculate the customer-based NTGR.

6-4-2 Distributor Component

The **Distributor** 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 Distributor'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.**
  - **Program Importance Score Question Bank**

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 contractors and your other customers purchase the energy efficient measure at this time?

[32] See 6-2for customer NTG framework.

- Program Importance Score

$$Program\ Importance\ Score = A5$$

- **The *Relative Program Influence Score* is based on the Distributor'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.**

  - Relative Importance Score Question Bank

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?

  - Relative Importance Score

$$Relative\ Importance\ Score = A5a\ program\ factor\ score$$

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

  - No-Program Score Question Bank

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 contractors and your other customers?

  - No-Program Score

$$No\ Program\ Score = 10 - A6$$

The Distributor-based NTGR is simply the average of these three scores divided by 10. If we only obtain two valid responses, we average the two values, otherwise the NTGR is set to missing if there are not at least two valid responses.

6-4-3 Combined NTGR

Once we calculate the distributor and customer scores, the overall NTGR is determined from a combination of findings from the participating customer and participating distributor surveys as discussed below.

We interviewed 7 tankless water heater distributors that represented 90% of PG&E's population savings and 74% of SCG's population savings. The 25 tankless water heater customers we interviewed represented 4% of PG&E's population savings and 18% of SCG's population savings. Because the distributors were such a large portion of the population for PG&E and SCG, the distributor responses had the largest impact on the overall NTGR. However, we also incorporated customer responses when available, which represented a smaller portion of the population.

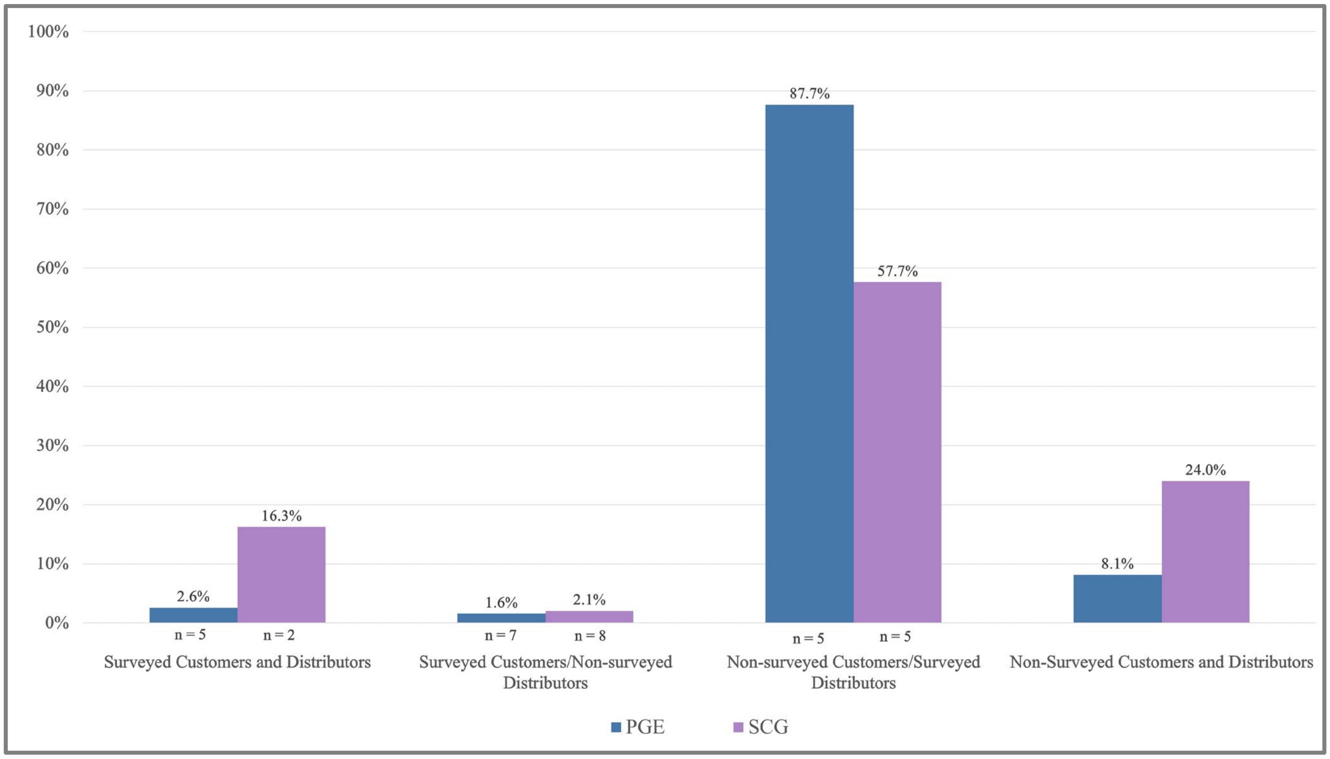
To develop the overall NTGR, we developed NTGRs in one of three ways:

- **For surveyed customers whose distributor was also interviewed, we averaged the customer NTGR with the distributor NTGR. For these NTGR values, we assigned a weight that corresponded to the customer's project ex post lifecycle therm savings.**
  - **The total weight associated with these (surveyed customers and distributors) values equaled 2.6% and 16% of PG&E and SCG's tankless water heater savings, respectively.**
- **For surveyed customers whose distributor was not interviewed, we used just the customer NTGR. For these NTGR values, we also assigned a weight that corresponded to the customer's project savings.**
  - **The total weight associated with these (surveyed customers and non-surveyed distributors) values equaled 1.6% and 2.1% of PG&E and SCG's tankless water heater savings, respectively.**
- **Because distributors did not have all of their customers interviewed, we also developed an NTGR corresponding to non-surveyed customers whose distributor was surveyed. For these NTGRs, we assigned a weight equal to all the non-surveyed customer's project savings with a surveyed distributor.**

- **The total weight associated with these (non-surveyed customer and surveyed distributors) values equaled 88% and 58% of PG&E and SCG's tankless water heater savings, respectively.**

Figure 6-1 summarizes these values, and also shows the number of distributor and customer surveys associated with each of these weights. It is important to note that there are some customers that were not surveyed, and their distributor was also not surveyed. These are also shown in Figure 6-1 and represent 8% and 24% of PG&E and SCG's savings, respectively.

Figure 6-1: Percentage of Savings and Number of Surveys by NTG Type



To develop the overall tankless water heater NTGR for each PA, we combined these three sets of NTGRs using their corresponding weights based on ex post lifecycle savings, as follows:

$$\boldsymbol{NTGR_{pa}} = \frac{\sum (\boldsymbol{W_{d,pa_i}} \times \boldsymbol{NTGR_{d,pa_i}} + \boldsymbol{W_{cd,pa_i}} \times \boldsymbol{NTGR_{cd,pa_i}} + \boldsymbol{W_{c,pa_i}} \times \boldsymbol{NTGR_{c,pa_i}})}{\sum (\boldsymbol{W_{d,pa_i}} + \boldsymbol{W_{cd,pa_i}} + \boldsymbol{W_{c,pa_i}})}$$

$\boldsymbol{Where}$

$NTGR_{pa} = overall\ weighted\ NTGR, for\ PA$

$W_{d,pa} = weight\ associated\ with\ all\ non - surveyed\ customers\ associated\ with\ an\ interviewed\ distributors, for\ PA$

$NTGR_{d,pa} = average\ distributor\ NTGR, weighted\ by\ ex\ post\ lifecycle\ savings, for\ PA$

$W_{cd,pa} = weight\ associated\ with\ customers\ that\ had\ a\ corresponding\ distributor\ interview, for\ PA$

$NTGR_{cd,pa} = average\ NTGR\ for\ customers\ that\ had\ a\ corresponding\ distributor\ interview, weighted\ by\ ex\ post\ lifecycle\ savings, for\ PA$

$W_{c,pa} = weight\ associated\ with\ customers\ that\ did\ not\ have\ a\ corresponding\ distributor, for\ PA$

$NTGR_{c,pa} = average\ NTGR\ for\ customers\ that\ did\ not\ have\ a\ corresponding\ distributor\ interview, weighted\ by\ ex\ post\ lifecycle\ savings, for\ PA$

This approach to incorporating both distributor and customer responses places more weight on the distributor responses, as the non-surveyed customers with interviewed distributors represents a large portion of the weight (as shown in Figure 6.1). This is justifiable considering that the distributors we interviewed represented 90% of PG&E's population savings and 74% of SCG's population savings. We considered other approaches where we would use the customer surveys to represent the non-surveyed population, such as using the customer responses in combination with the distributor responses to represent all customers. However, as shown in Figure 6.1, we only surveyed 7 PG&E and 8 SCG customers that also had a corresponding distributor interview. For this reason, we decided to allow the distributor responses without corresponding customer responses to remain unadjusted.

6-5 NTG RESULTS

Table 6-2 to Table 6-7 present the ex post NTGR scores by sample strata that we developed for the evaluated sampling domains using the above methodology along with the corresponding relative precision measured at the 90% confidence level. Also presented are the ex ante NTG values as well as the average PAI2, PAI3 and PAI N6 scores for each segment. We weighted these by ex post lifecycle savings. Table 6-2 presents these results for the Process Pump VFD measures.

Table 6-2 : Process Pump VFD – Ex Ante and Ex Post Net-To-Gross Ratios and PAI Scores

PA	Measure Type	Surveyed Responses	Surveyed Applications	NTGR*			PAI Score		
		n	#	Ex Ante	Ex Post	RP	PAI2	PAI3	PAI N6
PG&E	Booster	21	24	0.60	0.26	15%	3.8	1.5	2.0
PG&E	Well	34	38	0.60	0.28	9%	3.6	1.9	3.4
SCE	Overall	11	13	0.60	0.46	14%	6.2	3.4	4.6

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

Table 6-3 and

Table 6-4 present the results for the Ozone Laundry and Agricultural Irrigation measures, respectively. Recall from above that these PG&E Ozone Laundry and Agricultural Irrigation measures had very small sample sizes and that we did not use the customer responses to represent the remaining population of participants that we did not survey. Because of this, we are not presenting the relative precisions associated with those two measures.

Table 6-3: Ozone Laundry – Ex Ante and Ex Post Net-To-Gross Ratios and PAI Scores

PA	Surveyed Responses	Surveyed Applications	NTGR*			PAI Score		
	n	#	Ex Ante	Ex Post	RP	PAI2	PAI3	PAI N6
PG&E	4	4	0.60	0.55[33]	NA	6.0	0.5	0.5
SCG	9	46	0.60	0.79	8%	7.6	6.9	9.4
SDG&E	7	8	0.60	0.73	4%	6.1	8.6	9.1

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

Table 6-4: Agricultural Irrigation – Ex Ante and Ex Post Net-To-Gross Ratios and PAI Scores

PA	Surveyed Responses	Surveyed Applications	NTGR*		PAI Score		
	n	#	Ex Ante	Ex Post[34]	PAI2	PAI3	PAI N6
PG&E	2	19	0.50	0.58	6.1	4.5	7.7

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

Table 6-5 presents the NTGRs for Tankless Water Heaters by PA. Table 6-6 and Table 6-7 provide the supporting PAI scores and vendor component scores for the customers and distributors, respectively. Also shown are summaries of the sample that supported these values, including the number of customers and distributors, the corresponding savings, and the percentage of the respective populations that they represent.

[33] As mentioned in the report, this PG&E Ozone Laundry NTGR is not a sample based estimate, but an average of the ex ante NTGR and four survey based NTGRs, weighted by lifecycle gross expost savings. For this reason there is no RP.

[34] As mentioned in the report, this PG&E Agricultural Irrigation NTGR is not a sample based estimate, but an average of the ex ante NTGR and two survey based NTGRs, weighted by lifecycle gross expost savings. For this reason there is no RP.

Table 6-5: Tankless Water Heaters – Combined Customer and Distributor NTGR

PA	NTGR*		
	Ex Ante	Ex Post	Relative Precision
PG&E	0.57	0.56	3%
SCG	0.60	0.72	3%

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

Table 6-6: Tankless Water Heaters – Customer Table

PA	Surveyed Responses	Surveyed Applications	% Customers Surveyed		Life Cycle Gross Savings		PAI Score		
	n	#	% N	% Savings	Sample	Pop.	PAI2	PAI3	PAI N6
PG&E	12	12	4%	4%	567,855	13,577,725	2.9	2.7	1.2
SCG	13	81	14%	18%	1,381,890	7,540,360	5.3	3.0	2.0

Table 6-7: Tankless Water Heaters – Distributor Table

PA	Surveyed Responses	Surveyed Applications	% Customers Surveyed		Life Cycle Gross Savings		Vendor Score		
	n	#	% N	% Savings	Sample	Pop.	Score 1	Score 2	Score 3
PG&E	5	240	89%	90%	12,259,562	13,577,725	9.7	5.3	2.2
SCG	2	444	79%	74%	5,573,611	7,540,360	10.0	6.1	7.0

Table 6-8 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, we would apply results consistently statewide and vary by program delivery mechanism. The table presents the NTGRs by delivery approach when the data could support an estimate at that level. Because of the small sample size issue for Agricultural Irrigation, we do not provide results for this measure.

Table 6-8: Recommended Statewide DEER NTG Values Based on Evaluated Results

Measure Type	Overall	Deemed Downstream	Deemed Midstream
Process Pumping VFDs	0.34	0.34	---
Tankless Water Heating	0.62	---	0.62
Ozone Laundry	0.70	0.70	--

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

6-5-1 Process Pumping VFD Measure Group

PG&E NTGR Results

- **The ex post NTGRs associated with Booster Pumps and Well Pumps were 0.26 and 0.28, respectively.** We created separate sampling strata for PG&E Process Pump VFD applications -- Booster pumps and Well pumps. For Booster pumps, we completed 21 interviews representing 24 applications, and we completed 34 interviews covering 38 applications for Well pumps.

- **These values are 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 4 in all cases, reinforcing the program's weak influence for this measure.

SCE NTGR Results

- **The overall ex post NTGR for SCE was 0.46.** For SCE, sampling strata for NTG estimates were not segregated by Booster and Well categories, since there was insufficient sample to support a separate statistically-valid NTGR determination by pump type category. We completed a total of 11 interviews consisting of 13 applications. We pooled results by pump type into a single category, SCE Process Pumping VFDs.

- **The SCE NTGR demonstrates a medium-low 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, where PAI2 had the greatest value, at 6.2, and PAI3 had the lowest value, at 3.4.

6-5-2 Ozone Laundry Measure Group

PG&E NTGR Results

- **The overall ex post NTGR for PG&E was 0.55.** For PG&E Ozone Laundry measures, we completed a total of 4 NTG surveys, representing 4 applications. The sample sizes were not sufficient to generate population based NTGR estimates. Therefore, ex post NTGRs were applied to projects that completed an interview, and the ex ante NTGR of 0.60 was passed through for the remaining projects. The four PG&E surveys that we completed represented 28% of PG&E's savings.
- **The PG&E NTGR is based primarily on pass-through ex ante values, explaining why the value is close to the 0.60 ex ante NTGR.** The four customers that we interviewed had little impact on overall savings, resulting in an overall NTGR that is very close to ex ante. The four interviewed customers, however, had relatively low NTGRs, reflected by their PAI scores: PAI-2 of 6.0, PAI-3 of 0.5, and PAI-N6 of 0.5.

SCG NTGR Results

- **The overall ex post NTGR for SCG was 0.79.** For SCG Ozone Laundry measures, we completed a total of 9 NTG surveys, representing 46 applications.
- **This NTGR is substantially higher than the 0.60 ex ante NTGR**. Average PAI scores were very strong for these customers, with PAI-2 of 7.6, PAI-3 of 6.9 and PAI-N6 of 9.4.

SDG&E NTGR Results

- **The overall ex post NTGR for SDG&E was 0.73.** For SDG&E Ozone Laundry measures, we completed a total of 7 NTG surveys, representing 8 applications.
- **This NTGR is substantially higher than the 0.60 ex ante NTGR**. Average PAI scores were very strong for these customers, with PAI-2 of 6.1, PAI-3 of 8.6 and PAI-N6 of 9.1.

6-5-3 Agricultural Irrigation Measure Group

PG&E NTGR Results

- **The overall ex post NTGR for PG&E was 0.58.** For the Agricultural Irrigation measure, there was a single sampling stratum for PG&E. We completed a total of two NTG surveys, representing 19 applications. As discussed, because we only interviewed two customers, we decided to pass through the ex ante NTGR of 0.50 for projects without surveys.

- **This NTGR is somewhat higher than the 0.50 ex ante NTGR**. The two surveyed participants strongly influenced this overall result, as they represented 70% of PG&E's savings. Average PAI scores were very strong for these two customers, with PAI-2 of 8.9, PAI-3 of 8.0 and PAI-N6 of 10.

6-5-4 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 under the Midstream A approach where both customer and distributor contact information was made available.

PG&E NTGR Results

- **The overall ex post NTGR for PG&E was 0.56.** The NTGR for PG&E tankless water heaters is based on the results of the surveys completed by 5 distributors and 12 customers. The completed surveys represent 92% of PG&E's savings.

- **This NTGR is nearly identical to the ex ante NTGR of 0.57.** It is notable that the PG&E weighted average vendor scores show wide variation and range from a low value of 2.2 for Score 3 to a high value of 9.7 for Score 1. The PAI customer scores rank much lower, where the highest PAI score for PG&E is 2.9.

SCG NTGR Results

- **The overall ex post NTGR for SCG was 0.72.** The NTGR for SCG tankless water heaters is based on the results of the surveys completed by 2 distributors and 13 customers. The completed surveys represent 76% of SCG's savings.

- **This NTGR is considerably higher than the ex ante NTGR of 0.60.** The SCG weighted average vendor scores are higher than PG&E's vendor scores, where the lowest score is 6.1 for Score 2 and 10.0 for Score 1. The PAI customer scores rank much lower, where the highest PAI score for SCG is 5.3.

SECTION 7:

EVALUATION RESULTS

This section of the report presents the gross and net realization rates that our evaluation team developed for the 2019 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, where applicable.

7-1 GROSS FIRST YEAR REALIZATION RATES

Our 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). We 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, we applied the resulting GRR 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. Our measure group GRR results are based on the summed ratio of ex post impacts divided by ex ante impacts. In Table 7-1 and Table 7-2 below we 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. We also present the corresponding relative precision at the 90% confidence interval.[35]

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
Ozone Laundry Equipment	1,097,924	853,494	0.78	6%
Tankless Water Heaters	1,055,904	858,717	0.81	20%

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
Agricultural Pump VFDs	11,844	9,761	0.82	22%	6.0	1.3	0.22	50%
Agricultural Drip Irrigation	5,933	1,901	0.32	23%	4.7	0.8	0.18	27%

7-2 Gross Lifecycle Realization Rates

In Table 7-3 and Table 7-4 we 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. We also present the corresponding relative precision at the 90% confidence interval.

[35] 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% confidence level.

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
Ozone Laundry Equipment	10,979,241	8,534,943	0.78	6%
Tankless Water Heaters	21,118,085	17,174,352	0.81	20%

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
Agricultural Pump VFDs	44,686	91,283	2.04	24%	22.7	11.5	0.51	54%
Agricultural Drip Irrigation	118,668	38,030	0.32	23%	94.2	17.0	0.18	27%

7-3 NET FIRST YEAR REALIZATION RATES

Our 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.

In Table 7-5 and Table 7-6 below we 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
Ozone Laundry Equipment	713,651	677,478	0.95	8%
Tankless Water Heaters	667,891	593,238	0.89	20%

** 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
Agricultural Pump VFDs	7,699	3,377	0.44	23%	3.9	0.5	0.12	50%
Agricultural Drip Irrigation	3,264	1,195	0.37	23%	2.6	0.5	0.21	27%

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

7-4 NET LIFECYCLE REALIZATION RATES

In Table 7-7 and Table 7-8 we 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. We also present the corresponding relative precision at the 90% confidence interval.

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
Ozone Laundry Equipment	7,136,507	6,774,782	0.95	8%
Tankless Water Heaters	13,357,829	11,864,760	0.89	20%

** 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
Agricultural Pump VFDs	29,046	31,774	1.09	25%	14.7	4.1	0.28	54%
Agricultural Drip Irrigation	65,279	23,892	0.37	23%	51.8	10.7	0.21	27%

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

SECTION 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 OZONE LAUNDRY

Conclusion (Section 5) POL1: The addition of ozone laundry equipment is generally an effective technology for reducing hot water used by laundry equipment, resulting in energy savings. With ozone laundry equipment in place, laundry cycles are typically completed using less hot water, and the hot water temperature setpoint for the water heating system is lowered. Both factors combined contribute to a reduction in natural gas used to heat water, in a water heater or boiler that provides hot water to a given laundry facility. Furthermore, the ozone that is introduced into the water supply used by laundry equipment enhances sanitation, including the destruction of microorganisms, like bacteria and viruses, that can cause disease. The measures' dual effectiveness in combating climate change through energy savings and reducing the likelihood of contagious disease outbreaks makes this technology highly attractive as a program offering.

> **Recommendation POL1 [PG&E, SCG and SDG&E]: We recommend that this technology not only continue to be offered by the programs, but that the PAs increase participation levels through additional marketing and outreach supporting uptake of ozone laundry equipment.**

Conclusion (Section 5) POL2: Out of a total sample size of 35 sites we sampled 1 San Diego Gas and Electric (SDG&E) project, with a program-based savings estimate that accounts for 37% of all reported savings across all PAs.

While this project had great potential to save energy using ozone laundry equipment, the customer did not substantially adjust the hot water use per laundry load or change the water temperature settings, which resulted in a gross savings realization rate for this project of just 5%. While the resulting downward effect on the overall realization rate is substantial, the statewide result is still decent at nearly 80% of the reported savings. However, the effect on realized SDG&E savings is much greater, resulting in a realization rate of just 36%.

It is also notable that this business does not appear to be eligible to participate. This participating business supplies linens and work uniforms. The relevant SDG&E workpaper only allows participation in fitness, nursing home, correctional and hotel/motel facilities.

> **Recommendation POL2 [PG&E, SCG and SDG&E]: We recommend that large-scale projects of this nature are better served through a custom program channel where site-level reported savings are adequately vetted through the program application process.** Using a custom channel instead of a deemed program approach would likely have produced a more reliable estimate of PA-reported savings for this project. Custom program projects typically undergo a more rigorous verification of operating conditions that are in-turn incorporated within the project saving estimates.

Conclusion (Section 5) POL3: Ozone laundry equipment installations are not always properly screened for eligibility requirements. We found that two of our sample points replaced existing ozone laundry equipment with new equipment. The replaced ozone laundry equipment have equivalent functionality to the newly installed ozone laundry equipment, resulting in no savings being realized by the grid. CPUC policy does not allow programs to install like-for-like energy efficiency replacements. It is also notable that the program standards exclude eligibility for replacing ozone laundry equipment.

> **Recommendation POL3 [PG&E, SCG and SDG&E]: The program's application and review process should be enhanced to better screen projects against eligibility requirements and exclusions.**

Conclusion (Section 5) POL4: The percent reduction in hot water use, the number of laundry cycles per day and the reduction in hot water temperature settings generally brought down the resulting realization rate for SDG&E.

> **Recommendation POL4 [PG&E, SCG and SDG&E]: We recommend that the programs strengthen program requirements surrounding percent reduction in hot water use, number of laundry cycles per day and the reduction in hot water temperature settings to ensure adequate savings for all participating projects.**

Conclusion (Section 5) POL5: We selected ex post model-based parameters to present in Chapter 5 on the basis that they would be most useful to any future workpaper updates. In fact, several of the factors we presented do currently contribute to workpaper-based savings estimates. Also shown are ex post unit energy savings values expressed in a way that parallels ex ante workpaper values that are applied to the tracking data (expressed per pound of laundry machine capacity).

> **Recommendation POL5 [PG&E, SCG and SDG&E]: In support of any future workpaper updates for ozone laundry measures, it is recommended that the PA workpaper team mines this data source and applies our findings where feasible and, as noted above, modify program requirements to ensure all projects deliver adequate program savings.** Furthermore, our evaluation team has assembled a model for estimating ozone laundry equipment savings, and in doing so has amassed industry knowledge, tools and experience that can be shared with the workpaper team in order to hopefully improve the accuracy of resulting workpaper-based savings estimates and better align PA and evaluation results.

Conclusion (Section 5) POL6: In some cases we found that the gross impact sample and participants in the program tracking data do not always conform with program business type eligibility requirements.

Interestingly, these eligibility criteria are found to vary across PA workpapers, but the universe of eligible businesses includes hotel/motel, health facilities, nursing homes, correctional facilities and fitness centers. Within the sample exceptions to this include a commercial laundry, a party rental store, a linen and work apparel supplier and lodging facilities (that are not hotel/motels). In fact, we even observed business type exceptions to the eligible business list using business type variables available in the program tracking system.

> **Recommendation POL6 [PG&E, SCG and SDG&E]: We recommend that the program either better screen businesses for eligibility based on business type, or if warranted, expand the availability of businesses that can participate.** We also recommend better alignment among the PA workpapers in terms of businesses that are eligible and a consensus on why.

8-2 PROCESS PUMPING VFD MEASURES

Conclusion PPVFD1 [Section 5]: We found that VFD controls installed through the programs are not being properly screened in many cases for eligibility criteria.

Out of a total sample size of 45 pumps, commonly observed reasons for failing eligibility requirements includes the installation of speed controls in the following cases:

- 5 pumps run fewer than 1,000 hours per year
- 2 pumps pump well water into a water storage reservoir or trucks
- 12 pumps have settings that are at or near full load
- 4 pumps that previously ran uncontrolled.

Many of the VFDs are installed on new pumps that irrigate trees that have been planted in the last couple of years; this results in low run hours, many below 500 hours per year.

> **Recommendation PPVFD1 [PG&E, SCE and SDG&E]: The program's application and review process should be enhanced to better screen projects against eligibility requirements and exclusions.**

Conclusion PPVFD2 [Section 5]: In most cases, pump operations can be readily characterized using interval billing data, such as hourly demand measurements for a given pump. In fact, our evaluation applied interval billing data as a key model input used to determine VFD savings.

> **Recommendation PPVFD2a [PG&E, SCE and SDG&E]: We recommend that the programs make use of interval billing data 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.**

> **Recommendation PPVFD2b [PG&E, SCE and SDG&E]: The PAs should continue to track and report Service Account IDs (SAID) of meters that are affected by VFD installation.** Overall, the PAs did a good job of identifying the affected customers meters and accounts where loads were affected by VFD installation, but there were a few instances where this was not the case. Best practice would be to ensure that each record in the tracking system has an SAID that corresponds with the installed VFD/pump.

Conclusion PPVFD3 [Section 5]: Beside 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.

> **Recommendation PPVFD3 [PG&E, SCE and SDG&E]: For these reasons, we recommend that the appropriate baseline be determined as a function of pump type and size.** Current deemed savings estimates assume a throttle valve flow control baseline, in which partially closed valves

are used to control pump flow. However, this assumed baseline ignores the fact that VFD flow controls are commonly installed, even without the influences of program intervention.

Conclusion PPVFD4 [Section 5]: The workpaper-based estimates of savings currently draw results from a database of legacy custom and new construction projects involving pump VFDs. Our evaluation has assembled stipulated parameter values and results, including the following: operating hours, pump load distribution, assumed baseline condition, motor efficiency, VFD efficiency, pump OPE and the assumed affinity law exponent. Our evaluation also reported metric-based per-unit results that should prove useful to workpaper updates, in addition to updating the parameters noted above.

Recommendation PPVFD4a [PG&E, SCE and SDG&E]: We recommend that the results of this evaluation, and any trends observed, should be considered for any workpaper updates for the agricultural pump VFD measures, in order to improve the accuracy of future workpaper estimates.

Recommendation PPVFD4b [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. We recommend that the PAs consider including fields within the project application forms for estimated pump runtime, the acreage of the field to be served by the pump, the crop being served, irrigation end-point type (drip, sprinkler, flood), OPE, etc. The PAs should make use of those data to fine tune ex ante savings values to better 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 PPVFD4c [PG&E, SCE and SDG&E]: We recommend that the PAs consider using an enhanced deemed 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 of 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, crop-specific irrigation requirements, for example, could be used to better characterize and differentiate the measure savings algorithms. Continuing to use a database of legacy ex ante pump VFD results will likely continue to misrepresent realized program savings.

Conclusion PPVFD5 [Section 5]: Across both the PG&E and SCE samples (45 pumps), there were only 2 pumps where evaluation-based EUL assignments matched those applied by the PAs 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). The PAs are also not successfully differentiating EULs based on the pumps being new, where application of a 10-year EUL is appropriate.

Recommendation PPVFD5 [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. The utilities EUL estimates demonstrate some level of confusion surrounding proper us of DEER database resources.

8-3 AGRICULTURAL IRRIGATION

Conclusion AG1 [Section 5]: The agricultural drip irrigation measure is no longer offered through Pacific Gas and Electric (PG&E) programs. PG&E gradually altered the measure's eligibility requirements to accommodate specific irrigation technologies and crop types for which low-pressure irrigation was not yet a standard practice. By sunsetting the final eligible technology—drip tape irrigation at farms growing field vegetables—PG&E has deemed low-pressure irrigation to be standard practice throughout northern California.

Recommendation AG1 [PG&E]: We recommend that the agricultural irrigation realization rates and NTGRs presented in this evaluation report should not be applied prospectively to other agricultural irrigation measures. The drip irrigation measure was uniquely conducive to downstream distribution at scale. As a result, its gross and net performance does not serve as a reliable proxy for other agricultural measures such as irrigation pump upgrades.

Conclusion AG2 [Section 5]: The PA 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 our evaluated savings relative to the PA reported savings. For example, almost all of the 19 evaluated drip irrigation projects were a unique combination of the following parameters which were not considered in the PAs' 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 PAs' reported savings did not consider these factors, the savings values were inaccurate and generally overstated.

Recommendation AG2 [PG&E]: Should the drip irrigation measure reemerge, we recommend that future deemed savings estimates claims should be derived using evaluation data and results. The PAs should leverage findings from previous evaluations to refine model inputs and assumptions, correct errors and omissions, and otherwise improve the accuracy of reported savings for drip irrigation technologies. This will ensure better alignment between reported savings and evaluation-based savings results.

Conclusion AG3 [Section 5]: The PA reported savings overstated how long the equipment will last following installation. PG&E assumes the equipment will last 20 years based on the default value considered for agricultural irrigation pumps. We found that the drip irrigation equipment are often replaced more frequently than the pumps to conserve both water and energy.

Recommendation AG3 [PG&E]: While the evaluated drip irrigation measure is no longer offered by PG&E, we recommend for future measures that involve drip irrigation or similar upgrades that useful life estimates should reflect the expected life of the program-installed irrigation emitters, not the associated irrigation pump.

8-4 Tankless Water Heaters

Conclusion TWH1 [Section 5]: For many of the tankless water heaters evaluated, program tracking data did not provide sufficient information. For approximately 45% of projects in the population, we did not have sufficient participant contact data to verify water heater installations or evaluate savings. As a result, we expanded our evaluation recruitment pool and ultimately exceeded the target sample count. We are encouraged by the slight improvement in recent tracking data quality as compared to our previous experiences.

> **Recommendation TWH1 [PG&E, SCG]: We recommend that the PAs require participating distributors and partnering contractors to collaboratively collect and submit basic information for each customer ultimately receiving the equipment or other program support.** As noted above, this appears to be most challenging to accomplish for installed equipment that are delivered by the programs through retail or other equipment supplier sources, in contrast with equipment that are installed directly by contractors and should therefore be an area of focus for implementing this recommendation. This basic information is critical for the PAs, the CPUC, and its contractors to verify installations and maintain the integrity of ratepayer incentive dollars.

Conclusion TWH2 [Section 5]: We determined that 9 of the 51 evaluated projects either never saved energy or no longer save energy. Three claimed projects occurred at facilities that have since permanently closed, and six projects were claimed at service addresses that had no evidence of recent tankless water heater installations. These projects resulted in zero savings and significantly reduced overall realized program savings.

> **Recommendation TWH2 [PG&E, SCG]: We recommend that programs should 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.** This appears to be most challenging to accomplish for installed equipment that are delivered by the programs through retail or other equipment supplier sources, in contrast with equipment that are installed directly by contractors, and should therefore be an area of focus for implementing this recommendation.

Conclusion TWH3 [Section 5]: Twenty-nine of the 51 evaluated projects applied incorrect per-unit savings values or misclassified the type of facility in which the measure was installed. Correcting these errors resulted in slightly lower estimated savings.

> **Recommendation TWH3 [PG&E, SCG]: We recommend that the PAs redouble efforts to ensure that reported savings estimates are based on the correct application of per-unit deemed savings values.** We attribute these observed errors to the following: erroneous application of the wrong result, or mis-specification of the facility type, climate zone, water heater size, or efficiency tier.

Conclusion TWH4 [Section 5]: We found that water heaters operated at different temperatures than assumed in the applicable workpapers, which negatively affected the savings estimates. However, we also found that the installed water heaters were rated at higher efficiencies than assumed. Overall, the positive effects from increased efficiency outweighed the negative effects due to operating temperatures, resulting in an overall increase in savings.

> **Recommendation TWH4 [PG&E and SCG]: We recommend that future workpaper revisions incorporate recent evaluation results when available.** This will ensure better alignment between reported savings and evaluation-based savings. We note that the evaluated DHW temperatures presented in Table 5-36 include five cases of closed-loop systems that reduced the TWH's change in temperature. These five points should be excluded from prospective workpaper values if the programs screen out ineligible closed-loop systems as intended.

APPENDIX AA:

STANDARDIZED REPORTING TABLES

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	201,628	201,628	1.00	100.0%	
PGE	PGE - AG IRRIGATION	118,668	38,030	0.32	0.0%	0.32
PGE	PGE - AGRICULTURAL PUMP VFD	34,798	81,676	2.35	0.0%	2.35
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	2,740	2,740	1.00	100.0%	
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0	0			
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	11	7	0.64	0.0%	0.64
PGE	**Total**	**357,845**	**324,081**	**0.91**	**57.1%**	**0.78**
SCE	PASS THROUGH	43,678	43,678	1.00	100.0%	
SCE	SCE - AGRICULTURAL PUMP VFD	9,888	9,607	0.97	0.0%	0.97
SCE	**Total**	**53,566**	**53,285**	**0.99**	**81.5%**	**0.97**
SCG	PASS THROUGH	1,103	1,103	1.00	100.0%	
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0	0			
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0			
SCG	**Total**	**1,103**	**1,103**	**1.00**	**100.0%**	
SDGE	PASS THROUGH	2,870	2,870	1.00	100.0%	
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	321	321	1.00	100.0%	
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0	0			
SDGE	**Total**	**3,191**	**3,191**	**1.00**	**100.0%**	
MCE	PASS THROUGH	55	55	1.00	100.0%	
MCE	**Total**	**55**	**55**	**1.00**	**100.0%**	
LCE	PASS THROUGH	51	51	1.00	100.0%	
LCE	**Total**	**51**	**51**	**1.00**	**100.0%**	
	Statewide	***415,810***	***381,765***	***0.92***	***60.7%***	***0.79***

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	134,388	134,388	1.00	100.0%	0.67	0.67		
PGE	PGE - AG IRRIGATION	65,279	23,892	0.37	0.0%	0.55	0.63	0.55	0.63
PGE	PGE - AGRICULTURAL PUMP VFD	22,619	26,839	1.19	0.0%	0.65	0.33	0.65	0.33
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	1,781	1,781	1.00	100.0%	0.65	0.65		
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0	0						
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	7	4	0.60	0.0%	0.65	0.61	0.65	0.61
PGE	**Total**	**224,074**	**186,905**	**0.83**	**60.8%**	**0.63**	**0.58**	**0.57**	**0.42**
SCE	PASS THROUGH	29,173	29,173	1.00	100.0%	0.67	0.67		
SCE	SCE - AGRICULTURAL PUMP VFD	6,427	4,935	0.77	0.0%	0.65	0.51	0.65	0.51
SCE	**Total**	**35,600**	**34,108**	**0.96**	**81.9%**	**0.66**	**0.64**	**0.65**	**0.51**
SCG	PASS THROUGH	742	742	1.00	100.0%	0.67	0.67		
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0	0						
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0						
SCG	**Total**	**742**	**742**	**1.00**	**100.0%**	**0.67**	**0.67**		
SDGE	PASS THROUGH	1,893	1,893	1.00	100.0%	0.66	0.66		
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	241	241	1.00	100.0%	0.75	0.75		
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0	0						
SDGE	**Total**	**2,133**	**2,133**	**1.00**	**100.0%**	**0.67**	**0.67**		
MCE	PASS THROUGH	49	49	1.00	100.0%	0.90	0.90		
MCE	**Total**	**49**	**49**	**1.00**	**100.0%**	**0.90**	**0.90**		
LCE	PASS THROUGH	33	33	1.00	100.0%	0.65	0.65		
LCE	**Total**	**33**	**33**	**1.00**	**100.0%**	**0.65**	**0.65**		
	Statewide	***262,632***	***223,970***	***0.85***	***64.1%***	***0.63***	***0.59***	***0.58***	***0.43***

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	26.8	26.8	1.00	100.0%	
PGE	PGE - AG IRRIGATION	94.2	17.0	0.18	0.0%	0.18
PGE	PGE - AGRICULTURAL PUMP VFD	17.8	10.0	0.56	0.0%	0.56
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	0.0	0.0			
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0.0	0.0			
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0.0	0.0	0.64	0.0%	0.64
PGE	**Total**	**138.8**	**53.8**	**0.39**	**19.3%**	**0.24**
SCE	PASS THROUGH	7.0	7.0	1.00	100.0%	
SCE	SCE - AGRICULTURAL PUMP VFD	4.9	1.5	0.31	0.0%	0.31
SCE	**Total**	**11.9**	**8.5**	**0.72**	**59.0%**	**0.31**
SCG	PASS THROUGH	0.0	0.0	1.00	100.0%	
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0.0	0.0			
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0.0	0.0			
SCG	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
SDGE	PASS THROUGH	0.4	0.4	1.00	100.0%	
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	0.2	0.2	1.00	100.0%	
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0.0	0.0			
SDGE	**Total**	**0.5**	**0.5**	**1.00**	**100.0%**	
MCE	PASS THROUGH	0.0	0.0	1.00	100.0%	
MCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
LCE	PASS THROUGH	0.0	0.0	1.00	100.0%	
LCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
	Statewide	***151.2***	***62.9***	***0.42***	***22.7%***	***0.24***

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	17.7	17.7	1.00	100.0%	0.66	0.66		
PGE	PGE - AG IRRIGATION	51.8	10.7	0.21	0.0%	0.55	0.63	0.55	0.63
PGE	PGE - AGRICULTURAL PUMP VFD	11.6	3.3	0.28	0.0%	0.65	0.33	0.65	0.33
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	0.0	0.0						
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0.0	0.0						
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0.0	0.0	0.60	0.0%	0.65	0.61	0.65	0.61
PGE	**Total**	**81.1**	**31.6**	**0.39**	**21.8%**	**0.58**	**0.59**	**0.57**	**0.52**
SCE	PASS THROUGH	4.7	4.7	1.00	100.0%	0.67	0.67		
SCE	SCE - AGRICULTURAL PUMP VFD	3.2	0.8	0.25	0.0%	0.65	0.51	0.65	0.51
SCE	**Total**	**7.8**	**5.5**	**0.70**	**59.7%**	**0.66**	**0.64**	**0.65**	**0.51**
SCG	PASS THROUGH	0.0	0.0	1.00	100.0%	0.75	0.75		
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0.0	0.0						
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	0.3	0.3	1.00	100.0%	0.66	0.66		
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	0.1	0.1	1.00	100.0%	0.75	0.75		
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0.0	0.0						
SDGE	**Total**	**0.4**	**0.4**	**1.00**	**100.0%**	**0.68**	**0.68**		
MCE	PASS THROUGH	0.0	0.0	1.00	100.0%	0.90	0.90		
MCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.90**	**0.90**		
LCE	PASS THROUGH	0.0	0.0	1.00	100.0%	0.65	0.65		
LCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.65**	**0.65**		
	Statewide	***89.3***	***37.5***	***0.42***	***25.5%***	***0.59***	***0.60***	***0.57***	***0.52***

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	69,528	69,528	1.00	100.0%	
PGE	PGE - AG IRRIGATION	0	0			
PGE	PGE - AGRICULTURAL PUMP VFD	0	0			
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	0	0			
PGE	PGE - OZONE LAUNDRY EQUIPMENT	1,222	1,221	1.00	0.0%	1.00
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	13,578	8,670	0.64	0.0%	0.64
PGE	**Total**	**84,328**	**79,420**	**0.94**	**82.4%**	**0.67**
SCE	PASS THROUGH	787	787	1.00	100.0%	
SCE	SCE - AGRICULTURAL PUMP VFD	0	0			
SCE	**Total**	**787**	**787**	**1.00**	**100.0%**	
SCG	PASS THROUGH	61,641	61,641	1.00	100.0%	
SCG	SCG - OZONE LAUNDRY EQUIPMENT	5,103	5,656	1.11	0.0%	1.11
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	7,540	8,504	1.13	0.0%	1.13
SCG	**Total**	**74,285**	**75,801**	**1.02**	**83.0%**	**1.12**
SDGE	PASS THROUGH	374	374	1.00	100.0%	
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	0	0			
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	4,654	1,658	0.36	0.0%	0.36
SDGE	**Total**	**5,028**	**2,032**	**0.40**	**7.4%**	**0.36**
MCE	PASS THROUGH	-1	-1	1.00	100.0%	
MCE	**Total**	**-1**	**-1**	**1.00**	**100.0%**	
LCE	PASS THROUGH	0	0			
LCE	**Total**	**0**	**0**			
	Statewide	***164,427***	***158,039***	***0.96***	***80.5%***	***0.80***

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	45,354	45,354	1.00	100.0%	0.65	0.65		
PGE	PGE - AG IRRIGATION	0	0						
PGE	PGE - AGRICULTURAL PUMP VFD	0	0						
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	0	0						
PGE	PGE - OZONE LAUNDRY EQUIPMENT	794	734	0.92	0.0%	0.65	0.60	0.65	0.60
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	8,457	5,311	0.63	0.0%	0.62	0.61	0.62	0.61
PGE	**Total**	**54,605**	**51,399**	**0.94**	**83.1%**	**0.65**	**0.65**	**0.63**	**0.61**
SCE	PASS THROUGH	512	512	1.00	100.0%	0.65	0.65		
SCE	SCE - AGRICULTURAL PUMP VFD	0	0						
SCE	**Total**	**512**	**512**	**1.00**	**100.0%**	**0.65**	**0.65**		
SCG	PASS THROUGH	42,643	42,643	1.00	100.0%	0.69	0.69		
SCG	SCG - OZONE LAUNDRY EQUIPMENT	3,317	4,756	1.43	0.0%	0.65	0.84	0.65	0.84
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	4,901	6,554	1.34	0.0%	0.65	0.77	0.65	0.77
SCG	**Total**	**50,861**	**53,952**	**1.06**	**83.8%**	**0.68**	**0.71**	**0.65**	**0.80**
SDGE	PASS THROUGH	251	251	1.00	100.0%	0.67	0.67		
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	0	0						
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	3,025	1,285	0.42	0.0%	0.65	0.78	0.65	0.78
SDGE	**Total**	**3,276**	**1,536**	**0.47**	**7.7%**	**0.65**	**0.76**	**0.65**	**0.78**
MCE	PASS THROUGH	-1	-1	1.00	100.0%	0.90	0.90		
MCE	**Total**	**-1**	**-1**	**1.00**	**100.0%**	**0.90**	**0.90**		
LCE	PASS THROUGH	0	0						
LCE	**Total**	**0**	**0**						
	Statewide	***109,253***	***107,398***	***0.98***	***81.2%***	***0.66***	***0.68***	***0.64***	***0.73***

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	19,294	19,294	1.00	100.0%	
PGE	PGE - AG IRRIGATION	5,933	1,901	0.32	0.0%	0.32
PGE	PGE - AGRICULTURAL PUMP VFD	10,545	8,843	0.84	0.0%	0.84
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	548	548	1.00	100.0%	
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0	0			
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	1	0	0.64	0.0%	0.64
PGE	**Total**	**36,321**	**30,587**	**0.84**	**54.6%**	**0.65**
SCE	PASS THROUGH	6,836	6,836	1.00	100.0%	
SCE	SCE - AGRICULTURAL PUMP VFD	1,299	918	0.71	0.0%	0.71
SCE	**Total**	**8,136**	**7,754**	**0.95**	**84.0%**	**0.71**
SCG	PASS THROUGH	150	150	1.00	100.0%	
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0	0			
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0			
SCG	**Total**	**150**	**150**	**1.00**	**100.0%**	
SDGE	PASS THROUGH	304	304	1.00	100.0%	
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	32	32	1.00	100.0%	
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0	0			
SDGE	**Total**	**336**	**336**	**1.00**	**100.0%**	
MCE	PASS THROUGH	14	14	1.00	100.0%	
MCE	**Total**	**14**	**14**	**1.00**	**100.0%**	
LCE	PASS THROUGH	13	13	1.00	100.0%	
LCE	**Total**	**13**	**13**	**1.00**	**100.0%**	
	Statewide	***44,970***	***38,854***	***0.86***	***60.5%***	***0.66***

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	12,848	12,848	1.00	100.0%	0.67	0.67		
PGE	PGE - AG IRRIGATION	3,264	1,195	0.37	0.0%	0.55	0.63	0.55	0.63
PGE	PGE - AGRICULTURAL PUMP VFD	6,854	2,906	0.42	0.0%	0.65	0.33	0.65	0.33
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	356	356	1.00	100.0%	0.65	0.65		
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0	0						
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0	0	0.60	0.0%	0.65	0.61	0.65	0.61
PGE	**Total**	**23,322**	**17,305**	**0.74**	**56.6%**	**0.64**	**0.57**	**0.61**	**0.38**
SCE	PASS THROUGH	4,512	4,512	1.00	100.0%	0.66	0.66		
SCE	SCE - AGRICULTURAL PUMP VFD	845	472	0.56	0.0%	0.65	0.51	0.65	0.51
SCE	**Total**	**5,356**	**4,983**	**0.93**	**84.2%**	**0.66**	**0.64**	**0.65**	**0.51**
SCG	PASS THROUGH	100	100	1.00	100.0%	0.66	0.66		
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0	0						
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0						
SCG	**Total**	**100**	**100**	**1.00**	**100.0%**	**0.66**	**0.66**		
SDGE	PASS THROUGH	200	200	1.00	100.0%	0.66	0.66		
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	24	24	1.00	100.0%	0.75	0.75		
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0	0						
SDGE	**Total**	**224**	**224**	**1.00**	**100.0%**	**0.67**	**0.67**		
MCE	PASS THROUGH	12	12	1.00	100.0%	0.90	0.90		
MCE	**Total**	**12**	**12**	**1.00**	**100.0%**	**0.90**	**0.90**		
LCE	PASS THROUGH	8	8	1.00	100.0%	0.65	0.65		
LCE	**Total**	**8**	**8**	**1.00**	**100.0%**	**0.65**	**0.65**		
	Statewide	***29,023***	***22,632***	***0.78***	***62.2%***	***0.65***	***0.58***	***0.62***	***0.39***

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	2.4	2.4	1.00	100.0%	
PGE	PGE - AG IRRIGATION	4.7	0.8	0.18	0.0%	0.18
PGE	PGE - AGRICULTURAL PUMP VFD	5.4	1.2	0.21	0.0%	0.21
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	0.0	0.0			
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0.0	0.0			
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0.0	0.0	0.64	0.0%	0.64
PGE	**Total**	**12.5**	**4.4**	**0.35**	**19.0%**	**0.20**
SCE	PASS THROUGH	0.9	0.9	1.00	100.0%	
SCE	SCE - AGRICULTURAL PUMP VFD	0.6	0.2	0.26	0.0%	0.26
SCE	**Total**	**1.6**	**1.1**	**0.70**	**59.6%**	**0.26**
SCG	PASS THROUGH	0.0	0.0	1.00	100.0%	
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0.0	0.0			
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0.0	0.0			
SCG	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
SDGE	PASS THROUGH	0.0	0.0	1.00	100.0%	
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	0.0	0.0	1.00	100.0%	
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0.0	0.0			
SDGE	**Total**	**0.1**	**0.1**	**1.00**	**100.0%**	
MCE	PASS THROUGH	0.0	0.0	1.00	100.0%	
MCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
LCE	PASS THROUGH	0.0	0.0	1.00	100.0%	
LCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
	Statewide	***14.1***	***5.5***	***0.39***	***23.8%***	***0.20***

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	1.6	1.6	1.00	100.0%	0.66	0.66		
PGE	PGE - AG IRRIGATION	2.6	0.5	0.21	0.0%	0.55	0.63	0.55	0.63
PGE	PGE - AGRICULTURAL PUMP VFD	3.5	0.4	0.11	0.0%	0.65	0.33	0.65	0.33
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	0.0	0.0						
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0.0	0.0						
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0.0	0.0	0.60	0.0%	0.65	0.61	0.65	0.61
PGE	**Total**	**7.7**	**2.5**	**0.32**	**20.4%**	**0.61**	**0.57**	**0.60**	**0.46**
SCE	PASS THROUGH	0.6	0.6	1.00	100.0%	0.66	0.66		
SCE	SCE - AGRICULTURAL PUMP VFD	0.4	0.1	0.21	0.0%	0.65	0.51	0.65	0.51
SCE	**Total**	**1.0**	**0.7**	**0.68**	**60.1%**	**0.66**	**0.64**	**0.65**	**0.51**
SCG	PASS THROUGH	0.0	0.0	1.00	100.0%	0.75	0.75		
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0.0	0.0						
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	0.0	0.0	1.00	100.0%	0.66	0.66		
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	0.0	0.0	1.00	100.0%	0.75	0.75		
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0.0	0.0						
SDGE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.68**	**0.68**		
MCE	PASS THROUGH	0.0	0.0	1.00	100.0%	0.90	0.90		
MCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.90**	**0.90**		
LCE	PASS THROUGH	0.0	0.0	1.00	100.0%	0.65	0.65		
LCE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.65**	**0.65**		
	Statewide	***8.7***	***3.2***	***0.37***	***25.5%***	***0.62***	***0.58***	***0.61***	***0.46***

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	8,258	8,258	1.00	100.0%	
PGE	PGE - AG IRRIGATION	0	0			
PGE	PGE - AGRICULTURAL PUMP VFD	0	0			
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	0	0			
PGE	PGE - OZONE LAUNDRY EQUIPMENT	122	122	1.00	0.0%	1.00
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	679	434	0.64	0.0%	0.64
PGE	**Total**	**9,059**	**8,813**	**0.97**	**91.2%**	**0.69**
SCE	PASS THROUGH	197	197	1.00	100.0%	
SCE	SCE - AGRICULTURAL PUMP VFD	0	0			
SCE	**Total**	**197**	**197**	**1.00**	**100.0%**	
SCG	PASS THROUGH	6,090	6,090	1.00	100.0%	
SCG	SCG - OZONE LAUNDRY EQUIPMENT	510	566	1.11	0.0%	1.11
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	377	425	1.13	0.0%	1.13
SCG	**Total**	**6,977**	**7,081**	**1.01**	**87.3%**	**1.12**
SDGE	PASS THROUGH	46	46	1.00	100.0%	
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	0	0			
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	465	166	0.36	0.0%	0.36
SDGE	**Total**	**511**	**212**	**0.41**	**9.0%**	**0.36**
MCE	PASS THROUGH	0	0	1.00	100.0%	
MCE	**Total**	**0**	**0**	**1.00**	**100.0%**	
LCE	PASS THROUGH	0	0			
LCE	**Total**	**0**	**0**			
	Statewide	***16,744***	***16,303***	***0.97***	***87.1%***	***0.79***

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	5,387	5,387	1.00	100.0%	0.65	0.65		
PGE	PGE - AG IRRIGATION	0	0						
PGE	PGE - AGRICULTURAL PUMP VFD	0	0						
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	0	0						
PGE	PGE - OZONE LAUNDRY EQUIPMENT	79	73	0.92	0.0%	0.65	0.60	0.65	0.60
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	423	266	0.63	0.0%	0.62	0.61	0.62	0.61
PGE	**Total**	**5,889**	**5,726**	**0.97**	**91.5%**	**0.65**	**0.65**	**0.63**	**0.61**
SCE	PASS THROUGH	128	128	1.00	100.0%	0.65	0.65		
SCE	SCE - AGRICULTURAL PUMP VFD	0	0						
SCE	**Total**	**128**	**128**	**1.00**	**100.0%**	**0.65**	**0.65**		
SCG	PASS THROUGH	4,235	4,235	1.00	100.0%	0.70	0.70		
SCG	SCG - OZONE LAUNDRY EQUIPMENT	332	476	1.43	0.0%	0.65	0.84	0.65	0.84
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	245	328	1.34	0.0%	0.65	0.77	0.65	0.77
SCG	**Total**	**4,812**	**5,038**	**1.05**	**88.0%**	**0.69**	**0.71**	**0.65**	**0.81**
SDGE	PASS THROUGH	31	31	1.00	100.0%	0.67	0.67		
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	0	0						
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	303	129	0.42	0.0%	0.65	0.78	0.65	0.78
SDGE	**Total**	**333**	**159**	**0.48**	**9.3%**	**0.65**	**0.75**	**0.65**	**0.78**
MCE	PASS THROUGH	0	0	1.00	100.0%	0.90	0.90		
MCE	**Total**	**0**	**0**	**1.00**	**100.0%**	**0.90**	**0.90**		
LCE	PASS THROUGH	0	0						
LCE	**Total**	**0**	**0**						
	Statewide	***11,162***	***11,051***	***0.99***	***87.6%***	***0.67***	***0.68***	***0.64***	***0.74***

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	3,044.5	152.2	152.2
PGE	PGE - AGRICULTURAL PUMP VFD	0	0.0%	0.0%	3.3	1,964.3	212.7	595.2
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	0.0	0.0	0.0
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	0.0	0.0	0.0
PGE	PASS THROUGH	1	0.1%		16.5	170.5	16.3	16.2
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	1	0.0%		5.0	195,728.3	39,145.7	39,145.7
SCE	SCE - AGRICULTURAL PUMP VFD	0	0.0%	0.0%	7.6	1,825.5	174.4	239.9
SCE	PASS THROUGH	1	0.0%		5.6	4,645.3	727.0	727.0
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	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	0.7%		7.6	0.5	0.1	0.1
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	0.0	0.0	0.0
SDGE	PASS THROUGH	1	0.0%		5.0	22.0	2.3	2.3
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	1	0.0%		10.0	2,566.0	256.6	256.6
MCE	PASS THROUGH	1	0.0%		4.0	1,047.1	261.8	261.8
LCE	PASS THROUGH	1	0.0%		4.0	1,582.3	395.6	395.6

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 - AGRICULTURAL PUMP VFD	0	0.0%	0.0%	3.3	0.0	0.0	0.0
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	392.7	39.3	39.3
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	47.7	2.4	2.4
PGE	PASS THROUGH	1	0.1%		16.5	58.8	7.0	7.0
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	1	0.0%		5.0	0.0	0.0	0.0
SCE	SCE - AGRICULTURAL PUMP VFD	0	0.0%	0.0%	7.6	0.0	0.0	0.0
SCE	PASS THROUGH	1	0.0%		5.6	83.7	21.0	21.0
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	435.6	43.6	43.6
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	78.8	3.9	3.9
SCG	PASS THROUGH	1	0.7%		7.6	30.5	3.0	3.0
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	140.0	14.0	14.0
SDGE	PASS THROUGH	1	0.0%		5.0	2.9	0.4	0.4
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	1	0.0%		10.0	0.0	0.0	0.0
MCE	PASS THROUGH	1	0.0%		4.0	-13.8	-3.5	-3.5
LCE	PASS THROUGH	1	0.0%		4.0	0.0	0.0	0.0

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 - AG IRRIGATION	0	0.0%	0.0%	20.0	1,912.7	95.6	95.6
PGE	PGE - AGRICULTURAL PUMP VFD	0	0.0%	0.0%	3.3	645.5	69.9	195.6
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	0.0	0.0	0.0
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	0.0	0.0	0.0
PGE	PASS THROUGH	1	0.1%		16.5	113.6	10.9	10.8
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	1	0.0%		5.0	127,223.4	25,444.7	25,444.7
SCE	SCE - AGRICULTURAL PUMP VFD	0	0.0%	0.0%	7.6	937.8	89.6	123.2
SCE	PASS THROUGH	1	0.0%		5.6	3,102.6	479.8	479.8
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	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	0.7%		7.6	0.4	0.0	0.0
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	0.0	0.0	0.0
SDGE	PASS THROUGH	1	0.0%		5.0	14.5	1.5	1.5
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	1	0.0%		10.0	1,924.5	192.4	192.4
MCE	PASS THROUGH	1	0.0%		4.0	942.4	235.6	235.6
LCE	PASS THROUGH	1	0.0%		4.0	1,028.5	257.1	257.1

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 - AG IRRIGATION	0	0.0%	0.0%	20.0	0.0	0.0	0.0
PGE	PGE - AGRICULTURAL PUMP VFD	0	0.0%	0.0%	3.3	0.0	0.0	0.0
PGE	PGE - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	235.9	23.6	23.6
PGE	PGE - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	29.2	1.5	1.5
PGE	PASS THROUGH	1	0.1%		16.5	38.4	4.6	4.6
PGE	PGE - GLYCOL PUMP VFD PASS THROUGH	1	0.0%		5.0	0.0	0.0	0.0
SCE	SCE - AGRICULTURAL PUMP VFD	0	0.0%	0.0%	7.6	0.0	0.0	0.0
SCE	PASS THROUGH	1	0.0%		5.6	54.4	13.6	13.6
SCG	SCG - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	366.3	36.6	36.6
SCG	SCG - WATER HEATING TANKLESS WATER HEATER	0	0.0%	0.0%	20.0	60.7	3.0	3.0
SCG	PASS THROUGH	1	0.7%		7.6	21.1	2.1	2.1
SDGE	SDGE - OZONE LAUNDRY EQUIPMENT	0	0.0%	0.0%	10.0	108.5	10.9	10.9
SDGE	PASS THROUGH	1	0.0%		5.0	1.9	0.2	0.2
SDGE	SDGE - AGRICULTURAL PUMP VFD PASS THROUGH	1	0.0%		10.0	0.0	0.0	0.0
MCE	PASS THROUGH	1	0.0%		4.0	-12.4	-3.1	-3.1
LCE	PASS THROUGH	1	0.0%		4.0	0.0	0.0	0.0

APPENDIX AC:

RESPONSE TO RECOMMENDATIONS

EM&V Impact Study Recommendations

Study Title: 2019 Small/Medium Commercial Impact Evaluation

Study Manager: CPUC

ID		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)
POL1	PG&E, SCG and SDG&E	5	The addition of ozone laundry equipment is generally an effective technology for reducing hot water used by laundry equipment, resulting in energy savings. With ozone laundry equipment in place, laundry cycles are typically completed using less hot water, and the hot water temperature setpoint for the water heating system is lowered. Both factors combined contribute to a reduction in natural gas used to heat water, in a water heater or boiler that provides hot water to a given laundry facility. Furthermore, the ozone that is introduced into the water supply used by laundry equipment enhances sanitation, including the destruction of microorganisms, like bacteria and viruses, that can cause disease. The measures' dual effectiveness in combating climate change through energy savings and reducing the likelihood of contagious disease outbreaks makes this technology highly attractive as a program offering.	We recommend that this technology not only continue to be offered by the programs, but that the PAs' increase participation levels through additional marketing and outreach supporting uptake of ozone laundry equipment.		

ID		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)
POL2	PG&E, SCG and SDG&E	5	Out of a total sample size of 35 sites we sampled 1 San Diego Gas and Electric (SDG&E) project, with a program-based savings estimate that accounts for 37% of all reported savings across all PAs. While this project had great potential to save energy using ozone laundry equipment, the customer did not substantially adjust the hot water use per laundry load or change the water temperature settings, which resulted in a gross savings realization rate for this project of just 5%. While the resulting downward effect on the overall realization rate is substantial, the statewide result is still decent at nearly 80% of the reported savings. However, the effect on realized SDG&E savings is much greater, resulting in a realization rate of just 36%. It is also notable that this business does not appear to be eligible to participate. This participating business supplies linens and work uniforms. The relevant SDG&E workpaper only allows	We recommend that large-scale projects of this nature are better served through a custom program channel where site-level reported savings are adequately vetted through the program application process. Using a custom channel instead of a deemed program approach would likely have produced a more reliable estimate of PA-reported savings for this project. Custom program projects typically undergo a more rigorous verification of operating conditions that are in-turn incorporated within the project saving estimates.		

ID		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)
			participation in fitness, nursing home, correctional and hotel/motel facilities.			
POL3	PG&E, SCG and SDG&E	5	Ozone laundry equipment installations are not always properly screened for eligibility requirements. We found that two of our sample points replaced existing ozone laundry equipment with new equipment. The replaced ozone laundry equipment have equivalent functionality to the newly installed ozone laundry equipment, resulting in no savings being realized by the grid. CPUC policy does not allow programs to install like-for-like energy efficiency replacements. It is also notable that the program standards exclude eligibility for replacing ozone laundry equipment.	The program's application and review process should be enhanced to better screen projects against eligibility requirements and exclusions.		
POL4	PG&E, SCG and SDG&E	5	The percent reduction in hot water use, the number of laundry cycles per day and the reduction in hot water temperature settings generally brought down the resulting realization rate for SDG&E.	We recommend that the programs strengthen program requirements surrounding percent reduction in hot water use, number of laundry cycles per day and the reduction in hot water temperature settings to ensure adequate savings for all participating projects.		

ID		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)
POL5	PG&E, SCG and SDG&E	5	We selected ex post model-based parameters to present in Chapter 5 on the basis that they would be most useful to any future workpaper updates. In fact, several of the factors we presented do currently contribute to workpaper-based savings estimates. Also shown are ex post unit energy savings values expressed in a way that parallels ex ante workpaper values that are applied to the tracking data (expressed per pound of laundry machine capacity).	In support of any future workpaper updates for ozone laundry measures, it is recommended that the PA workpaper team mines this data source and applies our findings where feasible and, as noted above, modify program requirements to ensure all projects deliver adequate program savings. Furthermore, our evaluation team has assembled a model for estimating ozone laundry equipment savings, and in doing so has amassed industry knowledge, tools and experience that can be shared with the workpaper team in order to hopefully improve the accuracy of resulting workpaper-based savings estimates and better align PA and evaluation results.		
POL6	PG&E, SCG and SDG&E	5	In some cases we found that the gross impact sample and participants in the program tracking data do not always	We recommend that the program either better screen businesses for eligibility based on business type, or if warranted, expand the		

ID		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)
			conform with program business type eligibility requirements. Interestingly, these eligibility criteria are found to vary across PA workpapers, but the universe of eligible businesses includes hotel/motel, health facilities, nursing homes, correctional facilities and fitness centers. Within the sample exceptions to this include a commercial laundry, a party rental store, a linen and work apparel supplier and lodging facilities (that are not hotel/motels). In fact, we even observed business type exceptions to the eligible business list using business type variables available in the program tracking system.	availability of businesses that can participate. We also recommend better alignment among the PA workpapers in terms of businesses that are eligible and a consensus on why.		
PPVFD1	PG&E, SCG and SDG&E	5	We found that VFD controls installed through the programs are not being properly screened in many cases for eligibility criteria. Out of a total sample size of 45 pumps, commonly observed reasons for failing eligibility requirements includes the installation of speed controls in the following cases: • 5 pumps run fewer than 1,000 hours per year	The program's application and review process should be enhanced to better screen projects against eligibility requirements and exclusions.		

ID		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)
			• 2 pumps pump well water into a water storage reservoir or trucks • 12 pumps have settings that are at or near full load • 4 pumps that previously ran uncontrolled. Many of the VFDs are installed on new pumps that irrigate trees that have been planted in the last couple of years; this results in low run hours, many below 500 hours per year.			
PPVFD2a	PG&E, SCG and SDG&E	5	In most cases, pump operations can be readily characterized using interval billing data, such as hourly demand measurements for a given pump. In fact, our evaluation applied interval billing data as a key model input used to determine VFD savings.	We recommend that the programs make use of interval billing data 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.		
PPVFD2b	PG&E, SCG and SDG&E			The PAs should continue to track and report Service Account IDs (SAID) of meters that are affected by VFD installation. Overall, the PAs did a good job of identifying the affected		

ID		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)
				customers meters and accounts where loads were affected by VFD installation, but there were a few instances where this was not the case. Best practice would be to ensure that each record in the tracking system has a SAID that corresponds with the installed VFD/pump.		
PPVFD3	PG&E, SCG and SDG&E	5	Beside 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	For these reasons, we recommend that the appropriate baseline be determined as a function of pump type and size. Current deemed savings estimates assume a throttle valve flow control baseline, in which partially closed valves are used to control pump flow. However, this assumed baseline ignores the fact that VFD flow controls are commonly installed, even without the influences of program intervention.		

ID		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)
			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.			
PPVFD4a	PG&E, SCG and SDG&E	5	The workpaper-based estimates of savings currently draw results from a database of legacy custom and new construction projects involving pump VFDs. Our evaluation has assembled stipulated parameter values and results, including the following: operating hours, pump load distribution, assumed baseline condition, motor efficiency, VFD efficiency, pump OPE and the assumed affinity law exponent. Our evaluation also reported metric-based per-unit results that should prove useful to workpaper updates, in addition to updating the parameters noted above.	We recommend that the results of this evaluation, and any trends observed, should be considered for any workpaper updates for the agricultural pump VFD measures, in order to improve the accuracy of future workpaper estimates.		
PPVFD4b	PG&E, SCG and SDG&E	5		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. We recommend that the PAs consider including fields within the project application forms for estimated pump runtime, the acreage of the field to be served by the pump, the crop being served, irrigation end-point type		

ID		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)
				(drip, sprinkler, flood), OPE, etc. The PAs should make use of those data to fine tune ex ante savings values to better 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.		
PPVFD4c	PG&E, SCG and SDG&E	5		We recommend that the PAs consider using an enhanced deemed 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 of sample points and results suggests that irrigated fields, and the VFDs that serve		

ID		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)
				them, are unique to each farm, but nonetheless trends may be leveraged that can lead to more accurate savings claims. To that effect, crop-specific irrigation requirements, for example, could be used to better characterize and differentiate the measure savings algorithms. Continuing to use a database of legacy ex ante pump VFD results will likely continue to misrepresent realized program savings.		
PPVFD5	PG&E, SCG and SDG&E	5	Across both the PG&E and SCE samples (45 pumps), there were only 2 pumps where evaluation-based EUL assignments matched those applied by the PAs 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). The PAs are also not successfully differentiating EULs based	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. The utilities EUL estimates demonstrate some level of confusion surrounding proper us of DEER database resources.		

ID		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)
			on the pumps being new, where application of a 10-year EUL is appropriate.			
AG1	PG&E	5	The agricultural drip irrigation measure is no longer offered through Pacific Gas and Electric (PG&E) programs. PG&E gradually altered the measure's eligibility requirements to accommodate specific irrigation technologies and crop types for which low-pressure irrigation was not yet a standard practice. By sunsetting the final eligible technology—drip tape irrigation at farms growing field vegetables—PG&E has deemed low-pressure irrigation to be standard practice throughout northern California.	We recommend that the agricultural irrigation realization rates and NTGRs presented in this evaluation report should not be applied prospectively to other agricultural irrigation measures. The drip irrigation measure was uniquely conducive to downstream distribution at scale. As a result, its gross and net performance does not serve as a reliable proxy for other agricultural measures such as irrigation pump upgrades.		
AG2	PG&E	5	The PA 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 our evaluated savings relative to the PA reported savings. For example, almost all of the 19 evaluated drip irrigation projects were a unique	Should the drip irrigation measure reemerge, we recommend that future deemed savings estimates claims should be derived using evaluation data and results. The PAs should leverage findings from previous evaluations to refine model inputs and assumptions, correct		

ID		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)
			combination of the following parameters which were not considered in the PAs' 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 PAs' reported savings did not consider these factors, the savings values were inaccurate and generally overstated.	errors and omissions, and otherwise improve the accuracy of reported savings for drip irrigation technologies. This will ensure better alignment between reported savings and evaluation-based savings results.		
AG3	PG&E	5	The PA reported savings overstated how long the equipment will last following installation. PG&E assumes the equipment will last 20 years based on the default value considered for agricultural irrigation pumps. We found that the drip irrigation equipment are often replaced more frequently than the pumps to conserve both water and energy.	While the evaluated drip irrigation measure is no longer offered by PG&E, we recommend for future measures that involve drip irrigation or similar upgrades that useful life estimates should reflect the expected life of the program-installed irrigation emitters, not the associated irrigation pump.		
TWH1	PG&E and SCG	5	For many of the tankless water heaters evaluated, program tracking data did not provide sufficient information. For approximately 45% of projects in the population, we did not have sufficient	We recommend that the PAs require participating distributors and partnering contractors to collaboratively collect and submit basic information for each		

ID		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)
			participant contact data to verify water heater installations or evaluate savings. As a result, we expanded our evaluation recruitment pool and ultimately exceeded the target sample count. We are encouraged by the slight improvement in recent tracking data quality as compared to our previous experiences.	customer ultimately receiving the equipment or other program support. As noted above, this appears to be most challenging to accomplish for installed equipment that are delivered by the programs through retail or other equipment supplier sources, in contrast with equipment that are installed directly by contractors and should therefore be an area of focus for implementing this recommendation. This basic information is critical for the PAs, the CPUC, and its contractors to verify installations and maintain the integrity of ratepayer incentive dollars.		
TWH2	PG&E and SCG	5	We determined that 9 of the 51 evaluated projects either never saved energy or no longer save energy. Three claimed projects occurred at facilities that have since permanently closed, and six projects were claimed at service addresses that had no evidence of recent tankless water heater installations. These	We recommend that programs should require participating distributors and partnering contractors to submit more comprehensive installation documentation (e.g., invoices, commissioning reports) and photographs to prove measure		

ID		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)
			projects resulted in zero savings and significantly reduced overall realized program savings.	installation, quantity, size, fuel source, and efficiency. This appears to be most challenging to accomplish for installed equipment that are delivered by the programs through retail or other equipment supplier sources, in contrast with equipment that are installed directly by contractors, and should therefore be an area of focus for implementing this recommendation.		
TWH3	PG&E and SCG	5	Twenty-nine of the 51 evaluated projects applied incorrect per-unit savings values or misclassified the type of facility in which the measure was installed. Correcting these errors resulted in slightly lower estimated savings.	We recommend that the PAs' redouble efforts to ensure that reported savings estimates are based on the correct application of per-unit deemed savings values. We attribute these observed errors to the following: erroneous application of the wrong result, or mis-specification of the facility type, climate zone, water heater size, or efficiency tier.		

ID		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)
TWH4	PG&E and SCG	5	We found that water heaters operated at different temperatures than assumed in the applicable workpapers, which negatively affected the savings estimates. However, we also found that the installed water heaters were rated at higher efficiencies than assumed. Overall, the positive effects from increased efficiency outweighed the negative effects due to operating temperatures, resulting in an overall increase in savings.	We recommend that future workpaper revisions incorporate recent evaluation results when available. This will ensure better alignment between reported savings and evaluation-based savings. We note that the evaluated DHW temperatures presented in Table 5-36 include five cases of closed-loop systems that reduced the TWH's change in temperature. These five points should be excluded from prospective workpaper values if the programs screen out ineligible closed-loop systems as intended.		

APPENDIX A:

UPDATES TO NTG FRAMEWORK

This Appendix describes updates that the evaluation team made to the Nonresidential Net-to-Gross (NTG) framework for downstream programs during for the 2018 evaluation cycle. Evaluators have used this framework with minor modifications since the 2006-2008 evaluation cycle. Team members from both the Group A and Group D evaluation teams coordinated to develop changes that the evaluation team incorporated into the Small Commercial and Lighting evaluations that resulted in an alternative to the PAI-1 score. The evaluation team used these changes for the PY2019 evaluations for the Small Commercial and Nonresidential Lighting evaluations.

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 Nonresidential Working Group originally developed the existing Nonresidential Net-to-Gross (NTG) framework during the 2006-2008 evaluation cycle and updated it modestly during the 2010-2012 cycle. They designed the approach 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).

[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.

A-1 STANDARDIZED NONRESIDENTIAL NTG ALGORITHM IMPROVEMENTS

A-1-1 Previous 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).

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 decision making 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

[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.

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 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.

A-1-2 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.*

A-2 ALTERNATIVE TO CURRENT PAI-1 SCORING STRUCTURE

A-2-1 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% 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% of the time, and at least one non-program factor 80% of the time. Furthermore, 66% 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.

A-2-2 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

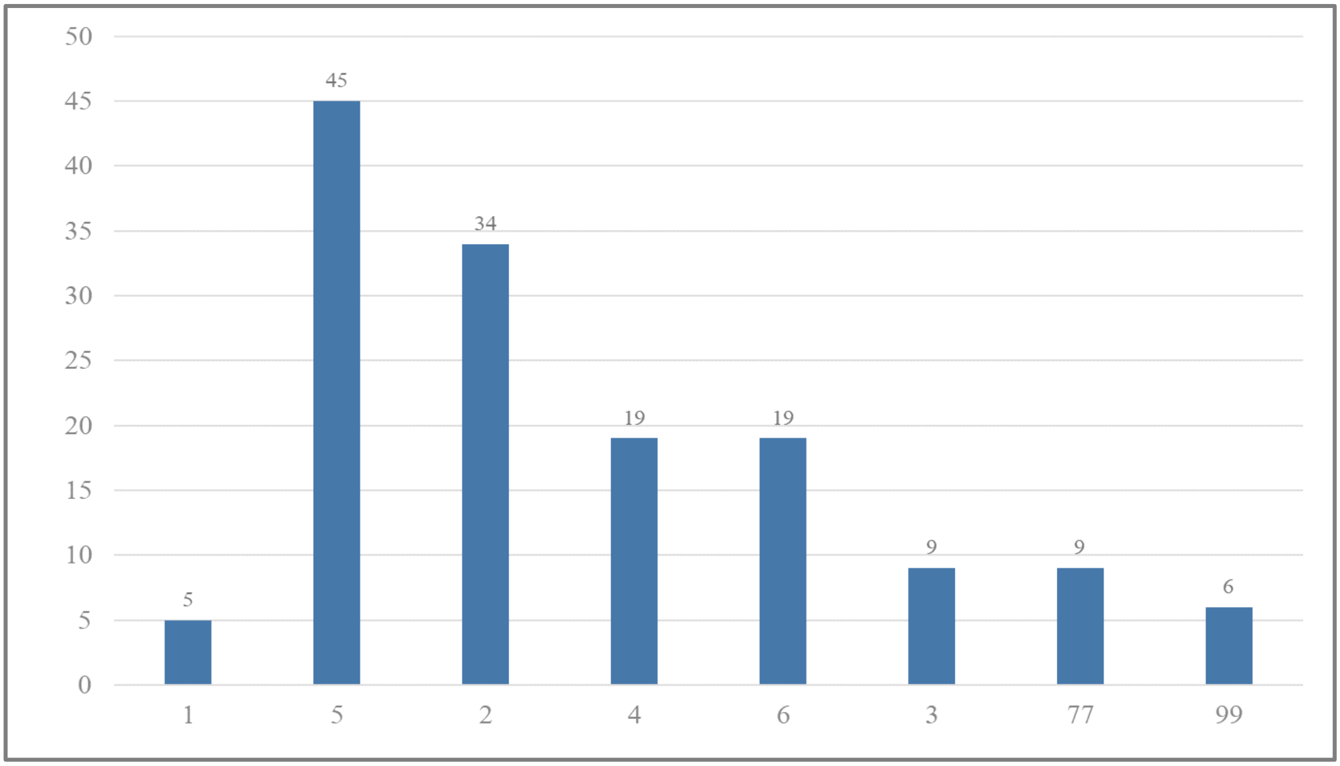
<u>NTGR_2c</u> – PAI-1 alternative 3 = Assign value based on No Program actions (N6). This Approach uses the N6 value and assigns a PAI score as follows.

- 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 A-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%). Other categories that were commonly selected were 2 (Install standard efficiency equipment or whatever required by code, 34%), 4 (Done nothing, 19% and 6 (Repair/rewind or overhaul the existing equipment, 19%).

Figure A-1: Distribution of Responses to Question N6 in Small Commercial Evaluation



<u>NTGR_2d</u> – 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)

A-2-3 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 A-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 A-2: Distribution of NTGRs Across Alternative Methods

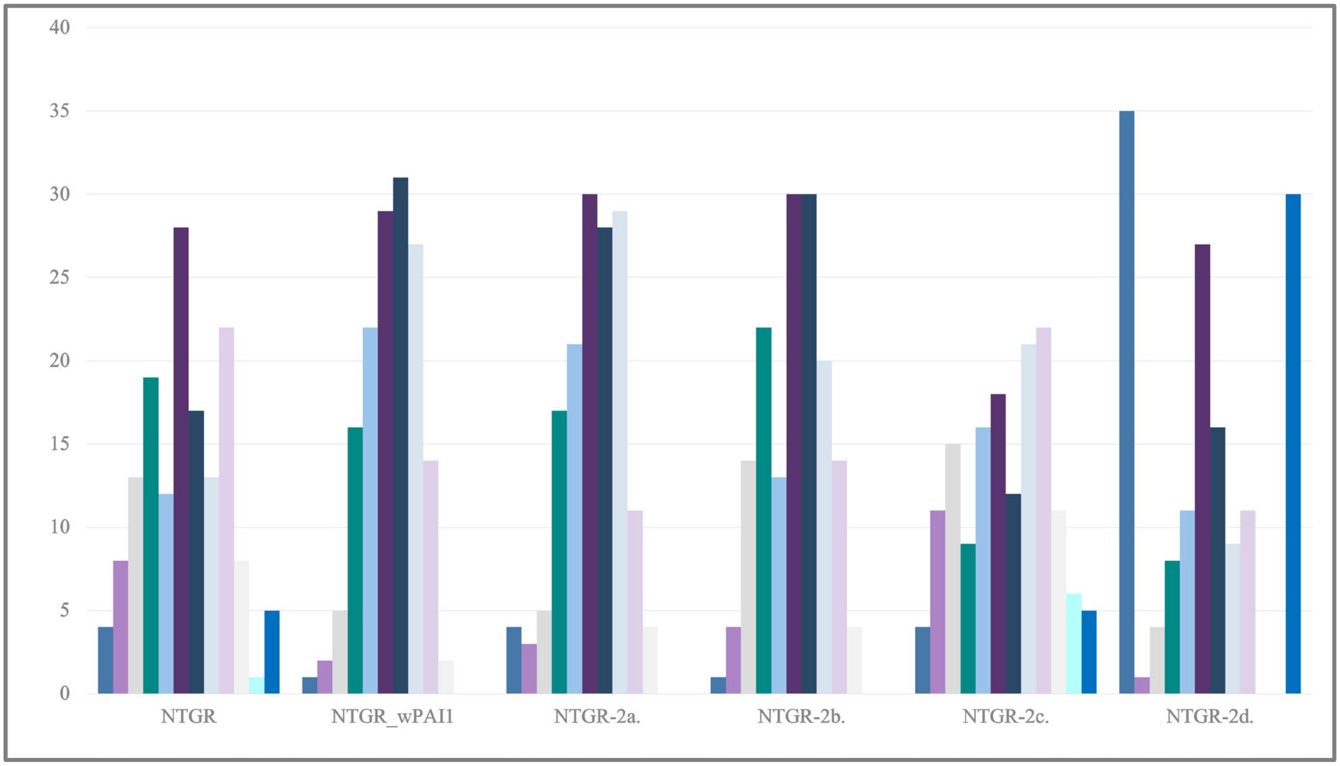
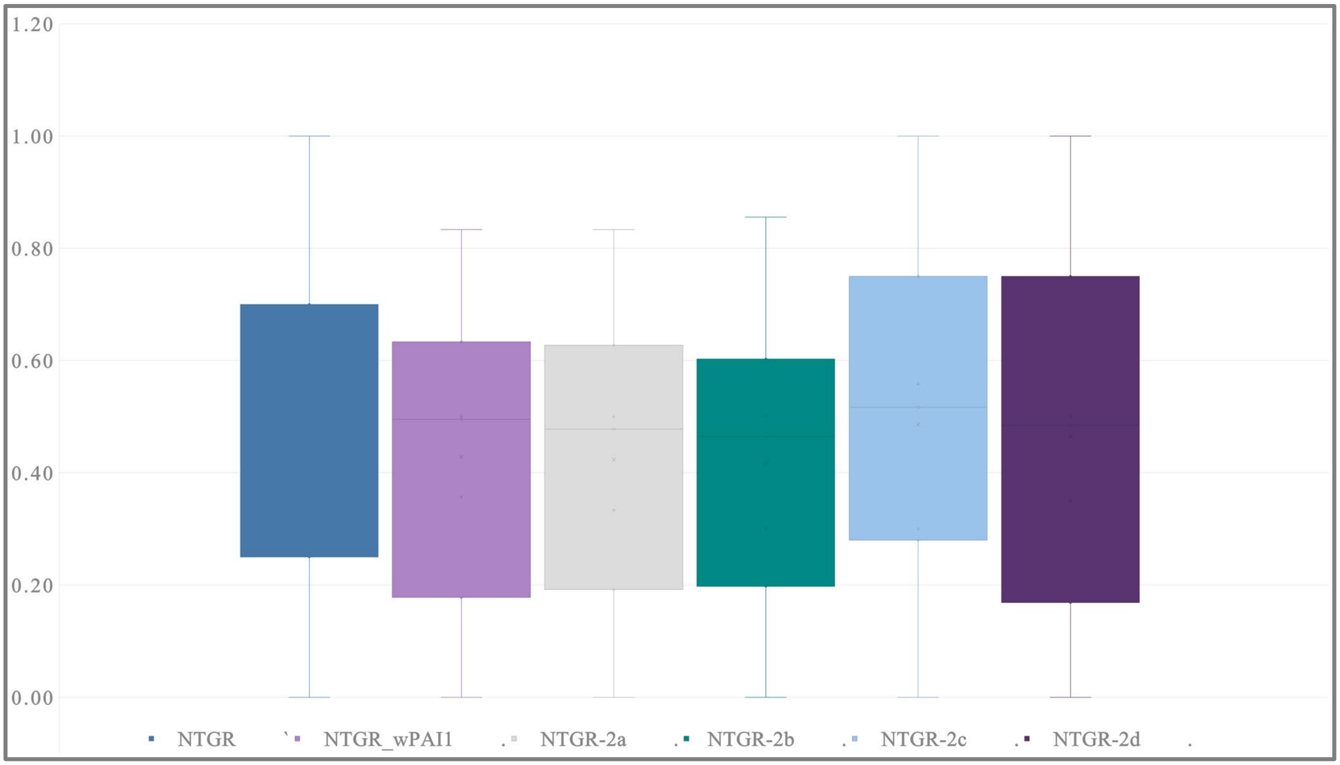


Figure A-3 below provides mean NTGR values and 90% confidence intervals across all six cases. The whiskers indicate the range of values analyzed.

Figure A-3: NTGR Mean Values and Confidence Intervals Across Alternative Methods



The following observations can be made from these two figures:

- **From Figure A-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 A-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.**

A-2-4 Method Change

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.

APPENDIX B:

PARTICIPANT PHONE SURVEY

<%CONTACT> – This variable should contain the decision makers name; probably the farmer

<%Business> – This variable should contain the business name

<%Utility> -- This variable should contain the relevant utility; either PG&E or SCE

<%Program> -- This variable should contain the name of the relevant program; for example, IDEEA365 or Commercial Deemed Incentives

<%Measure_x> -- This variable contains a readable measure description that includes the pump type and pump horsepower; for example, variable frequency drive flow controls for a 125 horsepower booster pump.

<%Measure_x_Date> -- This variable contains a readable installation date description; for example, December 6, 2019.

<%City> -- This variable contains the city name.

VFD1 should be the record and application randomly selected for evaluation

VFD2 should the second randomly selected record for evaluation, when populated (as some FarmIDs will only be associated with a single record)

VFDx should always be 1 for all measures, including all VFDs installed under a given FarmID

Participant Survey for CPUC PY2019

Small Commercial Evaluation

INTRODUCTION AND FINDING CORRECT RESPONDENT

OUTCOME1

This is %n calling on behalf of the CPUC, from Quantum Energy Analytics. 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.

READ IF NEEDED: This call concerns variable frequency drive flow controls that your business purchased in 2019.

XX	BEGIN THE INTERVIEW	Continue
101	NO ANSWER	Record response and attempt again at a later time
102	BUSY	Record response and attempt again at a later time
111	CHANGED NUMBER	Record new number and attempt again
107	ANSWERING MACHINE / VOICE MAIL	Record response and attempt again at a later time
104	CALLBACK-Specific	Record response and schedule time to callback
105	CALLBACK-General	Record response and get best time to callback
5	NON-WORKING NUMBER	Record response and resolve record
6	NON-BUSINESS NUMBER	Record response and T&T
14	OTHER PHONE PROBLEM / FAX / MODEM	Record response and resolve record
12	REFUSAL	Record response and T&T
19	ASKED TO BE PLACED ON DNC LIST	Record response and T&T
15	LANGUAGE/HEARING PROBLEM	Record response and T&T
10	CLAIMS TO HAVE BEEN PREVIOUSLY INTERVIEWED	Record response and T&T
94	MAXIMUM CALL ATTEMPTS	Record response and resolve record
900	DUPLICATE PHONE NUMBER	DO NOT LOAD - RESOLVE RECORD
999	INVALID PHONE NUMBER	DO NOT LOAD - RESOLVE RECORD
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.

READ IF NEEDED: This call concerns variable frequency drive flow controls that your business purchased in 2019.

77	There is no one here who can help you	T&T
02	CALL BACK TO REACH PR0PER PARTY	Record response and get best time to callback
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 Quantum Energy Analytics. 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 2019...I was told that would be you.
...Your organization participated in <%UTILITY>'s <%PROGRAM> by installing variable frequency drive flow controls in 2019.

Through this program, your organization installed a....

<%MEASURE_1> on <MEASURE_1_DATE>

AND IF NEEDED: and a……
<%MEASURE_2> on <MEASURE_2_DATE>
Are you the best person to speak to about your organization's participation in this program?

[If you need to provide validation for this survey, provide the following contact name and number: Mona Dzvova, California Public Utilities Commission 415-703-1231/ mona.dzvova@cpuc.ca.gov and the following website: www.cpuc.ca.gov/eevalidation]

1	Yes	DISPLAY
2	No, there is someone else	PBLOCK Hi
3	No and I don't know who to refer you to	Thank&Terminate
5	A contractor handles this	CNAME
99	Don't know/refused	Thank&Terminate

CNAME May I please have the name and contact information of your contractor?

1	Yes – RECORD	Record Response and T&T
88	Refused	Thank&Terminate
99	Don't Know	Thank&Terminate

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 phone number and move on.]

77	Record Name, as &CONTACT, and Phone as &PHONE	May_I
88	Refused	Thank&Terminate
99	Don't know	Thank&Terminate

May_I May I speak with him/her?

77	Yes	Intro3:s
88	No (not available right now@, set cb)	Get best time to callback

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 businesses like yours. We are interested in how businesses like yours think about and manage their energy consumption.

Your input will allow the California Public Utilities Commission to build and maintain better energy saving programs for customers like you. And we would like to remind you, your responses will not be connected with your business in any way.

SCREENER

VERIFY For verification purposes only, may I please have your name?

77	Get name	Bus_Name
88	Refused	Bus_Name
99	Don't know	Bus_Name

DISPLAY For the sake of expediency, I will refer to ....<%UTILITY>'s <%PROGRAM> ...program as the PROGRAM, and to variable speed flow controls as the VFD(s).

BUS_NAME First, I'd like to ask you a question about your business. Our records show your business name as: <%BUSINESS>. Is that correct?

1	Yes	V1
2	No	Bus_Correct
88	Refused	V1
99	Don't Know	V1

BUS_CORRECT What is the correct name for your business?

&BUS_CORRECT	Corrected Business	V1

ROLE OF CONTRACTORS

V1 Did you use a contractor/vendor to install the VFD(s) that were purchased through the program?

1	Yes	V2
2	No	AA3
88	Refused	AA3
99	Don't Know	AA3

If V1 = 1 then ask; else skip to AA3

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 contractor/vendor 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 **else skip to V2b**

V2ab Did the contractor/vendor recommend purchasing VFD flow controls instead of standard flow controls, such as throttling valve controls?

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	AA3
88	Refused	AA3
99	Don't Know	AA3

V3a. Did you install what your contractor/vendor recommended?

1	Yes	V4
2	No	V4
88	Refused	V4
99	Don't Know	V4

Ask if V3 = 1; else skip to AA3

V4 Prior to coming into contact with the contractor/vendor, did your organization have plans to install the VFD(s)?

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 VFD(s) had the contractor/vendor not recommended it?

1	0-10 response	V40
88	Refused	V40
99	Don't Know	V40

NOTE: We are skipping this question for VFDs:

V4b Using the same scale, how likely is it that your organization would have installed the VFD(s) 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	AA3
88	Refused	AA3
99	Don't Know	AA3

NET TO GROSS BATTERY

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 the variable frequency drive flow controls we discussed earlier as THE VFD(s).

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	AA3a
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	AA3a
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 AA3=1, 4 or 10 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 VFD(s) before after, or at the same time as you became aware 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 the VFD(s). There are many equipment features that you may consider in your purchase decisions other than energy efficiency. These might include such features as the performance of the equipment or how necessary it is for current operations. However, in the following questions, we are interested specifically in how the program might or might not have affected your decisions about the energy efficiency of the equipment. That is, we are interested in what influenced you to choose the VFD(s) you did rather than a other flow control options. 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 (_______)	N3b
66	Equipment is new, no old equipment	N3b
88	Refused	N3b
99	Don't know	N3b

N3b Availability of the PROGRAM rebate [IF NEEDED: to reduce the cost of the measure]

#	Record 0 to 10 score (_______)	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

#	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 (_______)	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 (_______)	N3j
88	Refused	N3j
99	Don't know	N3j

N3j Standard practice in your business/industry

#	Record 0 to 10 score (_______)	N3l
88	Refused	N3l
99	Don't know	N3l

N3l Endorsement or recommendation by your account rep?

#	Record 0 to 10 score (_______)	N3m
88	Refused	N3m
99	Don't know	N3m

N3m Corporate policy or guidelines

#	Record 0 to 10 score (_______)	N3n
88	Refused	N3n
99	Don't know	N3n

N3n Payback or return on investment of installing the VFD(s)

#	Record 0 to 10 score (_______)	N3o
88	Refused	N3o
99	Don't know	N3o

N3o Improved product quality

#	Record 0 to 10 score (_______)	N3r
88	Refused	N3r
99	Don't know	N3r

N3r Compliance with your business's normal irrigation or equipment replacement practices?

#	Record 0 to 10 score (_______)	N3s
88	Refused	N3s
99	Don't know	N3s

N3s Were there any other factors we haven't discussed that were influential in your decision to install VFD(s)?

1	Nothing else influential	P1
77	Record verbatim	N3ss
88	Refused	P1
99	Don't know	P1

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 (_______)	P1
88	Refused	P1
99	Don't know	P1

PAYBACK BATTERY

ASK P1 if N3n >=7; else SKIP to N41 (including the DISPLAY before N41)

P1 What financial calculations does your business typically make before proceeding with the installation of energy efficient equipment like the VFD(s) 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

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 the VFD(s) 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

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	N41
88	Don't know	N41
99	Refused	N41

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 (_______)	N41
88	Refused	N41
99	Don't know	N41

DISPLAY Next, with regard to your decision to install the VFD(s) *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.

BELOW List the following items if they received a rating of 7 or higher

IF there are at least 1 program and 1 nonprogram factor, then say:

"Program-related factors include:"	
<%N3B> Availability of the PROGRAM rebate	List if N3b>=7
<%N3H> Information from the Program, Utility, or Program Administrator Marketing materials	List if N3h>=7
<%N3L> Endorsement or recommendation by your account rep?	List if N3L>=7
"And Non-Program factors include:"	
<%N3E> Previous experience with this measure	List if N3e>=7
<%N3F> Previous experience with this program	List if N3f>=7
<%N3J> Standard practice in your business/industry	List if N3j>=7
<%N3M> Corporate policy or guidelines	List if N3m>=7
<%N3O> To improve product quality	List if N3o>=7
<%N3R> Compliance with your business's normal irrigation or equipment replacement practices	List if N3r>=7

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 in choosing to install VFD(s) rather than alternative flow controls?

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 <> 88 and N41 <> 99 and N42 <> 88 and N42 <> 99, compute N41 + N42. While N41+N42 <> 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 the VFD(s) *at the time you did* rather than waiting to install new equipment sometime in the future, regardless of the type of flow controls 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 the VFD(s) at the time you did rather than waiting to install new flow controls 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 THE VFD(s) 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 N41P <> 88 and N41P <> 99 and N42P <> 88 and N42P <> 99, compute N41P + N42P. While N41P+N42P <> 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 the VFD(s) a replacement of existing equipment or does the VFD/do the VFDs serve a new irrigation pump/new irrigation pumps?

1	Replace/Modification/Retrofit	DISPLAY
2	Add-on	DISPLAY
88	Refused	DISPLAY
99	Don't know	DISPLAY

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 N5; 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 VFD(s) that you did for this project regardless of when you would have installed it?

#	Record 0 to 10 score (_______)	N5B
88	Refused	N5B
99	Don't know	N5B

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 (_______)	N6
88	Refused	N6
99	Don't know	N6

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 VFD(s) at the same time as you did?	
#	Record 0 to 10 score (_______)	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 VFDs	N6aa
2	Install standard efficiency equipment or whatever is 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	N6a
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	N6a
2	Within one year	N6a
3	At a later time	N6ab
88	Don't know	N6a
99	Refused	N6a

N6ab How many years later would it have been?

77	Record VERBATIM	N6a
88	Don't know	N6ac
99	Refused	N6a

N6ac Would it have been….

1	Less than one year	N6a
2	About a year	N6a
3	A couple of years	N6a
4	A few years	N6a
5	More than four years	N6a
88	Don't know	N6a
99	Refused	N6a

If N6 = 4 THEN ASK, ELSE N6ca

N6ba How long would you have waited to replace your equipment?

1	Less than one year	N6a
2	About a year	N6a
3	A couple of years	N6a
4	A few years	N6a
5	More than four years	N6a
88	Don't know	N6a
99	Refused	N6a

IF N6=77, 88, 99 THEN ASK, ELSE N6a

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	N6a
2	Within one year	N6a
3	At a later time	N6cb
88	Don't know	N6a
99	Refused	N6a

N6cb How many years later would it have been?

77	Record VERBATIM	N6a
88	Don't know	N6cc
99	Refused	N6a

N6cc Would it have been….

1	Less than one year	N6a
2	About a year	N6a
3	A couple of years	N6a
4	A few years	N6a
5	More than four years	N6a
88	Don't know	N6a
99	Refused	N6a

Ask if N6(1) else skip to N6b;

N6a How many fewer VFDs would you have installed? (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) else skip to N6C

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) else skip to ER2

N6c How long do you think the repaired equipment would have lasted before requiring replacement?

77	RECORD VERBATIM	ER2
88	Don't know	ER2
99	Refused	ER2

EARLY REPLACEMENT BATTERY

IF REPLACE(1) AND N6c IS UNRECORDED;

ER2 How many more years do you think the VFD(s) would have gone before failing and requiring 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	Vendor_name
88	Don't know	Vendor_name
99	Refused	Vendor_name

Ask if V1(1)

Vendor_Name	Earlier you stated that you had a vendor/contractor that helped you with the installation of the VFD(s) that was/were installed through the <%UTILITY> Program. Could you provide me with their name and phone number?	
1	Cannot provide	MoreVFDs
77	Record Name, Phone Number, Email Address or any other information they can provide. More is better.	MoreVFDs
88	Refused	MoreVFDs
99	Don't know	MoreVFDs

ASK IF MORE THAN 2 PUMPS PER FARMID, ELSE GO TO END

MoreVFDs In addition to the VFD installation(s) we described earlier, according to our records your business installed additional VFDs in 2019 through <%Utility>'s energy efficiency programs.

This includes....

<%MEASURE_3> on <MEASURE_3_DATE>

AND IF NEEDED: and a……
<%MEASURE_4> on <MEASURE_4_DATE>

AND IF NEEDED: and a……
<%MEASURE_x> on <MEASURE_x_DATE>

And thinking about the decision making to install the VFD measures that you just shared with us, do you think the answers you provided generally apply to the additional VFD installation(s)?

1	Yes	END
2	No	END
3	Other, record verbatim ________________________	END
99	Don't know/refused	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.	

APPENDIX C:

VENDOR NTG PHONE SURVEY

Vendor NTG Survey Instrument – Tankless Water Heaters

Introduction

AA1 This is <% Interviewer? calling on behalf of the CPUC [California Public Utilities Commission] from <<ERS>> regarding your firm's involvement with the sales and/or installations of ...<Tankless Water Heaters>… through ...<UTILITY'S Commercial Deemed Incentive PROGRAM> ... between January 1, 2019 and December 31, 2019. Our records indicate that ...<%CONTACT>... would be the person most knowledgeable about this. Are they available?

1 Yes A2

2 No AA2

AA2 Who would be the person most knowledgeable about your firm's involvement with ...< UTILITY'S Commercial Deemed Incentive PROGRAM > during 2019?

1 Record name and start over

A1 <%UTILITY>... has indicated that your firm implements the <%Commercial Deemed Incentives PROGRAM> and was involved in selling and/or installing energy-efficient...<%Tankless WHs> throughout their service territory during 2019. Is this correct?

1 Yes A1.1

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]

A1.2 Great, we are trying to understand the water heater market in general. This includes standard and energy efficient models. Can you please give us a quick overview of the types of water heaters that you stock for Commercial customers?

RECORD ANSWER HERE:

A2 According to <%UTILITY>, your firm promotes and sells program-qualifying tankless water heaters through the <%UTILITY> Commercial Deemed Incentives Program. Is that correct??

1 Yes A3

2 No A11

[READ: Throughout the remainder of this survey, for the sake of brevity, I'm going to refer to the program qualifying equipment that you sell as "Tankless Water Heaters".]

The focus of this survey is on your business' sales and promotional practices of <% Tankless Water Heaters> **before** the COVID-19 shutdown. Please answer the following questions based on your business' approach during 2019; that is, before the COVID-19 shutdown.

A3 Now, I'm going to ask you about the various strategies you might have used to sell program-qualified Tankless Water Heaters. 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 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, I am going to ask you to rate the importance of the various UTILITY PROGRAM and NON-PROGRAM factors in influencing your decision to recommend Tankless Water Heaters to contractors and your other 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** Tankless Water Heaters to contractors and your other customers.

(Do not read – note that these are the program factors)

a. Program incentive — Record 0 to 10 score (_______)
b. Program promotional materials — Record 0 to 10 score (_______)
c. Program-provided training of sales staff — Record 0 to 10 score (_______)
d. Information from <%UTILITY> website — Record 0 to 10 score (_______)

(Do not read – note that these are the non-program factors)

e. Increased awareness of Tankless WH benefits among contractors and customers
Record 0 to 10 score (_______)

f. Reduced Tankless WH prices from Manufacturers
Record 0 to 10 score (_______)

g. Availability of manufacturers' promotional rebates/spiffs
Record 0 to 10 score (_______)

h. Information about the cost-effectiveness of more efficient units
Record 0 to 10 score (_______)

i. Increased stocking of high-efficiency Tankless WH Record 0 to 10 score (_______)

j. Past participation in <%UTILITY> rebate or audit program
Record 0 to 10 score (_______)

A4a. Was there another way the <Commercial Deemed Incentive Program> influenced your recommendations regarding your promotion of program-qualified Tankless Water Heaters?

RECORD ANSWER HERE:

A4aa. Using a 0 to 10 scale, how important was this factor's influence on your Tankless WH recommendations?

Record 0 to 10 score (_______) A5

Next, I am going to ask you to rate the importance of the <Commercial Deemed Incentive Program> in general in influencing your decision to recommend Tankless Water Heaters to <%UTILITY> contractors and customers.

A5 Using this 0 to 10 scale where 0 is NOT AT ALL IMPORTANT and 10 is EXTREMELY IMPORTANT, how important was the <Commercial Deemed Incentive Program>, including incentives as well as program services and information, in influencing your decision to recommend that <%UTILITY> contractors and customers purchase the energy efficiency Tankless water heaters at this time?

Record 0 to 10 value (_______) A5a

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?

#	Program Factors	Record 0 to 10 score (______)	A6
#	Non-Program Factors	Record 0 to 10 score (______)	A6

A6 And using a 0-to-10 likelihood scale where 0 is NOT AT ALL LIKELY and 10 is EXTREMELY LIKELY, if the Commercial Deemed Incentive 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 **Tankless water heater** measure to <%UTILITY>'s contractors and customers?

Record 0 to 10 score (________) A7

A7 Approximately, in what percent of sales situations did you recommend this **Tankless water heater** MEASURE before you learned about the **Commercial Deemed Incentive Program**?

% Record PERCENTAGE A8

A8 And approximately in what percent of sales situations do you recommend this **Tankless water heater** MEASURE now that you have worked with the **Commercial Deemed Incentive Program**?

% Record PERCENTAGE A9

A9 And what role, if any, has the <%UTILITY>'s **Commercial Deemed Incentive Program** played in increasing your recommendations of **Tankless Water Heaters** since you began working with the **Commercial Deemed Incentive Program**?

RECORD ANSWER HERE:

A10 Approximately, what percentage of your sales over the last 12 months of this **Tankless Water Heater** 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 and customers in <%UTILITY>'s territory to purchase program qualifying **tankless water heaters**?

% Record PERCENTAGE A11a

IF A11 << 100;

A11a In what situations do you NOT encourage your contractors and customers to purchase energy efficient **tankless water heaters** if they qualify for a rebate? Why is that?

RECORD ANSWER HERE:

A12 Of those installations of **Tankless water heaters** 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 **Tankless water heaters** in areas where contractors and other customers do not have access to incentives for energy efficient models?

1 Yes A14A

2 No A16

A14a. And what role, if any, have the California utilities' rebate programs played in your decision to promote and sell Tankless Water Heaters in areas where contractors/customers do not have access to incentives for energy efficient models?

RECORD ANSWER HERE:

A15 About what percent of your sales of **Tankless water heaters** are represented by these areas where incentives are not offered?

RECORD ANSWER HERE:

IF A15 > 10% & A15 < 100%;

A15a And approximately what percentage of your sales of **Tankless water heaters** 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	A16a
2	No	A17

A16a How so?

RECORD ANSWER HERE:

IF A14=1

A17 Do you promote energy efficient **Tankless water heaters** equally in areas with and without incentives?

1 Yes A18

2 No A18

A18 For the commercial program, we are trying to better understand the flow of benefits to distributors, contractors and customers. We understand that the Utility provides the incentives to you the distributor. How do your contractors and/or customers receive these benefits?

RECORD ANSWER HERE:

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

END OF SURVEY

APPENDIX D:

GROSS IMPACT DATA COLLECTION FORMS

This appendix includes the data collection forms used for each of the measures included in this evaluation:

- Process Ozone Laundry
- Process Pumping Variable Speed Drives (VFDs)
- Agricultural Irrigation
- Tankless Water Heaters

D-1 PROCESS OZONE LAUNDRY

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:		<Normalizing Unit>
Number of Units Installed (connected washing machine capacity)	Measure 1:		Pounds of material processed
	Measure 2:		Pounds of material processed
Project Application Date			
Project Installation Date			Engineer update below as needed [ENTER]:
Business Name			
Business Street Address			
Business City			
Facility Contact Name			
Facility Contact Phone Number			
Facility Contact E-mail Address			
Corporate Contact Name			
Corporate Contact Phone Number			
Corporate 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			
Customer Rep. Agrees to Take Pictures Y/N			
Engineer E-Mail Address to Send Pictures			
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:		
Account Number from Tracking Data	Measure 2:		

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	
O3 Laundry Controls Information	
Is there a central control system for the laundry area?	
Do you log information about laundry loads processed (dry weight, lbs/ wash,	
Can you share that with us?	
A full month of pre-retrofit and post-retrofit laundry load dry weight information is ideal	
Do you log information about water consumption (could be utility bills, etc.)?	
Can you share that with us? A full month's data would be ideal	
Decision Maker Contact Information	
Explain that we are also interested in a separate conversation with the project decision maker that ultimately made the facilty choice to purchase ozone laundry equipment (likely someone at corporate unless a smaller independent operation)	
Decision maker name	
Decision maker telephone number(s)	
Decision maker e-mail	
Best time to reach or schedule an appointment	
Project Information Requested from Participants	
Describe how facility operations and laundry in particular has been affected by COVID	
How long has your business been in operation at this location?	
Besides the new ozone laundry installation are there other changes to the facility since 2018 that might account for changes in natural gas usage at the facility? If so, describe:	

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)

Short NTG Battery (page 1 of 4)

Application # ________________________ <=== Enter Application Code

[Answer for Measure #1] **[Answer for Measure #2]**

Now we'd like to ask you some questions about your decision to purchase your ozone laundry equipment. Specifically, we are interested in why you chose to install ozone laundry equipment.

[Circle One Entry]	First, did your organization make the decision to install ozone laundry equipment before, after, or at the same time as you became aware that rebates were available through the PROGRAM? [IF NEEDED: to reduce the cost of the measure]	[Circle One Entry]	First, did your organization make the decision to install ozone laundry equipment before, after, or at the same time as you became aware that rebates were available through the PROGRAM? [IF NEEDED: to reduce the cost of the measure]
1	Before	**1**	Before
2	After	**2**	After
3	Same time	**3**	Same time
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

[Ask ALL]

[Answer for Measure #1] **[Answer for Measure #2]**

I'd like you to consider the importance of the program and all program related factors such as the program rebate; and the program information and recommendations you have received from your utility, account representative and program administrator. We are interested in how these program related factors affected your decision about the ozone laundry equipment you installed. That is, we are interested in what influenced you to choose to install ozone laundry equipment.

(Enter Score)	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 these program related factors.	(Enter Score)	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 these program related factors.
#	Record 0 to 10 score _______	#	Record 0 to 10 score _______
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Short NTG Battery (page 2 of 4)

Application # ___________________________ <=== Enter Application Code

[Ask ALL]

[Answer for Measure #1] **[Answer for Measure #2]**

Now I'd like you to consider a number of factors I will call the "non-program factors". These include reasons unrelated to the program that may have influenced you to choose to install ozone laundry equipment, such as choosing your equipment …

because it was standard practice in your industry,
because of previous experience with similar equipment,
because of corporate policies or guidelines,
or other reasons that were not related to the program

[Enter Score]	Using the same scale of 0 to 10 where 0 means not at all important and 10 means extremely important, how would you rate the importance of these "non-program" factors.	**[Enter Score]**	Using the same scale of 0 to 10 where 0 means not at all important and 10 means extremely important, how would you rate the importance of these "non-program" factors.
#	Record 0 to 10 score _______	#	Record 0 to 10 score _______
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

[Ask ALL]

[Answer for Measure #1] **[Answer for Measure #2]**

Next, I would like you to compare the importance of the program related factors to the other Non-program factors that may have influenced your decision.

If you were given 10 points to award in total, how many points would you give to the importance of the program related factors versus the other non-program factors in choosing to install ozone laundry equipment?

[Enter Score]	How many of the ten points would you give to the importance of the PROGRAM factors in your decision?	**[Enter Score]**	How many of the ten points would you give to the importance of the PROGRAM factors in your decision?
#	Record 0 to 10 score _______	#	Record 0 to 10 score _______
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Short NTG Battery (page 3 of 4)

Application # ___________________________ <=== Enter Application Code

[Ask ALL]

[Enter Score]	[Answer for Measure #1] 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 ozone laundry eqiupment that you did for this project, regardless of when you would have installed it?	[Enter Score]	[Answer for Measure #2] 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 ozone laundry eqiupment that you did for this project, regardless of when you would have installed it?
#	Record 0 to 10 score _______	#	Record 0 to 10 score _______
88	Refused	**88**	Refused
99	Don’t know	**99**	Don’t know

Provide additional comments as needed [ENTER] ===>

[Ask ALL]

Now I would like you to think about what action you would have taken if the program had not been available.

(Circle One Entry)	[Answer for Measure #1] Which of the following alternatives would you have been MOST likely to do if the program had not been available?	(Circle One Entry)	[Answer for Measure #2] Which of the following alternatives would you have been MOST likely to do if the program had not been available?
1	Waited longer to install ozone laundry equipment	**1**	Waited longer to install ozone laundry equipment
2	Install whatever is required by code	**2**	Install whatever is required by code
3	Install non-program qualifying ozone laundry equipment	**3**	Install non-program qualifying ozone laundry equipment
4	Done nothing (keep existing equipment as is)	**4**	Done nothing (keep existing equipment as is)
5	Installed the same ozone laundry equipment	**5**	Installed the same ozone laundry equipment
6	Upgrade existing laundry equipment	**6**	Upgrade existing laundry equipment
7	Make operation changes	**7**	Make operation changes
77	Something else _____ (Specify below)	**77**	Something else _____ (Specify below)
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Short NTG Battery (page 4 of 4)

Application # ____________________________ <=== Enter Application Code

[Ask IF response above =1, waited longer, else skip]

[Circle One Entry]	**[Answer for Measure #1]** And if the program had not been available…... How many years longer would you have waited to install ozone laundry equipment?	**[Circle One Entry]**	**[Answer for Measure #2]** How many years longer would you have waited to install ozone laundry equipment?
1	Within 1 year	**1**	Within 1 year
2	1-2 years	**2**	1-2 years
3	2-4 years	**3**	2-4 years
4	> 4 years	**4**	> 4 years
77	Something else _____ (Specify below)	**77**	Something else _____ (Specify below)
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

EE Measure Installation Verification

Application # ___________________________

[Ask ALL]

[Answer for Measure #1]

[Circle One Entry]	Did you replace a previously installed ozone laundry system with a new ozone laundry system?
1	Yes
2	No
3	Other / Provide Related Commentary Below [ENTER]

[Answer for Measure #2]

[Circle One Entry]	Did you replace a previously installed ozone laundry system with a new ozone laundry system?
1	Yes
2	No
3	Other / Provide Related Commentary Below [ENTER]

[If 1/yes above, then provide additional comments]

Provide additional comments to explain [ENTER] ===>

Application # ___________________________

[Ask ALL]

[Answer for Measure #1]

[Circle One Entry]	Is the newly installed Ozone laundry system operable at this time?
1	Yes
2	No
3	Other / Provide Related Commentary Below [ENTER]

[Answer for Measure #2]

[Circle One Entry]	Is the newly installed Ozone laundry system operable at this time?
1	Yes
2	No
3	Other / Provide Related Commentary Below [ENTER]

[If 2/No above, then provide additional comments]

Provide additional comments to explain [ENTER] ===>

[Ask ALL]

[Circle One Entry]	[Answer for Measure #1] Do you ever reset the temperature or bypass Ozone laundry use for certain wash cycles?	[Circle One Entry]	[Answer for Measure #2] Do you ever reset the temperature or bypass Ozone laundry use for certain wash cycles?
1	Yes	1	Yes
2	No	2	No
3	Other / Provide Related Commentary Below [ENTER]	3	Other / Provide Related Commentary Below [ENTER]

[If 1/Yes above, then provide additional comments]

Provide additional comments to explain [ENTER] ===>
Including frequency or percentage of loads
and specify unique operating conditions
relative to normal/typical loads

Application # ___________________________

[Ask ALL]

[Write Down Response]	[Answer for Measure #1] Record Make, Model and Other Equipment Specifications	[Write Down Response]	[Answer for Measure #2] Record Make, Model and Other Equipment Specifications
1	Make ____________________________________	1	Make ____________________________________
2	Model ___________________________________	2	Model ___________________________________
3	Rated Washer Capacity __________ pounds	3	Rated Washer Capacity __________ pounds
4	Take and send pictures?	4	Take and send pictures?
5	Maximum Flow Rate __________ gpm	5	Maximum Flow Rate __________ gpm

Provide additional comments as needed below	Provide additional comments as needed below

Post-Installation Washing Machines and Wash Cycles

Application # ___________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] How many washing machines are served by the ozone machine?	(Circle One Entry)	[Answer for Measure #2] How many washing machines are served by the ozone machine?
1	___________________ washing machines	1	___________________ washing machines
2	Other / Provide Related Commentary Below:	2	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

[Write Down Response]	[Answer for Measure #1] Record Make, Model and Other Washing Machine Specifications	[Write Down Response]	[Answer for Measure #2] Record Make, Model and Other Washing Machine Specifications
1	Make ___________________________________	1	Make ___________________________________
2	Model __________________________________	2	Model __________________________________
3	Rated Capacity __________ pounds dry weight laundry	3	Rated Capacity __________ pounds dry weight laundry
4	Modified Energy Factor __________ MEF	4	Modified Energy Factor __________ MEF
5	Take and send pictures	5	Take and send pictures
6	Front or top loading? __________	6	Front or top loading? __________

Provide additional comments as needed below

Provide additional comments as needed below

[Ask ALL]

(Write down response)	[Answer for Measure #1] What is the capacity of the average clothes washing machine, expressed in pounds of dry weight laundry? Alternatively, what is the volume of the average washing machine in cubic feet of capacity?	(Write down response)	[Answer for Measure #2] What is the capacity of the average clothes washing machine, expressed in pounds of dry weight laundry? Alternatively, what is the volume of the average washing machine in cubic feet of capacity?
1	___________________ pounds dry weight laundry	1	___________________ pounds dry weight laundry
2	___________________ cubic feet	2	___________________ cubic feet
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] Approximately what percentage of washing machine capacity is used on average per wash cycle (now)? [GET BEST ESTIMATE]	(Circle One Entry)	[Answer for Measure #2] Approximately what percentage of washing machine capacity is used on average per wash cycle (now)? [GET BEST ESTIMATE]
1	______________ %	1	______________ %
2	Other / Provide Related Commentary Below:	2	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] During the detergent/washing stage of each wash cycle is the water cold, warm or hot (now)? [GET BEST ESTIMATE]	(Circle One Entry)	[Answer for Measure #2] During the detergent/washing stage of each wash cycle is the water cold, warm or hot (now)? [GET BEST ESTIMATE]
1	Cold	1	Cold
2	Warm	2	Warm
3	Hot	3	Hot
4	Water Temperature __________ Deg F	4	Water Temperature __________ Deg F
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

[Answer for Measure #1]

(Circle One Entry)	During the rinsing stage of each wash cycle is the water cold, warm or hot (now)? [GET BEST ESTIMATE]
1	Cold
2	Warm
3	Hot
4	Water Temperature __________ Deg F
88	Refused
99	Don't know

[Answer for Measure #2]

(Circle One Entry)	During the rinsing stage of each wash cycle is the water cold, warm or hot (now)? [GET BEST ESTIMATE]
1	Cold
2	Warm
3	Hot
4	Water Temperature __________ Deg F
88	Refused
99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ____________________________

[Ask ALL]

[Answer for Measure #1]

(Circle One Entry)	Approximately how many gallons of hot water are consumed per wash cycle (now)? [GET BEST ESTIMATE]
1	Gals of hot water consumed: ______ gallons
2	Other / Provide Related Commentary Below:
88	Refused
99	Don't know

[Answer for Measure #2]

(Circle One Entry)	Approximately how many gallons of hot water are consumed per wash cycle (now)? [GET BEST ESTIMATE]
1	Gals of hot water consumed: ______ gallons
2	Other / Provide Related Commentary Below:
88	Refused
99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ____________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] What is the hot water temperature setpoint of the boiler or other water heating system that feeds the ozone laundry system/washers (now)? [GET BEST ESTIMATE]	(Circle One Entry)	[Answer for Measure #2] What is the hot water temperature setpoint of the boiler or other water heating system that feeds the ozone laundry system/washers (now)? [GET BEST ESTIMATE]
1	Hot water temperature: ______ deg. F	1	Hot water temperature: ______ deg. F
2	Take and send pictures	2	Take and send pictures
3	Other / Provide Related Commentary Below:	3	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] Approximately how many cycles of laundry are washed per day across all washing machines served by this ozone laundry machine (now)?	(Circle One Entry)	[Answer for Measure #2] Approximately how many cycles of laundry are washed per day across all washing machines served by this ozone laundry machine (now)?
1	Cyles per Day: ______ cycles	1	Cyles per Day: ______ cycles
2	Other / Provide Related Commentary Below:	2	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] Approximately how many days per week is laundry washed (now)?	(Circle One Entry)	[Answer for Measure #2] Approximately how many days per week is laundry washed (now)?
1	Days per week: ______ days	1	Days per week: ______ days
2	Other / Provide Related Commentary Below:	2	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

[Answer for Measure #1]		**[Answer for Measure #2]**	
(Circle One Entry)	Approximately how old is the average laundry machine in use (now)?	**(Circle One Entry)**	Approximately how old is the average laundry machine in use (now)?
1	Age in years: ______ years	**1**	Age in years: ______ years
2	Other / Provide Related Commentary Below:	**2**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Post-Installation Water Heating

Application # ____________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] How is water currently heated that serves the ozone laundry and washing machines?	(Circle One Entry)	[Answer for Measure #2] How is water currently heated that serves the ozone laundry and washing machines?
1	Gas boiler(s)	1	Gas boiler(s)
2	Gas storage water heater(s)	2	Gas storage water heater(s)
3	Gas Tanklwess water heater(s)	3	Gas Tanklwess water heater(s)
4	Take and send pictures	4	Take and send pictures
5	Other / Provide Related Commentary Below:	5	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ____________________________

[Ask ALL]

[Write Down Response]	[Answer for Measure #1] Record Make, Model and Other Water Heating Specifications	[Write Down Response]	[Answer for Measure #2] Record Make, Model and Other Water Heating Specifications
1	Make ____________________________________	1	Make ____________________________________
2	Model ___________________________________	2	Model ___________________________________
3	Rated Capacity __________ Btu	3	Rated Capacity __________ Btu
4	Combustion efficiency __________ %	4	Combustion efficiency __________ %

Provide additional comments as needed below

Provide additional comments as needed below

Application # ____________________________

[Ask ALL]

[Answer for Measure #1]		**[Answer for Measure #2]**	
(Circle One Entry)	Approximately how old is the water heating system in use (now)?	**(Circle One Entry)**	Approximately how old is the water heating system in use (now)?
1	Age in years: ______ years	**1**	Age in years: ______ years
2	Other / Provide Related Commentary Below:	**2**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

[Answer for Measure #1]		**[Answer for Measure #2]**	
(Circle One Entry)	Are you able to record information at this time for the <UTILITY> gas meter that serves the water heating (now)?	**(Circle One Entry)**	Are you able to record information at this time for the <UTILITY> gas meter that serves the water heating (now)?
1	Meter number on meter face: _________________	**1**	Meter number on meter face: _________________
2	Take and send picture of meter face?	**2**	Take and send picture of meter face?
3	Other / Provide Related Commentary Below:	**3**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle All that Apply)	**[Answer for Measure #1]** In addition to the water heating system serving the laundry machines, are there other gas using equipment on the same <UTILITY> gas meter, such as gas space heating equipment or gas cooking equipment (now)?	(Circle All that Apply)	**[Answer for Measure #2]** In addition to the water heating system serving the laundry machines, are there other gas using equipment on the same <UTILITY> gas meter, such as gas space heating equipment or gas cooking equipment (now)?
1	Other water heating equipment	1	Other water heating equipment
2	Gas space heating equipment	2	Gas space heating equipment
3	Gas cooking equipment	3	Gas cooking equipment
4	Describe other gas using equipment on <UTILITY> gas meter below:	4	Describe other gas using equipment on <UTILITY> gas meter below:
5	Water heater or boiler serving laundry is on a dedicated <UTILITY> meter	5	Water heater or boiler serving laundry is on a dedicated <UTILITY> meter
6	Other / Provide Related Commentary Below:	6	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle All that Apply)	**[Answer for Measure #1]** Does the water heating system that serves the laundry machines also provide hot water for other uses in the building (now)?	(Circle All that Apply)	**[Answer for Measure #2]** Does the water heating system that serves the laundry machines also provide hot water for other uses in the building (now)?
1	Used for cleaning	1	Used for cleaning
2	Used for cooking	2	Used for cooking
3	Used for bathing	3	Used for bathing
4	Describe other hot water uses below:	4	Describe other hot water uses below:
5	Water heating system is used exclusively to serve the laundry equipment	5	Water heating system is used exclusively to serve the laundry equipment
6	Other / Provide Related Commentary Below:	6	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Pre-Installation Washing Machines and Wash Cycles

Application # ___________________________

[Ask if washing machines where replaced at time as ozone laundry installation]

[Answer for Measure #1]		**[Answer for Measure #2]**	
(Circle One Entry)	Was the number of washing machines in operation before the installation of the ozone machine the same as current?	**(Circle One Entry)**	Was the number of washing machines in operation before the installation of the ozone machine the same as current?
1	Same number of washing machines	**1**	Same number of washing machines
2	Fewer washing machines __________ number	**2**	Fewer washing machines __________ number
3	More washing machines __________ number	**3**	More washing machines __________ number
2	Other / Provide Related Commentary Below:	**2**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask if washing machines where replaced at time as ozone laundry installation]

[Answer for Measure #1]		**[Answer for Measure #2]**	
(Write down response)	What was the capacity of the average clothes washing machine, expressed in pounds of dry weight laundry (then)? Alternatively, what was the volume of the average washing machine in cubic feet of capacity (then)?	**(Write down response)**	What was the capacity of the average clothes washing machine, expressed in pounds of dry weight laundry (then)? Alternatively, what was the volume of the average washing machine in cubic feet of capacity (then)?
1	___________________ pounds dry weight laundry	**1**	___________________ pounds dry weight laundry
2	___________________ cubic feet	**2**	___________________ cubic feet
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle One Entry)	**[Answer for Measure #1]** Approximately what percentage of washing machine capacity was used on average per wash cycle (then)? [GET BEST ESTIMATE]	(Circle One Entry)	**[Answer for Measure #2]** Approximately what percentage of washing machine capacity was used on average per wash cycle (then)? [GET BEST ESTIMATE]
1	______________ %	1	______________ %
2	Other / Provide Related Commentary Below:	2	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ____________________________

[Ask ALL]

(Circle One Entry)	**[Answer for Measure #1]** During the detergent/washing stage of each wash cycle was the water cold, warm or hot (then)? [GET BEST ESTIMATE]	(Circle One Entry)	**[Answer for Measure #2]** During the detergent/washing stage of each wash cycle was the water cold, warm or hot (then)? [GET BEST ESTIMATE]
1	Cold	1	Cold
2	Warm	2	Warm
3	Hot	3	Hot
4	Water Temperature __________ Deg F	4	Water Temperature __________ Deg F
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ____________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] During the rinsing stage of each wash cycle was the water cold, warm or hot (then)? [GET BEST ESTIMATE]	(Circle One Entry)	[Answer for Measure #2] During the rinsing stage of each wash cycle was the water cold, warm or hot (then)? [GET BEST ESTIMATE]
1	Cold	1	Cold
2	Warm	2	Warm
3	Hot	3	Hot
4	Water Temperature __________ Deg F	4	Water Temperature __________ Deg F
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] Approximately how many gallons of hot water were consumed per wash cycle (then)? [GET BEST ESTIMATE]	(Circle One Entry)	[Answer for Measure #2] Approximately how many gallons of hot water were consumed per wash cycle (then)? [GET BEST ESTIMATE]
1	Gals of hot water consumed: ______ gallons	1	Gals of hot water consumed: ______ gallons
2	Other / Provide Related Commentary Below:	2	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] What was the hot water temperature setpoint of the boiler or other water heating system that fed the washing machines (then)? [GET BEST ESTIMATE]	(Circle One Entry)	[Answer for Measure #2] What was the hot water temperature setpoint of the boiler or other water heating system that fed the washing machines (then)? [GET BEST ESTIMATE]
1	Hot water temperature: ______ deg. F	1	Hot water temperature: ______ deg. F
2	Other / Provide Related Commentary Below:	2	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

(Circle One Entry)	[Answer for Measure #1] Approximately how many cycles of laundry were washed per day across all washing machines (then)?	(Circle One Entry)	[Answer for Measure #2] Approximately how many cycles of laundry were washed per day across all washing machines (then)?
1	Cyles per Day: ______ cycles	1	Cyles per Day: ______ cycles
2	Other / Provide Related Commentary Below:	2	Other / Provide Related Commentary Below:
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask ALL]

[Answer for Measure #1]		**[Answer for Measure #2]**	
(Circle One Entry)	Approximately how many days per week was laundry washed (then)?	**(Circle One Entry)**	Approximately how many days per week was laundry washed (then)?
1	Days per week: ______ days	**1**	Days per week: ______ days
2	Other / Provide Related Commentary Below:	**2**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Pre-Installation Water Heating

Application # ___________________________

[Ask All]

(Circle One Entry)	[Answer for Measure #1] Was the same water heating system and <UTILITY> gas meter used to supply the laundry equipment prior to ozone laundry system installation?	(Circle One Entry)	[Answer for Measure #2] Was the same water heating system and <UTILITY> gas meter used to supply the laundry equipment prior to ozone laundry system installation?
1	Same water heating system was in place then	**1**	Same water heating system was in place then
2	Same <UTILITY> gas meter supplied hot water to laundry machines	**2**	Same <UTILITY> gas meter supplied hot water to laundry machines
3	Different -- Gas boiler(s)	**3**	Different -- Gas boiler(s)
4	Different -- Gas storage water heater(s)	**4**	Different -- Gas storage water heater(s)
5	Different -- Gas Tanklwess water heater(s)	**5**	Different -- Gas Tanklwess water heater(s)
6	Different <UTILITY> gas meter supplied hot water to laundry machines	**6**	Different <UTILITY> gas meter supplied hot water to laundry machines
7	Other / Provide Related Commentary Below:	**7**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask if water heating system was replaced at time of ozone laundry installation]

[Write Down Response]	[Answer for Measure #1] Record Previous Hot Water System Make, Model and Other Water Heating Specifications	[Write Down Response]	[Answer for Measure #2] Record Previous Hot Water System Make, Model and Other Water Heating Specifications
1	Make ____________________________________	**1**	Make ____________________________________
2	Model ___________________________________	**2**	Model ___________________________________
3	Rated Capacity __________ Btu	**3**	Rated Capacity __________ Btu
4	Combustion efficiency __________ %	**4**	Combustion efficiency __________ %

Provide additional comments as needed below

Provide additional comments as needed below

Application # ___________________________

[Ask if water heating system was replaced at time of ozone laundry installation]

(Circle One Entry)	**[Answer for Measure #1]** Approximately how old was the water heating system that was replaced (then)?	**(Circle One Entry)**	**[Answer for Measure #2]** Approximately how old was the water heating system that was replaced (then)?
1	Age in years: ______ years	**1**	Age in years: ______ years
2	Other / Provide Related Commentary Below:	**2**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Application # ___________________________

[Ask if water heating system was replaced at time of ozone laundry installation]

(Circle One Entry)	**[Answer for Measure #1]** Was the replaced water heating system on the same <UTILITY> meter (then)?	**(Circle One Entry)**	**[Answer for Measure #2]** Was the replaced water heating system on the same <UTILITY> meter (then)?
1	Yes	**1**	Yes
2	No	**2**	No
3	Other / Provide Related Commentary Below:	**3**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

2020 Laundry System Operation by Measure

Measure # ___________________________

Application # ___________________________

Month of 2020	Where there any months in 2020 with normal or typical levels of laundry use? **[Check All that Apply]**	For months with atypical or abnormal levels of laundry use, express laundry loads as fraction relative to normal use? **[Enter Fractions]**	Describe what led to these differences? **[Enter Explanation]**	Is laundry use by month in 2020 generally comparable with laundry use in 2019? **[Check All that Apply]**	For months with differing laundry use in 2020, express laundry loads as fraction relative to 2019 use? **[Enter Fractions]**	Is laundry use by month in 2020 generally comparable with laundry use in 2018? **[Check All that Apply]**	For months with differing laundry use in 2020, express laundry loads as fraction relative to 2018 use? **[Enter Fractions]**
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]

2020 Laundry System Operation by Measure

Measure # ___________________________

Application # ___________________________

Month of 2020	Were there any months in 2020 with a normal or typical mix of fabric in the wash loads? **[Check All that Apply]**	For months with an unusual mix of fabric explain what led to these differences? **[Enter Explanation]**	Are you able to articulate how the fabric mix is different? **[Enter Explanation]**	Is the mix of fabric by month in 2020 generally comparable with the fabric mix in 2019? **[Check All that Apply]**	For months with differing fabric mix in 2020, describe what led to the differences relative to 2019? **[Enter Explanation]**	Is the mix of fabric by month in 2020 generally comparable with the fabric mix in 2018? **[Check All that Apply]**	For months with differing fabric mix in 2020, describe what led to the differences relative to 2018? **[Enter Explanation]**
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]

2020 Facility Natural Gas Use

Measure # ___________________________

Application # ___________________________

Month of 2020	Where there any months in 2020 with normal or typical levels of natural gas use across all usage, such as cleaning, bathing, cooking, heating, etc.? **[Check All that Apply]**	For months with atypical or abnormal levels of natural gas use, express natural gas usage as fraction relative to normal use? **[Enter Fractions]**	Describe what led to these differences? **[Enter Explanation]**	Other than ozone laundry differences, do you think natural gas use by month in 2020 is generally comparable with natural gas use in 2019? **[Check All that Apply]**	For months with differing natural gas use in 2020, express natural gas use as fraction relative to 2019 use? **[Enter Fractions]**	Other than ozone laundry differences, do you think natural gas use by month in 2020 is generally comparable with natural gas use in 2018? **[Check All that Apply]**	For months with differing natural gas use in 2020, express natural gas use as fraction relative to 2018 use? **[Enter Fractions]**
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]

Provide of sketch of the Laundry Operation, depicting the ozone system and related washing machines

Additional Notes from Interview

D-2 PROCESS PUMPING VARIABLE SPEED DRIVES (VFDS)

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			
Facility Contact Name			
Facility Contact Phone Number			
Faciity Contact E-mail Address			
Decision Maker Contact Name			
Decision Maker Contact Phone Number			
Decision Maker 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			
Customer Rep. Agrees to Take Pictures Y/N			
Engineer E-Mail Address to Send Pictures			
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 Measure 1 Y/N			
If no, describe other loads on meter including			
Associated Electric Meter Number for Measure 1			
Account Number from Tracking Data	Measure 2:		
Dedicated Electric Meter for Pump Measure 2 Y/N			
If no, describe other loads on meter including			
Associated Electric Meter Number for Measure 2			

On-Site 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?	
Decision Maker Contact Information	
Explain that we are also interested in a separate conversation with the project decision maker that ultimately made the farmers choice to purchase VFD pump controls (likely the farmer him/herself)	
Possibly offer a $100 incentive to gain full cooperation for both data collection elements	
Decision maker name	
Decision maker telephone number(s)	
Decision maker e-mail	
Best time to reach or schedule an appointment	
Project Information Requested from Participants	
Describe how farm operations and irrigation in particular has been affected by COVID	
Monthly pumped water data for last three years	

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)

EE Measure Replacement Battery (page 1 of 4)

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] ===>

EE Measure Replacement Battery (page 2 of 4)

Application # ___________________________ <=== Enter Application Code

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

[Circle One Entry]	**[Answer for Measure #1]** How would you describe the condition of the pump being controlled by the VFD? Would you say it is in…	**[Circle One Entry]**	**[Answer for Measure #2]** 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]

[Circle One Entry]	**[Answer for Measure #1]** How many years are left in the pump itself until you will replace it?	**[Circle One Entry]**	**[Answer for Measure #2]** 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] ===>

EE Measure Replacement Battery (page 3 of 4)

Application # ____________________________ <=== Enter Application Code

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

[Circle One Entry]	[Answer for Measure #1] What type of pump flow controls were in place BEFORE the VFD was installed?	[Circle One Entry]	[Answer for Measure #2] 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]

(Circle One Entry)	[Answer for Measure #1] Approximately how old were the replaced pump flow controls? Would you say...	(Circle One Entry)	[Answer for Measure #2] 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] ===>

EE Measure Replacement Battery (page 4 of 4)

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] ===>

EE VFD Battery (page 1 of 4)

Application # ____________________ <=== Enter Application Code

[Ask ALL]

	[Answer for Measure #1]		**[Answer for Measure #2]**
[Circle One Entry]	What was the main reason you decided to control your pump flow using a VFD?	**[Circle One Entry]**	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	**31**	Wanted improved pump performance or functionality
32	Other / Provide Related Commentary Below:	**32**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don’t know	**99**	Don’t know

Provide additional comments as needed [ENTER] ===> ____________________

EE VFD Battery (page 2 of 4)

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	**33**	Yes
34	No	**34**	No
35	Other / Provide Related Commentary Below:	**35**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

EE VFD Battery (page 3 of 4)

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	36	Within a one-year period
37	Between 1 and 2 years	37	Between 1 and 2 years
38	Between 2 and 4 years	38	Between 2 and 4 years
39	4 or more years	39	4 or more years
40	Would never have installed a VFD	40	Would never have installed a VFD
41	Stated _______ years	41	Stated _______ years
88	Refused	88	Refused
99	Don't know	99	Don't know

Provide additional comments as needed [ENTER] ===>

EE VFD Battery (page 4 of 4)

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] ===>

Short NTG Battery (page 1 of 4)

Application # ____________________________ <=== Enter Application Code

[Answer for Measure #1] **[Answer for Measure #2]**

Now we'd like to ask you some questions about your decision to purchase your VFD flow controls. Specifically, we are interested in why you chose that VFD flow controls rather than a less efficient flow contrtol option.

[Circle One Entry]	First, did your organization make the decision to install VFD flow controls before, after, or at the same time as you became aware that rebates were available through the PROGRAM? [IF NEEDED: to reduce the cost of the measure]	[Circle One Entry]	First, did your organization make the decision to install VFD flow controls before, after, or at the same time as you became aware that rebates were available through the PROGRAM? [IF NEEDED: to reduce the cost of the measure]
1	Before	**1**	Before
2	After	**2**	After
3	Same time	**3**	Same time
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

[Ask ALL]

[Answer for Measure #1] **[Answer for Measure #2]**

I'd like you to consider the importance of the program and all program related factors such as the program rebate; and the program information and recommendations you have received from your utility, account representative and program administrator. We are interested in how these program related factors affected your decision about the VFD flow controls you installed. That is, we are interested in what influenced you to choose VFD flow controls you did rather than a less efficient flow control option.

(Enter Score)	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 these program related factors.	(Enter Score)	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 these program related factors.
#	Record 0 to 10 score _______	#	Record 0 to 10 score _______
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Short NTG Battery (page 2 of 4)

Application # ___________________________ <=== Enter Application Code

[Ask ALL]

[Answer for Measure #1] **[Answer for Measure #2]**

Now I'd like you to consider a number of factors I will call the "non-program factors". These include reasons unrelated to the program that may have influenced you to choose VFD flow controls rather than a less efficient flow control option, such as choosing your equipment …

because it was standard practice in your industry,
because of previous experience with similar equipment,
because of corporate policies or guidelines,
or other reasons that were not related to the program

[Enter Score]	Using the same scale of 0 to 10 where 0 means not at all important and 10 means extremely important, how would you rate the importance of these "non-program" factors.	**[Enter Score]**	Using the same scale of 0 to 10 where 0 means not at all important and 10 means extremely important, how would you rate the importance of these "non-program" factors.
#	Record 0 to 10 score _______	#	Record 0 to 10 score _______
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

[Ask ALL]

[Answer for Measure #1] **[Answer for Measure #2]**

Next, I would like you to compare the importance of the program related factors to the other Non-program factors that may have influenced your decision.

If you were given 10 points to award in total, how many points would you give to the importance of the program related factors versus the other non-program factors in choosing pump VFD flow controls, rather than a less efficient flow control option?

[Enter Score]	How many of the ten points would you give to the importance of the PROGRAM factors in your decision?	**[Enter Score]**	How many of the ten points would you give to the importance of the PROGRAM factors in your decision?
#	Record 0 to 10 score _______	#	Record 0 to 10 score _______
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Short NTG Battery (page 3 of 4)

Application # ___________________________ <=== Enter Application Code

[Ask ALL]

[Enter Score]	**[Answer for Measure #1]** 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 VFD flow controls that you did for this project, regardless of when you would have installed it?	**[Enter Score]**	**[Answer for Measure #2]** 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 VFD flow controls that you did for this project, regardless of when you would have installed it?
#	Record 0 to 10 score _______	#	Record 0 to 10 score _______
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

[Ask ALL]

Now I would like you to think about what action you would have taken if the program had not been available.

(Circle One Entry)	**[Answer for Measure #1]** Which of the following alternatives would you have been MOST likely to do if the program had not been available?	**(Circle One Entry)**	**[Answer for Measure #2]** Which of the following alternatives would you have been MOST likely to do if the program had not been available?
1	Waited longer to install VFD	**1**	Waited longer to install VFD
2	Install standard flow controls such as throttling valve controls	**2**	Install standard flow controls such as throttling valve controls
3	Install bypass controls	**3**	Install bypass controls
4	Done nothing (keep existing controls)	**4**	Done nothing (keep existing controls)
5	Installed the same VFD flow controls	**5**	Installed the same VFD flow controls
6	Repair the existing flow controls	**6**	Repair the existing flow controls
77	Something else _____ (Specify below)	**77**	Something else _____ (Specify below)
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

Short NTG Battery (page 4 of 4)

Application # ____________________________ <=== Enter Application Code

[Ask IF response above =1, waited longer, else skip]

[Answer for Measure #1]		**[Answer for Measure #2]**	
	And if the program had not been available…...		
[Circle One Entry]	How many years longer would you have waited to install pump VFD flow controls	**[Circle One Entry]**	How many years longer would you have waited to install pump VFD flow controls
1	Within 1 year	**1**	Within 1 year
2	1-2 years	**2**	1-2 years
3	2-4 years	**3**	2-4 years
4	> 4 years	**4**	> 4 years
77	Something else _____ (Specify below)	**77**	Something else _____ (Specify below)
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

Provide additional comments as needed [ENTER] ===>

2020 Pumping System Operation by Measure

Measure # ___________________________

Application # ___________________________

IOU Measure Description ___________________________

Number of units installed # ___________________________

Month of 2020	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 any other pumps that irrigate the same acreage, and how/when those pumps operate relative to the pump w/ VFD.	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]	Provide additional comments as needed [ENTER BELOW]

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 any other pumps that irrigate the same acreage, and how/when those pumps operate relative to the pump w/ VFD.	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]	Provide additional comments as needed [ENTER BELOW]

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 any other pumps that irrigate the same acreage, and how/when those pumps operate relative to the pump w/ VFD.	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]	Provide additional comments as needed [ENTER BELOW]

2020 Pumping System Operation by Measure (part 2) (page 1 of 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]

2020 Pumping System Operation by Measure (part 2) (page 2 of 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]

EE Measure Installation Verification

Measure # ___________________________
Application # ___________________________
IOU Measure Description ___________________________
Number of units installed # ___________________________

[Circle One Entry]	Was the VFD installed and operable at the time of the interview?	
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] ===>

EE Pumping System Specifications

Measure # ___________________________
Application # ___________________________
IOU Measure Description ___________________________
Number of units installed # ___________________________

[ENTER OBSERVED PUMP OPERATIONS]	**[Circle One per Line or Write Down Units if Different]**
Pump Type ___________________________	Vertical turbine Submersible Centrifugal
Pumping Application ___________________________	Booster pump Well pump
Current Operating Output Pressure ___________________________	PSIG
Current Operating Flow Rate ___________________________	gpm
[ENTER VFD OBSERVED OPERATIONS]	
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	

Please provide of sketch of the Pumping Operation/ Field, depicting pump configuration (On-site only)

Additional Notes from Interview

D-3 Agricultural Irrigation

Category	Dialogue	Response	Additional notes
Introduction	Hello, is this #####?		
	[If yes] Hi, my name is ________________, calling on behalf of PG&E about an irrigation conversion project that was rebated in 2019. Does this project sound familiar?		
Different Contact	[If no] Is there someone I can talk to who might be more familiar with the PG&E rebate application?		
	[If yes] Can I get that person's contact information?		
	[Record contact information]		[record name and number]
Introduction Continued	[If yes] Great! PG&E and the State of California are conducting a research study to assess the energy savings performance of irrigation conversions like the one that occurred at your farm.		
	My company, ERS, has been contracted to analyze the energy savings associated with irrigation conversion projects in order to improve PG&E's energy efficiency programs.		
	As part of the program assessment, we are reaching out to past participants to collect some information that will be helpful in determining actual energy savings.		
	Do you have approximately 15 minutes for this survey?		
	[If no] Would it be possible to schedule a time for this survey over the next couple of weeks? Or if you prefer, we can send you an email version of the survey.		[record date/time for callback] [or record email address]
Basic Project Details	[If yes] Ok great. First, I'd like to get a few basic details about the project.		
	According to our records, the project involved the conversion of #### acres to a drip irrigation system. Is this correct?		
	[If no] Can you estimate the number of acres that underwent the irrigation conversion and were rebated by PG&E?		[record acreage]
	[If yes] Great. And just to confirm, our records indicate that the farm is located at ######. Is this correct?		
	[If no] Where is the farm located?		[record address and town]
	When did the irrigation project occur?		[record date]
	PG&E classified the project as a Sprinkler to Drip Irrigation conversion. Can you elaborate on what was actually installed through this project?		[record in their words]
Crop Details	Ok. Next, I want to confirm a couple of details about the farmland that was converted to drip irrigation.		
	What types of crops are currently grown on this acreage?		[record addt'l crops and their acreage here]
Irrigation Details	Ok. Next, I'll ask a few questions about your irrigating schedule.		
	At what month of the year does the crop growing season begin?		
	What month of the year does the crop growing season end?		
	Does irrigation occur outside the growing season?		
	[If yes] At what month of the year does irrigation begin?		
	[If yes] At what month does irrigation end?		
	Is the acreage divided into multiple sets for irrigation?		
	[If yes] How many sets?		[record number of sets]
	About how many times per month, on average, is each set irrigated over the course of the growing season?		[record number of irrigations]
	[Alternative] During the hottest/driest month, how many times is each set irrigated?		[record number of irrigations]
	For how many hours is each set typically irrigated at a time?		[record number of hours]
	Have your irrigation practices changed due to drought conditions in recent years? *(if yes, explain how)*		[record in their own words]
	What is the source of the irrigation water? *(see dropdown: district water main, well, other (use notes), unknown)*		
	How many pumps supply the water for the new irrigation system?		[record number of pumps]
	What is the total pumping horsepower for the new irrigation system?		[record total horsepower]
	How are the irrigation pumps controlled? *(see dropdown: constant speed, two-speed, soft start, VFD, other- use notes)*		
	About what discharge pressure do the irrigation pumps currently operate at?		[record in psi]
Rebated System Details	Next, I'd like to get some information on the type of irrigation system you installed.		
	Can you provide the make and model of the emitters installed?		[record make/model]
	Do you recall the rated gallons-per-minute or gallons-per-hour of the emitters?		[indicate gpm or gph]
	Can you estimate the number of emitters per acre?		

Category		Dialogue	Response	Additional notes
Pre-project Details		Ok great. The next questions are about the farm before the new irrigation system was installed.		
		Was the farm's acreage divided into similar sets before the project?		
		[If no] How was the acreage divided before the project?		*[record number of sets and acreage of each]*
		Were similar crops grown at the farm before the new irrigation system was installed?		
		[If no] What crops were grown before the project?		*[record old crop type - should be different from cell D24]*
		[If either pre or post is deciduous] How old were the trees at the time of the project?		*[record age]*
		[If different crop] At what month of the year did the old crop's growing season begin?		*[record month]*
		[If different crop] At what month of the year did the old crop's growing season end?		*[record month]*
		[If different crop] Did irrigation occur outside of the growing season?		
		[If yes] In which month did the old crop's irrigation begin?		*[record month]*
		[If yes] In which month did the old crop's irrigation end?		*[record month]*
		What type of irrigation system was in place before the project? *(see dropdown: flood, furrow, sprinkler, drip tape)*		*[record irrigation method]*
		[If sprinkler] Do you recall the make, model, or nozzle color of the old sprinkler nozzles?		*[record sprinkler make/model/color nozzle]*
		[If flood/furrow] About how many inches deep did you flood the field during each irrigation?		*[record irrigation depth in inches]*
		How old was your existing irrigation equipment?		*[record age in years]*
		What condition was the exisitng irrigation equipment in?		
		How much longer do you think it would have lasted if you had not replaced it?		*[record age in years]*
		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?		
		About how many times per month, on average, was each set irrigated over the course of the old crop's growing season?		*[record number of irrigations]*
		[Alternative] During the hottest/driest month, how many times was each set irrigated?		*[record number of irrigations]*
		For how many hours was each set typically irrigated at a time?		*[record number of hours]*
		Did the irrigation water come from a different source before the project?		
		[If yes] What was the source of the irrigation water?		*[record water source]*
		Was the irrigation pumping plant any different before the project?		
		[If yes] How many irrigation pumps supplied the water before the project?		*[record number of pumps]*
		[If yes] What was the total horsepower of the irrigation pumps?		*[record total horsepower]*
		[If yes] How were the irrigation pumps controlled? *(see dropdown: constant speed, two-speed, soft start, VFD, other- use notes)*		*[record pump control method]*
		[If yes] Was the old pump powered by a PG&E electric meter?		*[record yes/no; this response affects project eligiblity]*
		About what pressure did the irrigation pumps operate at before the project?		*[record discharge psi]*
		Thank you for your time in helping to improve PG&E's programs.		

Phone survey date:	

Reference Information if Needed

Contact at CPUC		I'd be happy to direct you to our contact at the California Public Utilities Commission. Her name is Mona Dzvova, and she can be reached at mona.dzvova@cpuc.ca.gov.
Confidentiality		The information we collect during this study will be kept confidential to the California Public Utilities Commission and its contractors.
		The results of each site assessment will be aggregated and kept anonymous in any subsequent public reports.
		The information we collect will not in any way influence your past or future participation in any PG&E energy efficiency programs.
		The results of the study will in no way impact your PG&E electric bill.

D-4 TANKLESS WATER HEATERS

Category heading
Fill in
Auto-populated

General Info

ERS Site ID	
Visit Date & Time	
Field Engineer	
PA Site ID	
Facility/Customer Name	
Street Address	
City	
Building Type	
Climate Zone	
Contact	
Phone	
Project Installation Date	

BEFORE CONTACTING SITES - check if site area is affected by:
Wildfires ----------------------->>>>>> https://www.fire.ca.gov/incidents/
https://gispub.epa.gov/airnow/
Power Outages -------------->>>>>> https://pgealerts.alerts.pge.com/updates/

Measure Data

ID#	Measure Description	Capacity (kBtu/h)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

	Question	Response detail	Response	Note
Introduction	Hello, my name is ______________________ and I'm calling from ERS on behalf of [PG&E/SCG].			
	My company has been contracted by the California Public Utilities Commission to analyze the energy savings associated with projects funded by [PG&E's/SCG's] Tankless Water Heater midstream incentive programs. The tankless water heater installation(s) for [Facility Name/Owner] in [Install Year] has been selected for this evaluation and we would greatly appreciate your participation in this important study.			
	Our records indicate that your organization installed [Describe size and quantity of TWHs] through the program on [Install Date]. Does this sound familiar? [If yes] record name and title of respondent and proceed [If no] Is there someone I can talk to who might be more familiar with this particular project? [Record contact information and retry.]	*Record name and title of respondent [Site Contact]*		Record contact info here
	Our original plan for the evaluation was to conduct a site visit to the facility to confirm measure installation and collection water heater operational data to estimate energy savings. However, to avoid any risks associated with exposure to the COVID-19 virus, we are conducting virtual assessments in place of site visits to gather data for our evaluation analysis. I would like to ask you a few questions about the project, the building characteristics, and the measure's operation prior to the COVID-19 pandemic to gather data for the evaluation. It would take approximately 30 minutes for this assessment.			
	Would now be a good time for you to talk? [If not, obtain the time that would work best for site contact]	Schedule time for call		
	You may have been contacted already by a [RMS call center] we are working with to complete surveys about the decision making process. Are you familiar with and could you speak to the decision to install this equipment?			
	[If no] Who could I speak to that would be familiar with this decision? (record contact information, and proceed) We are working with a [RMS call center] to complete interviews on the decision making process to install this equipment. They may reach out to [decision maker name] in the coming weeks. Today, I'd like to get a few basic details about the project and the installed water heater(s).	*Record name and title of respondent [Decision Maker]*		Record contact info here
	[If yes] We are working with a [RMS call center] to concurrently complete interviews on the decision making process, have you already been contacted by the [RMS call center]? [If yes] Ok great, then I only need to get some basic details about the project and the installed water heater(s) (complete gross data collection, not NTG survey) [If no] Ok great. First, I'd like to get a few basic details about the project and the installed water heater(s) (complete both gross and NTG survey)			

	Question	Response detail	Response	Note
Project Tracking & Facility Details	According to our records, the project occurred at [Site Address], Is this correct?	*Confirm installation site, note if different*		
	We see from our records that the tankless or "instantaneous" water heaters were installed in [Month/Year]. Is this correct?	*Month/Year*		
	Is your natural gas service provided by [Utility]? Is gas used for water heating?	*Confirm correct utility*		
	Can you provide the contact information of the vendor who assisted you with the project installation?	*Provide contact info*		Record contact info here
	Would you classify the building as a [Building Type]?	*Record bldg type*		Record bldg type here
Operational Details	What are the facility's typical hours of operation?	*record day/wk/yr hours*		
	Does the facility operate on holidays? Indicate holidays with no operation.	*If no, list holidays*		
	Is there any seasonality associated with the building operations that could have an impact on the energy bills?	*If yes, explain*		
	Do the new tankless water heaters serve a DHW circulation system/loop or use external storage tank? [if yes] What are the size or size(s) of the HW storage tanks	*If yes, record details on tank volume(s)*		
	Do the tankless water heaters provide hot water for space heating? (if yes, TWH used for space heating are ineligible)	*If yes, explain*		

As part of our energy study, we are hoping to gather information about the installed 'tankless' water heaters.
(Methods: 1) video conference, or 2) photos of WHs/nameplates, etc or 3) over the phone have contact read out WH model numbers and other information)

•**If you choose to record the video conference; be sure to notify the contact and ask for their permission first. California is a two-party consent state for recording private or confidential conversations**

1) Have the contact go to the water heaters (recently installed; 2019) to visually inspect (at least 3 WHs; if there are 3 or more sizes or models - randomly select one of each, up to 3)
- A) If the location had several water heaters installed that were incentivized;
  - 1) If they are willing, collect information on all of them, even if these were not in the sample.
  - 2) If they are hesitant have them only help you inspect the ones we sampled.
  - 3) If they have multiple water heaters of the same size that were incentivized AND they are hesitant to inspect all of them -> have them randomly select one to inspect.
- B) Have them take photos of the water nameplate(s)
- C) Have them get the hot water temperature (supply temperature) off the water heaters display (if it has one).

		CRITICAL			CRITICAL			CRITICAL				
	Question											Note
Measure Specifications - TWH Information	**[Gather TWH nameplate information from the measure units]**; [either by video conference walkthrough, photos of nameplate, or interview]											
					Efficiency					Water Temperature		
	WH #	Make/Model	Location	Max GPM (@ temp rise)	UEF or EF	Et (thermal eff)	Recovery Efficiency	Input Capacity (Btu/h)	Quantity	Water Supply Temp (F) - Setpoint	Inlet Water Temp (F)*	
	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											
	10											
	11											
	12											
	13											
	14											
	15											
	16											
	17											
	18											
	19											
	20											

*Temperature in will be based on default city water temperatures

Pre-Existing Water Heating Technology & EUL Questions	What kind of water heaters were replaced by the new tankless water heaters? (Storage/tankless?)	*Dropdown*		
	Were fuel did your previous water heaters natural use, natural gas, propane, or electric?	*Dropdown*		
	(for Storage) What size were the storage water heaters? (for tankless) What was the rated heating capacity? (e.g., kBtu/h)	*Record typical or average size if different sizes*		
	How many water heaters were installed previously?	*Record quantity of pre-existing water heaters*		
	How old was your existing water heater equipment?†	*Dropdown*		
	What condition was the existing water heating equipment in?	*Dropdown*		
	How much longer do you think your existing water heater(s) would have lasted if you had not replaced it?	*RUL estimate (in years)*		
	How is your new tankless water heater(s) functioning so far?	*Dropdown*		
	When are you anticipating replacing your water heater(s) next?	*Estimate in years*		

† Use increments of 5 years for estimation

Conclusion	Thank you for taking the time to answer these questions today. We may call back in the future if we need further clarification on anything that was discussed.	*No response required*		
	Again, thank you for taking time to answer my questions.			

Reference Information if Needed

"This evaluation and the results of our measurement and verification will have no impact on the incentive you have already received, or your eligibility for future projects."
"Your responses will not affect your ability to participate in the program in the future. All information obtained in this evaluation will be strictly confidential."
"I am not selling anything. I simply want to estimate the impacts from the energy efficiency measure that was installed with assistance from this program."

Other Notes

APPENDIX E:

MEASURE NAME TO ESPI MAPPING

PA	ESPI_Category	Measure Description
PGE	AG IRRIGATION	Sprinkler to Drip irrigation - Field/Vegs (well and non well)
PGE	PROCESS OZONE LAUNDRY	Ozone Laundry
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- 10HP
PGE	PROCESS PUMPING VFD	Glycol Pump VFD- 25HP
PGE	PROCESS PUMPING VFD	Glycol Pump VFD- 7.5HP
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 T2 LED LTBAR <= 5FT UNIT NO OCC SENS CTRL REPLACE MULT LAMP PROFILE
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	WATER HEATING STORAGE WATER HEATER	Condensing Hot Water Heater 300-2500 kBTUh TE>94%
PGE	WATER HEATING STORAGE WATER HEATER	Condensing Hot Water Heater >2500 kBTUh TE>94%
PGE	WATER HEATING STORAGE WATER HEATER	Condensing Hot Water Heater, 300-2500 kBTUh, TE>94%
PGE	WATER HEATING STORAGE WATER HEATER	Condensing Hot Water Heater, >2500 kBTUh, TE>94%
PGE	WATER HEATING STORAGE WATER HEATER	Condensing domestic hot water heater with thermal efficiency > 90%. Minimum 75 kBTUh input rating
PGE	WATER HEATING STORAGE WATER HEATER	Forced Draft Hot Water Heater 300-2500 kBTUh TE>85%
PGE	WATER HEATING STORAGE WATER HEATER	Forced Draft Hot Water Heater >2500 kBTUh TE>83%
PGE	WATER HEATING STORAGE WATER HEATER	Forced Draft Hot Water Heater, 300-2500 kBTUh, TE>85%
PGE	WATER HEATING STORAGE WATER HEATER	Forced Draft Hot Water Heater, >2500 kBTUh, TE>83%
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 - Condensing, > 200 kBTUh, > 90% TE
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 > 200 kBTUh > 85% 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 Booster Pumps (<=150hp) NEW Express only
SCE	PROCESS PUMPING VFD	Variable Frequency Drive on Agricultural Well Pumps (<=300hp)
SCE	PROCESS PUMPING VFD	Variable Frequency Drive on Agricultural Well Pumps (<=300hp) NEW Express only
SCG	PROCESS OZONE LAUNDRY	Ozone Laundry
SCG	WATER HEATING CONTROLS	Demand-controlled DHW recirculation pump in commercial buildings
SCG	WATER HEATING STORAGE WATER HEATER	50 Gallon Medium Draw water heater with a rating of =0.64 UEF
SCG	WATER HEATING STORAGE WATER HEATER	Central System Natural Gas Storage Water Heater Tier II (>=90%TE)
SCG	WATER HEATING STORAGE WATER HEATER	Large Storage Water heater >= 75 kBTUh and/or TE >= 90%, UEF >= .76 for MD, UEF >= .80 for HD Units
SCG	WATER HEATING TANKLESS WATER HEATER	Small Tankless Water Heater, Tier 2 (UEF>=0.87), High Draw
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)-Tier1(>=80%TE)
SCG	WATER HEATING TANKLESS WATER HEATER	TanklessWaterHeaters-Large(>200MBtuh)-Tier2(>=90%TE)
SDGE	PROCESS OZONE LAUNDRY	Ozone Laundry System (SWAP005A)
SDGE	PROCESS PUMPING VFD	VFD on New Agricultural Well Pumps for 300 HP and below
LCE	null	(1) 60in Retrofits in Low Temp Reach-in Display Cases LED
LCE	null	(1) 60in Retrofits in Medium Temp Reach-in Display Cases LED
LCE	null	(1) 72in Retrofits in Medium Temp Reach-in Display Cases LED
MCE	null	HUMIDISTAT CONTROL FOR ANTI-SWEAT HEATERS
PGE	null	0.5 GPM Flow Rate Laminar Flow Restrictor being installed on a 2.7 GPM Flow Rate Faucet Base Case
PGE	null	1 inch Insulation layer <= 1 inch pipe >15 psig steam Indoor
PGE	null	1 inch Insulation layer, 1 inch < pipe <= 4 inch, <=15 psig steam, Indoor
PGE	null	1 inch Insulation layer, 1 inch < pipe <= 4 inch, >15 psig steam, Indoor
PGE	null	1 inch Insulation layer, 1 inch < pipe <= 4 inch, >15 psig steam, Outdoor
PGE	null	1 inch Insulation layer, 1 inch < pipe <= 4 inch, Hot Water, Indoor
PGE	null	1 inch Insulation layer, 1 inch < pipe <= 4 inch, Hot Water, Outdoor
PGE	null	1 inch Insulation layer, <= 1 inch pipe, <=15 psig steam, Indoor
PGE	null	1 inch Insulation layer, <= 1 inch pipe, >15 psig steam, Indoor
PGE	null	1 inch Insulation layer, > 4 inch pipe, >15 psig steam, Indoor
PGE	null	1 inch Insulation layer, > 4 inch pipe, >15 psig steam, Outdoor
PGE	null	1 inch Insulation layer, > 4 inch pipe, Hot Water, Outdoor
PGE	null	1.0 GPM Flow Rate Laminar Flow Restrictor being installed on a 2.7 GPM Flow Rate Faucet Base Case
PGE	null	1.5 GPM Flow Rate Laminar Flow Restrictor being installed on a 2.7 GPM Flow Rate Faucet Base Case
PGE	null	15 - 29 cubic feet Glass-Door Reach-In Refrigerator
PGE	null	15 - 29 cubic feet Solid-Door Reach-In Freezer
PGE	null	15 - 29 cubic feet Solid-Door Reach-In Refrigerator
PGE	null	2.2 GPM Flow Rate Laminar Flow Restrictor being installed on a 2.7 GPM Flow Rate Faucet Base Case
PGE	null	30 - 49 cubic feet Glass-Door Reach-In Refrigerator
PGE	null	30 - 49 cubic feet Solid-Door Reach-In Freezer

PA	ESPI_Category	Measure Description
PGE	null	30 - 49 cubic feet Solid-Door Reach-In Refrigerator
PGE	null	50 cubic feet Solid-Door Reach-In Freezer
PGE	null	50 cubic feet Solid-Door Reach-In Refrigerator
PGE	null	< 15 cubic feet Glass-Door Reach-In Refrigerator
PGE	null	< 15 cubic feet Solid-Door Reach-In Freezer
PGE	null	< 15 cubic feet Solid-Door Reach-In Refrigerator
PGE	null	>50 cubic feet Glass-Door Reach-In Refrigerator
PGE	null	AG CL TO CL LT 0.96 PEI GT 50HP LTE 200HP
PGE	null	AG CL TO CL LT 0.96 PEI GTE 3HP LTE 50HP
PGE	null	AG, CL TO CL, LT 0.96 PEI, GT 50HP, LTE 200HP
PGE	null	AG, CL TO CL, LT 0.96 PEI, GTE 3HP, LTE 50HP
PGE	null	Commercial Combination Oven/Steamer 15 to 28 pan capacity (Electric)
PGE	null	Commercial Combination Oven/Steamer 15 to 28 pan capacity (Gas)
PGE	null	Commercial Combination Oven/Steamer < 15 pan capacity (Electric)
PGE	null	Commercial Combination Oven/Steamer < 15 pan capacity (Gas)
PGE	null	Commercial Combination Oven/Steamer > 28 pan capacity (Gas)
PGE	null	Commercial Conveyor Oven - Gas
PGE	null	Commercial Fryer (Electric)
PGE	null	Commercial Fryer (Gas)
PGE	null	Commercial Full-Size Convection Oven (Electric)
PGE	null	Commercial Full-Size Convection Oven (Gas)
PGE	null	Commercial Ice Machines IMH 300 to 800 lbs/day
PGE	null	Commercial Ice Machines IMH 801 to 1500 lbs/day
PGE	null	Commercial Ice Machines RCU 988 or greater lbs/day
PGE	null	Commercial Ice Machines RCU <988 lbs/day
PGE	null	Commercial Kitchen Demand Ventilation Controls
PGE	null	Commercial Pool Heaters
PGE	null	Commercial Rack Oven - Gas
PGE	null	Commercial Steam Cooker-Electric
PGE	null	Commercial Steam Cooker-Gas
PGE	null	Compressor: Multiplex - Air Cooled Condenser
PGE	null	Compressor: Multiplex - Air to Evaporative Cooled Condenser
PGE	null	Display Case Cooler Evaporator Fan ECM Motor replacing Shaded Pole Motor
PGE	null	Display Case Freezer Evaporator Fan ECM Motor replacing Shaded Pole Motor
PGE	null	ENERGY EFFICIENT COMMERCIAL CONVEYOR BROILERS 22-28 INCH WIDE CONVEYOR
PGE	null	ENERGY EFFICIENT COMMERCIAL CONVEYOR BROILERS >28 INCH WIDE CONVEYOR
PGE	null	ENERGY STAR GRIDDLE - GAS Per Len. Ft
PGE	null	FHP Single, Low Temperature Condensing Unit
PGE	null	FHP Single, Low Temperature Remote Condenser
PGE	null	FHP Single, Medium Temperature Condensing Unit
PGE	null	FHP Single, Medium Temperature Remote Condenser
PGE	null	Fitting Insulation <= 1 inch pipe, <=15 psig steam, Indoor
PGE	null	Fitting Insulation 1 inch < pipe <= 4 inch, <=15 psig steam, Indoor
PGE	null	Fitting Insulation 1 inch < pipe <= 4 inch, >15 psig steam, Indoor
PGE	null	Fitting Insulation 1 inch < pipe <= 4 inch, Hot Water, Indoor
PGE	null	Fitting Insulation > 4 inch pipe, >15 psig steam, Indoor
PGE	null	Fitting Insulation, 1 inch < pipe <= 4 inch, >15 psig steam, Outdoor
PGE	null	Fitting Insulation, 1 inch < pipe <= 4 inch, Hot Water, Outdoor
PGE	null	Fitting Insulation, > 4 inch pipe, >15 psig steam, Outdoor
PGE	null	Floating SST control on suction groups
PGE	null	HUMIDISTAT CONTROL FOR ANTI-SWEAT HEATERS
PGE	null	High Efficiency Ultra-Low Temperature (ULT -80 C) Freezers 15 to <24 ft3
PGE	null	High Efficiency Ultra-Low Temperature (ULT -80 C) Freezers 24 to 29 ft3
PGE	null	High Efficiency Ultra-Low Temperature (ULT, -80 C) Freezers, 15 to <24 ft3
PGE	null	High Efficiency Ultra-Low Temperature (ULT, -80 C) Freezers, 24 to 29 ft3
PGE	null	Insulated Holding Cabinet Full-Size
PGE	null	Insulated Holding Cabinet Half-Size
PGE	null	Insulated Holding Cabinet, Full-Size
PGE	null	Insulated Holding Cabinet, Half-Size
PGE	null	Low Temperature Display Case Anti-Sweat Heater (ASH) Controls
PGE	null	Low Temperature Open Vertical Night Cover
PGE	null	Low temp Narrow Coffin to Reach-in
PGE	null	Low-Flow Pre-Rinse Spray Valves, 1.15 gpm Flow Rate
PGE	null	Medium Temperature Open Case, Standard Efficiency to High Efficiency
PGE	null	Modulating Gas Valve for natural gas dryers for on-site commercial dryers
PGE	null	Motor: ECM Evaporator Display Case
PGE	null	Multiplex system, air-cooled condenser, control SCT to ambient + 12F TD, 70F min, backflood setpoint of 68F, var-speed fan control
PGE	null	Multiplex system, evap-cooled condenser, control SCT to wetbulb + 17F TD, 70F min, backflood setpoint of 68F, var-speed fan control
PGE	null	New Low Temperature Display Case with Doors

PA	ESPI_Category	Measure Description
PGE	null	New Medium Temperature Display Case with Doors
PGE	null	On-demand Hand Wrap Machine
PGE	null	REFRIG: AUTO CLOSER: COOLER
PGE	null	REFRIG: AUTO CLOSER: FREEZER
PGE	null	Steam Boiler, >2500 kBTUh, TE>80%
PGE	null	Steam Process Boiler
PGE	null	Submersible Well Pump System Overhaul (<=25hp)
PGE	null	Tier 2- 15% below Energy Star Minimum Speciation for Energy Efficient High Temperature Door-Type Commercial Dishwashers with water usage <= 0.76 gal/rack and idle energy rate <= 0.7 kW
PGE	null	Turbine Booster Pump System Overhaul (<=25hp)
PGE	null	Turbine Well Pump System Overhaul (<=25hp)
PGE	null	Vending Machine Controller
PGE	null	Vertical Ref Case, Med. Temp w/Night Covers: Open to Closed with LED
PGE	null	Vertical Ref Case, Med. Temp: Open w/ Night Covers to Closed (Retrofit)
PGE	null	Walk-in Cooler Evaporator Fan ECM Motor replacing Shaded Pole Motor
PGE	null	Walk-in Freezer Evaporator Fan ECM Motor replacing Shaded Pole Motor
PGE	null	Water Process Boiler
SCE	null	1.0 GPM Faucet Aerator replacing No Faucet Aerator
SCE	null	1.5 GPM Low Flow Showerhead replacing Standard Showerhead
SCE	null	15 - 29 cubic feet Glass-Door Reach-In Refrigerator
SCE	null	15 - 29 cubic feet Solid-Door Reach-In Freezer
SCE	null	15 - 29 cubic feet Solid-Door Reach-In Refrigerator
SCE	null	30 - 49 cubic feet Glass-Door Reach-In Refrigerator
SCE	null	30 - 49 cubic feet Solid-Door Reach-In Freezer
SCE	null	30 - 49 cubic feet Solid-Door Reach-In Refrigerator
SCE	null	< 15 cubic feet Solid-Door Reach-In Freezer
SCE	null	< 15 cubic feet Solid-Door Reach-In Refrigerator
SCE	null	= 5 Pans Full-Size Convection Oven
SCE	null	= 50 cubic feet Glass-Door Reach-In Refrigerator
SCE	null	= 50 cubic feet Solid-Door Reach-In Freezer
SCE	null	= 50 cubic feet Solid-Door Reach-In Refrigerator
SCE	null	>5 HP to 75 HP Variable Speed Drive on Process Fan Control
SCE	null	>50 cubic feet Glass-Door Reach-In Refrigerator
SCE	null	>= 50 cubic feet Solid-Door Reach-In Refrigerator
SCE	null	Add Door to Medium Temperature Open Vertical Display Case
SCE	null	Add Glass Door to Open Vertical Refrigerated Display Case Medium Temperature
SCE	null	Automatic Conveyor Broilers Belt Width 20-26""
SCE	null	Automatic Conveyor Broilers Belt Width >26""
SCE	null	Boilerless and Connectionless Steamer
SCE	null	Commercial Air-Cooled Multiplex Floating Head Pressure Control
SCE	null	Commercial Combination Oven/Steamer 15 to 28 pan capacity (Electric)
SCE	null	Commercial Combination Oven/Steamer < 15 pan capacity (Electric)
SCE	null	Commercial Electric Fryer: Cooking Efficiency >= 80%
SCE	null	Commercial Evap-Cooled Multiplex Floating Head Pressure Control
SCE	null	Commercial Ice Machines IMH 300 to 800 lbs/day Ice Machine
SCE	null	Commercial Ice Machines IMH 300 to 800 lbs/day-Super High-Efficiency Ice Machine
SCE	null	Commercial Ice Machines RCU 988 or greater lbs/day Ice Machine
SCE	null	Commercial Ice Machines RCU 988 or greater lbs/day-Super High-Efficiency Ice Machine
SCE	null	Commercial Ice Machines RCU <988 lbs/day Ice Machine
SCE	null	Commercial Ice Machines RCU <988 lbs/day-Super High-Efficiency Ice Machine
SCE	null	Commercial Ice Machines SCU >200 lbs/day-Super High-Efficiency Ice Machine
SCE	null	Commercial Multiplex Floating Suction Pressure Control
SCE	null	Cooking Efficiency =60% Commercial Electric Combination <15 Pans Oven
SCE	null	Cooking Efficiency > 80% Electric Fryer
SCE	null	Cooler Anti-Sweat Heater (ASH) Control
SCE	null	Display Case Cooler Evaporator Fan ECM Motor replacing Shaded Pole Motor
SCE	null	Electric Griddle
SCE	null	Energy efficient electric griddle
SCE	null	Floating Head Pressure Controls on Commercial Evap-Cooled Multiplex Refrigeration System
SCE	null	Floating Suction Pressure Controls on Commercial Multiplex Refrigeration System
SCE	null	Full Size (= 15 cu. ft) = 20 W/cu. ft Insulated Holding Cabinet
SCE	null	Full Size (>= 15 cu. ft) <= 20 W/cu. ft Insulated Holding Cabinet
SCE	null	Full Size <= 0.4 KW Insulated Holding Cabinet replacing ENERGY STAR Holding Cabinet
SCE	null	High efficiency commercial electric steam cooker
SCE	null	IND CL TO CL LT 0.96 PEI GTE 3HP LTE 50HP-High efficiency clean water pumps
SCE	null	Main Cooler Door Auto Closer
SCE	null	Main Freezer Door Auto Closer
SCE	null	Medium Temperature Display Case Anti-Sweat Heater (ASH) Controls
SCE	null	RF-20965
SCE	null	RI0001
SCE	null	Walk-In Cooler with Auto Door Closer

PA	ESPI_Category	Measure Description
SCE	null	Walk-In Freezer with Auto Door Closer
SCG	null	Automatic Conveyor Broilers Belt Width 20-26""
SCG	null	Automatic Conveyor Broilers Belt Width 20-26""-Gas Only-NV
SCG	null	Commercial Combination Oven-Gas 15-28 pan capacity
SCG	null	Commercial Combination Oven-Gas <15 pan capacity
SCG	null	Commercial Combination Oven-Gas >28pan capacity
SCG	null	Commercial Dishwasher-High Temperature Door-Type Tier 2-Gas Only
SCG	null	Commercial Fryer-Gas
SCG	null	Commercial Full-Size Convection Oven-Gas
SCG	null	Commercial Griddle-Gas per foot
SCG	null	Commercial Rack Oven-Gas
SCG	null	Commercial Steamer-Gas
SCG	null	CommercialBlr-DWH-Large(>200MBtuh)-Tier1(>=84%TE or 0.86%CE)
SCG	null	CommercialBlr-DWH-Large(>200MBtuh)-Tier1(>=84%TE)
SCG	null	CommercialBlr-DWH-Large(>200MBtuh)-Tier2(>=0.90%TE or 0.92%CE)
SCG	null	CommercialBlr-DWH-Large(>200MBtuh)-Tier2(>=90%TE)
SCG	null	CommercialBlr-DWH-Small(<=200MBtuh)-Tier2(>=87%EF)
SCG	null	CommercialBlr-DWH-Small(<=200MBtuh)-Tier2(>=90%EF)
SCG	null	EER Commercial Combination Oven-Gas 15-28 pan capacity
SCG	null	EER Commercial Combination Oven-Gas <15 pan capacity
SCG	null	EER Commercial Combination Oven-Gas >28 pan capacity
SCG	null	EER Commercial Fryer-Gas
SCG	null	EER Commercial Full-Size Convection Oven-Gas
SCG	null	EER Commercial Gas Conveyor Oven Large
SCG	null	EER Commercial Griddle-Gas per foot
SCG	null	EER Commercial Rack Oven-Gas
SCG	null	EER Commercial Steamer-Gas
SCG	null	Efficient Underfired Broiler
SCG	null	Faucet Aerator for Commercial Buildings, Private Lavatory - 0.5 GPM Flow Rate
SCG	null	Faucet Aerator for Commercial Buildings, Private Lavatory - 1.0 GPM Flow Rate
SCG	null	Faucet Aerator for Commercial Buildings, Public Lavatory - 0.5 GPM Flow Rate
SCG	null	Faucet Aerator, Bathroom Sink, 1.5 gpm - Com
SCG	null	Faucet Aerator, Bathroom Sink, Private, 1.0 gpm - Com
SCG	null	Faucet Aerator, Bathroom Sink, Public, 1.0 gpm - Com
SCG	null	Faucet Aerator, Kitchen Sink, 1.5 gpm - Com
SCG	null	Fitting Insulation 1"" < pipe <= 4"" >15 psig steam_Outdoor
SCG	null	Fitting Insulation 1"" < pipe <= 4"" Hot Water_Outdoor
SCG	null	Fitting Insulation > 4"" pipe Hot Water_Outdoor
SCG	null	Greenhouse Heat Curtain
SCG	null	Infrared Film for Greenhouses
SCG	null	Laminar Flow Restrictor - 0.5 GPM
SCG	null	Laminar Flow Restrictor - 1.0 GPM
SCG	null	Laminar Flow Restrictor - 1.5 GPM
SCG	null	Laminar Flow Restrictor - 2.2 GPM
SCG	null	Large Commercial Fitting Insulation 1"" < pipe <= 4"" Hot Water_Outdoor
SCG	null	Large Commercial Fitting Insulation > 4"" pipe Hot Water_Outdoor
SCG	null	Large Commercial Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" <=15 psig steam_Outdoor
SCG	null	Large Commercial Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" Hot Water_Indoor
SCG	null	Large Commercial Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" Hot Water_Outdoor
SCG	null	Large Commercial Pipe Insulation 1"" Insulation <= 1"" pipe Hot Water_Indoor
SCG	null	Large Commercial Pipe Insulation 1"" Insulation <= 1"" pipe Hot Water_Outdoor
SCG	null	Large Commercial Pipe Insulation 1"" Insulation > 4"" pipe <=15 psig steam_Outdoor
SCG	null	Large Commercial Pipe Insulation 1"" Insulation > 4"" pipe Hot Water_Indoor
SCG	null	Large Commercial Pipe Insulation 1"" Insulation > 4"" pipe Hot Water_Outdoor
SCG	null	Low Flow Pre-Rinse Spray Valve, 0.75 - 1.07 GPM
SCG	null	Low Flow Pre-Rinse Spray Valve, < .75 GPM
SCG	null	Low Flow Showerhead, 1.5 gpm - Com
SCG	null	Low Flow Showerhead, 1.8 gpm - Com
SCG	null	Modulating Gas Valve for Com Dryers up to 200 lbs cap
SCG	null	NATURAL GAS POOL HEATER >=84% TE
SCG	null	Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" <=15 psig steam_Indoor
SCG	null	Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" <=15 psig steam_Outdoor
SCG	null	Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" >15 psig steam_Indoor
SCG	null	Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" >15 psig steam_Outdoor
SCG	null	Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" Hot Water_Indoor
SCG	null	Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" Hot Water_Outdoor
SCG	null	Pipe Insulation 1"" Insulation <= 1"" pipe Hot Water_Indoor
SCG	null	Pipe Insulation 1"" Insulation > 4"" pipe >15 psig steam_Indoor
SCG	null	Pipe Insulation 1"" Insulation > 4"" pipe Hot Water_Outdoor
SCG	null	Pool Cover-Outdoor
SCG	null	ProcessBoiler-Steam-(>=83%CE)

PA	ESPI_Category	Measure Description
SCG	null	ProcessBoiler-Water-Tier1(>=85%CE)
SCG	null	Small Commercial Fitting Insulation 1"" < pipe <= 4"" Hot Water_Indoor
SCG	null	Small Commercial Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" >15 psig steam_Indoor
SCG	null	Small Commercial Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" Hot Water_Indoor
SCG	null	Small Commercial Pipe Insulation 1"" Insulation 1"" < pipe <= 4"" Hot Water_Outdoor
SCG	null	Small Commercial Pipe Insulation 1"" Insulation <= 1"" pipe Hot Water_Indoor
SCG	null	Small Commercial Pipe Insulation 1"" Insulation <= 1"" pipe Hot Water_Outdoor
SCG	null	Steam Trap Replacement - Commercial/Other
SCG	null	Tank Insulation - High Temperature Applic. (LF) 2 in, Indoor
SCG	null	Tank Insulation - High Temperature Applic. (LF) 2 in, Outdoor
SCG	null	Tank Insulation - Low Temperature Applic. (LF) 2 in, Indoor
SCG	null	Tank Insulation - Low Temperature Applic. (LF) 2 in, Outdoor
SCG	null	Water Heating -Commercial Pool Heater
SDGE	null	Food Service - Commercial Gas Fryer (SWFS011B)
SDGE	null	Food Service - Convection Oven-Electric (SWFS001B)
SDGE	null	Food Service - Convection Oven-Gas (SWFS001D)
SDGE	null	Food Service - Electric Combination Oven 15 to 28 Pans (Eff>=60) (SWFS003B)
SDGE	null	Food Service - Electric Combination Oven <15 Pans Oven (Eff >= 60) (SWFS003A)
SDGE	null	Food Service - Gas Combination Oven < 15 Pans Oven (Eff>=30) (SWFS003D)
SDGE	null	Food Service - Griddle-Gas (SWFS004B)
SDGE	null	Food Service - IceMach-Commercial Ice Machines IMH 300 to 799 lbs/day (SWFS006E)
SDGE	null	Food Service - IceMach-Commercial Ice Machines RCU 988 or greater lbs/day (SWFS006I)
SDGE	null	Food Service - IceMach-Commercial Ice Machines SCU >200 lbs/day (SWFS006C)
SDGE	null	Heating - Greenhouse Heat Curtain (SWBE001A)
SDGE	null	High Efficiency Ultra Low Temperature Freezer (>= 24 cubic feet)
SDGE	null	Public Lavatory Faucet FCV Commercial Buildings: 1.0 GPM - DI
SDGE	null	Refrigeration - Anti-Sweat Heater Controls
SDGE	null	Refrigeration - New Refrigeration Case w/Doors-Medium Temperature Case (SWCR021A)
SDGE	null	Refrigeration - New Refrigeration Case w/Doors-Special doors Low Temp
SDGE	null	Refrigeration - Special Doors with Low/No ASH on Low Temp Display Case
SDGE	null	Water Heating- Aerator Faucet for Commercial Buildings- Public - 0.5 gpm (SWWH019B)
SDGE	null	Water Heating- Aerator Faucet for Commercial Buildings- Public - 1.0 gpm (SWWH019A)

APPENDIX F:

RESPONSE TO COMMENTS

Comment #	PA	Location	Page	Topic	Question/Comment	Evaluator Response
1	SDG&E		Page 5-8, CPUC PCG Meeting		The report discusses to consider deemed to custom rollover process. We discussed on the PCG call what "thresholds" or "triggers" could be recommended to better distinguish what could be applicable more for a custom application than deemed, including complexity, referencing the 4 largest projects from the impact evaluation, and incorporate further workpaper requirements. Please incorporate the items shared from the PCG call , as well as any other items for further clarity.	Given current participation trends, the Quantum evaluation team recommends that most ozone laundry projects could be directed to deemed programs and a minority of projects be directed instead to custom. Some of the factors that might result in a project being better suited to custom includes: the large size and sophistication or complexity of a given project. However, there is also a regulatory component of the decision that might over-ride this evaluation focused conclusion. Furthermore, the effectiveness of the ozone laundry measure in leading to energy savings is predicated on the post-installation operations resulting in a reduction in hot water setpoint temperature and a reduction in the use of hot water in a given laundry cycle. However, no thresholds or expectations are established for percent reduction; such thresholds would normally be established using using eligiblity requirements. For example, the evaluation found that projects that did not reduce hot water use in a given laundry cycle by more than 80% tended to have lower realization rates, and hot water temperature reduction of less than 40 deg F also resulted in relatively low realization rates.
2	SDG&E		Page 5-8, CPUC PCG Meeting		The evaluation noted that for SDGE_OzL_11, the customer "did not adjust hot water use per laundry load or change the water temperature settings". Does the evaluator have any insight on why that is? For example, was it due to lack of customer awareness/knowledge or customer preference?	We inquired further and were told that this was due, at least in-part, to lack of customer awareness surrounding changes in operations.
3	PG&E	Overarching		Overarching	PG&E commends the evaluation team for a well-written and thorough draft report. PG&E appreciates the level of content detail provided throughout, such as sample design, explanations of results, sample points, recommendations and supporting data to take action on recommendation, and the application of IESR tables. The draft report reflects best practices in technical report writing.	Thank you for your comments.
4	PG&E	Overarching		Overarching	The draft report contained a few typo's as well as slightly different formatting and font use (e.g., see Table 3-6 footnotes). Can the evaluation team please complete a final copy edit to correct any typo's and ensure consistent formatting before the final report is published?	
5	PG&E	Executive Summary	pp. 1-4	Results	On Page 1-3, there is a footnote that states "all net savings and net-to-gross ratios include the 0.05 market effects adder." However, for Tables 1-1 and 1-2, the evaluated NTGs are not equal to the evaluated net savings divided by evaluated gross savings. The evaluated NTGs appear to be less the 0.05 market effects adder. Can the evaluation team please re-calculate and enter the correct evaluated NTGs in both tables within the report? Can the evaluation team also add the same footnote underneath the two Tables for clarity?	In Tables 1-1 and 1-2, the NTG mentioned is the "evaluated NTG", without the market adder. It is what we estimated during the evaluation. The footnote is meant to alert the reader to the fact that the Evaluated Net Savings divided by the Evaluated Gross Savings represent NTGR plus the 0.05 market adder.
6	PG&E	Executive Summary	pp. 1-6	Process Pumps VFD	Within the recommendations for Agricultural Pump Variable Frequency Drives (VFDs), the report states that "5 pumps run fewer than 1,000 hours per year". PG&E Program considers an average over the life of the crops; younger crops use less water than older ones. For these 5 pumps, can the evaluation team please clarify the possible drivers for running fewer than 1,000 hours per year (e.g., type of crop, age of crop, acres served, etc.) and lessons learned for future workpaper updates or program improvements?	Some of the observed reasons for low run hours in our PY2018/PY2019 samples has included recently planted orchards, where the measure is a well pump but the farmers prefer using district water and where the farmer irrigates a given acreage with more than one pump.
7	PG&E	Executive Summary	pp. 1-6	Process Pumps VFD	Within the Recommendations for Agricultural Pump Variable Frequency Drives (VFDs), the report states that "12 pumps have settings are at or near full load". SWWP005 used automatic controls to determine motor speed. PG&E believes this technology should be promoted over the standard VFD (SWWP002). Can the evaluation team please share any thoughts on this idea?	To our knowledge most farmers use automatic controls to adjust speed in response to rotating irrigation set water requirements, expressed as pressure in the lines. Farmers target a given pressure at the irrigation end-points, even for the measures covered by SWWP002.

Comment #	PA	Location	Page	Topic	Question/Comment	Evaluator Response
8	PG&E	Executive Summary	pp. 1-6	Process Pumps VFD	Within the Recommendations for Agricultural Pump Variable Frequency Drives (VFDs), the draft report states that "We recommend that the programs make use of interval billing data for characterizing pump operations, including use of those data to derive updated estimates of savings for the pump VFD measure, and as screening criteria for pump run hours." PG&E believes this to be a good suggestion for possible screening and to determine actual run-time hours.	Thank you for your comments.
9	PG&E	Executive Summary	pp. 1-6	Process Pumps VFD	Within the Recommendations for Agricultural Pump Variable Frequency Drives (VFDs), the draft report states that "Some pumps cannot continue to operate without the VFD due to operational requirements, such as the use of VFD controls to automatically adjust pump speed." Can the evaluation team please clarify what "VFD controls" include? Does the VFD include controls such as "pressure difference sensors" of flow sensors?	The operation of the pump varies by farm, but many of the farmers that we talked to used a pressure setting to control the pumps. On the VFD the farmer sets the desired pressure, for example 30 psi, and the VFD modulates the speed to achieve the desired preformance.
10	PG&E	Executive Summary	pp. 1-7	Process Pumps VFD	Within the Recommendations for Agricultural Pump Variable Frequency Drives (VFDs), the draft report states that "Furthermore, the VFD pumps can save on equipment maintenance and extend the life of the pump." PG&E agrees that a VFD may extend the life of a motor and installation in general. At the same time, one must also consider that by adding another piece of equipment, the maintenance costs increases for a farmer. And in some cases, VFD's have such complicated controls that a user may not be qualified to operate it and bypass the measure altogether.	We agree, the maintence costs and the more complicated controls may be bariers for some farmers to install the VFDs. Based on the survey responses many of the participants would have installed the VFDs without the incentive so we recommend that the utilites re-examine ISP to assess whether throttle valve controls represent the baseline for various pump type and size configrations and irrigation applications.
11	PG&E	Executive Summary	pp. 1-7	Process Pumps VFD	Within the Recommendations for Agricultural Pump Variable Frequency Drives (VFDs), the draft report states that "VFD flow controls may already be the most commonly installed approach for certain pump type and size combinations." Can the evaluation team please share any data that support this statement?	The evaluation team can certainly document a finding from an April 2019 PG&E ISP study that found that VFD controls were more likely to be installed in pumps with a capacity greater than 100 HP than in smaller pumps. While we have an understanding of some of the reasons for this differentiation, such as inrush current mitigation, we are not comfortable with the ISP study data collection approach, analysis and conclusions. More generally this ISP study did not develop results as a function of pump type and size, which would have further illuminated differences in ISP by pump segment. For example, the ISP study does not have results that differentiate additional pump size categories for well pumps, such as 150-250 HP pumps, >250 HP, etc. Futhermore, the results were generated by assiging probabilities of VFD purchase based on likelihood of purchase ratings, and evaluators are not comfortable with the probabilities assigned. For example, a score of likely was assigned a 63% probability of purchase. For these reasons we think an ISP study update is warranted.
12	PG&E	Executive Summary	pp. 1-7	Agricultural Irrigation	Within the Recommendations for Agricultural Irrigation, the draft report states that "Agricultural drip irrigation is no longer offered through Pacific Gas and Electric (PG&E) programs". PG&E thanks the evaluation team for acknowledging that this measure has been sunsetted and is considered Industry Standard Practice (ISP) for many crops.	Thank you for your comments.
13	PG&E	Executive Summary	pp. 1-8	Agricultural Irrigation	Within the Recommendations for Agricultural Irrigation, the draft report states that "We recommend that for measures that involve drip irrigation or similar equipment upgrades that the useful life estimates applied should reflect the expected life of the program installed equipment, not the associated irrigation pump." Given that PG&E has retired this measure, can the evaluation team please consider removing this recommendation or else re-phrasing the recommendation to be more generic for future application?	We have slightly rephrased the wording to make the recommendation more applicable to future irrigation offerings.

Comment #	PA	Location	Page	Topic	Question/Comment	Evaluator Response
14	PG&E	Studied Measure Groups	pp. 2-5	Tankless Water Heater	Regarding Table 2-2: PY2019 Participation Summary – Expected Net Lifecycle Electric Savings (GWh), can the evaluation team please explain within the report why the numbers are very low for the water heating tankless water heater measure group?	Participation for this measure is largely constrained to gas equipment, and the associated 893 records with positive gas savings. The low electric savings in Table 2-2 is due to a lack of participation among electric equipment, and the associated 2 records wih positive electric savings.
15	PG&E	Data Sources	pp. 3-13, 3-15	Ozone Laundry	Tables 3-3 and 3-4. Under PY2019 Tracking Population, both "Sites" and "Ex Ante Net Lifecycle Savings (MTherms)" had asterisks, but a footnote or reference explaining the asterisks could not be found. Can the evaluation team please add an explanation for each set of asterisks within the report?	Footnotes have been added that explains each asterisk.
16	PG&E	Data Sources	pp. 3-19	Process Pumps VFD	Table 3-6. PG&E commends the evaluator for explaining the actual counts (the triple asterisk) under the "Sample Design and Data Collection (Farmers)" column. This could easily have been missed and created confusion for a reader.	Thank you for your comments.
17	PG&E	Data Sources	pp. 3-25	Tankless Water Heater	Table 3-9. Under PY2019 Tracking Population, "Distributor Counts" column, "Distributor Counts" appears to be missing the single asterisk as there is a footnote about count of sites found directly underneath the table. Can the evaluation team please confirm whether or not the asterisk is missing, and if so, to add within the report?	Thanks for the observation. We have removed the single-asterisk footnote, as it was an unintentional carryover from the 2018 report.
18	PG&E	Sample Design and Data Collection	pp. 3-12 to 3-27	Sampling	For all measures where a strata is created, it is not clear if sample points were randomly selected within each strata and over-sampled in order to reach the target sample size, OR if all possible sample points were included and the completed actuals reflect sample points that responded to the request to participate. Can the evaluation team please clarify this point within the report?	In general, where measure populations by strata were sufficient in size and good contract information was available, a sample was pulled for gross impact recruitment; where insufficient a census was performed. In general for NTG sampling, a census was performed.
19	PG&E	Gross Results	pp. 5-4	Ozone Laundry	Under the statement that "one sample point out of the total sample size of 7 ozone laundry machines does not save energy," the draft report states that "This project had a relatively large sample-based weight due to the fact that the ex ante claim was roughly 4 times as large as the other 6 projects that we sampled. If not for this one sample point, the sample-weighted mean realization rate for PG&E would have exceeded 1.0, but was instead 0.69." PG&E acknowledges that program eligibility screening should be strengthened to exclude ineligible projects from participation. At the same time, PG&E hopes that the resulting lowered GRR does not impact the PAs ability to claim future savings for this measure when the sample point may not have been representative of the measure population.	This finding should not impact future saving claims.
20	PG&E	Gross Results	pp. 5-7	Typo	Within the paragraph that begins with "In Table 5-5, we present …", the second sentence refers to "PG&E gross impact results", which may have been a typo and should have read, "SDG&E gross impact results." Can the evaluation team please confirm and correct this typo within the report?	Changed to SDG&E
21	PG&E	Gross Results	pp. 5-24	Process Pumps VFD	Table 5-15. Under the "Pump Peak Coinc. Factor" column, it shows there were 10 instances of this discrepancy. However, on pp. 5-25, within the second observation, it was stated that 9 well pumps were not observed to operate at the time of coincident peak. After reviewing Table 5-14 on pp. 5-23, it appears that PGE_Booster_9 may have been incorrectly indicated. Can the evaluation team please review and confirm the indicator, and correct within the report, if needed?	Both the table and the observation are correct. The indicators in the table indicate if the pump has a coincidence factor less than 0.5, while the observation is pointing out that there are 9 pumps that have zero peak demand savings. There is one pump that has a coincidence factor that is less than 0.5, so a 1 in the table, but the demand savings is greater than 0.

Comment #	PA	Location	Page	Topic	Question/Comment	Evaluator Response
22	PG&E	Gross Results	pp. 5-3 to 5-52	Discrepancy Tables	PG&E commends the evaluation team for providing the excellent tables (e.g., Tables 5-2, 5-11, 5-15, 5-33, 5-40) describing the discrepancy factor per measure. These were useful to know what key drivers impacted the evaluated savings estimates up or down from report savings estimates. To allow an opportunity for PAs to identify possible areas of program improvements, can the evaluation team please provide, in a secure manner, a map of the evaluated sample point identifiers and its corresponding Claim ID or Project IDs to assist the PAs in researching specific projects (e.g., zero-savers); understanding any failures in project screening, if applicable; and identify opportunities for program improvement?	The CPUC has elected to not comply with this request. There is a desire to retain confidentiality of respondent reports.
23	PG&E	Net-to-Gross Analysis	pp. 6-3	Score PAI-2	Can the evaluation team please clarify within the report how N42 was accounted for in the PAI-2 Score?	N42 is not used in the PAI-2 score. N42 is asked as a consistency check to make sure that N41 + N42 = 10.
24	PG&E	Net-to-Gross Analysis	pp. 6-6	Ozone Laundry	Can the evaluation team please explain why the target number of sites (n=7) was not met? Are there ways that the PA and the evaluation team can improve future processes in order to meet the target sample size?	The target sample size for data collection of 7 sites was achieved, as shown in Table 3-3. However, the site contact was unable to provide responses to the NTG related questions in 4 instances. In three of these instances, the decision maker no longer worked for the company, and in the other instance we were unable to make contact with the decision maker. We attempeted to supplement the NTG sample with other participants that had not already been visited, but because of the small participant population, we were only able to complete one additional NTG survey. We do coordinate with the PAs to assist us with data collection, but recruitment for these types of activities always provide challenges, particularly with small participant populations.
25	PG&E	Conclusions and Recommendations	pp. 8-2	Ozone Laundry	Regarding "Recommendation POL2", it is not clear if the evaluation report is recommending that the measure overall would be better served through a custom program channel, OR that eligibility requirements should be updated in a way such that some projects, such as large-scale projects, should run through a custom channel, while all others should run through a deemed channel. Can the evaluation team please clarify this recommendation within the report? If the latter, can the evaluation team please include suggestions on parameters or thresholds that can differentiate between a deemed versus custom channel?	Given current participation trends, the Quantum evaluation team recommends that most ozone laundry projects could be directed to deemed programs and a minority of projects be directed instead to custom. Some of the factors that might result in a project being better suited to custom includes: the large size and sophistication or complexity of a given project. However, there is also a regulatory component of the decision that might over-ride this evaluation focused conclusion.
26	PG&E	Conclusions and Recommendations	pp. 8-5	Process Pumps VFD	Regarding "Conclusion PPVD3", the evaluation team cited common reasons that farmers decide to install VFD controls, which results in "high free ridership rate for VFD controls because a considerable number of farmers indicate they would have installed VFD controls independent of the program / incentive." While PG&E acknowledges that this could indeed be the case, PG&E also recognizes that decision-making criteria may differ among customer segments (e.g., larger customers/projects versus smaller customers/projects). Can the report please acknowledge that the free ridership results may not be applicable to the customer population and may only apply to a customer segment? In addition, PG&E recommends that future evaluations consider a natural segmentation, for example based on size (e.g., acreage), and group the results accordingly.	That is a good point that decision making criteria could vary among larger versus smaller customers, and good to take into consideration for future evaluation sample designs as you suggest. The comments that you reference from the report are more focused on size of pump due to electric service requirements (i.e., current inrush considerations), the need for automated pressure adjustments with irrigation set rotation, and remote control of pumps (i.e, telemetry), among other factors. This comment also invokes concerns that the evaluation team has with the lack of sufficient pump type and size segmentation from a recently completed ISP study. We believe the ISP study/segmentation should be updated due to these concerns.
27	PG&E	Conclusions and Recommendations	pp. 8-10	Tankless Water Heater	Regarding "Conclusion TWH4 [Section 5]: We found that water heaters operated at different temperatures than assumed in the applicable workpapers, which negatively affected the savings estimates," can the evaluation team please confirm within the report if these are DEER model data (operating temperatures)?	Since the PG&E and SCG workpapers reference DEER models for unit energy savings derivation, we believe that the ex ante savings reflect temperatures assumed in DEER models.

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28	PG&E	Appendix AA	pp. AA-1 to AA-13	Pass-thru savings	The evaluation included 69,528 MTherms of Gross Lifecycle Savings that were passed through for PG&E, representing 82.4% of the MTherms covered by the evaluation. There appeared to be similarly high percent of pass through for Therms in Net Lifecycle Savings, Gross First Year Savings, and Net First Year Savings. Can the evaluation team please clarify what measures were included in the passed through savings?	Appendix E contains the exhaustive list of measures that were assigned to the Small Commercial evaluation: evaluated measures appear first, with the corresponding ESPI category, followed by non-evaluated (pass through) measures, with ESPI category set to "null". Appendix AA shows results for the evaluated measures (by ESPI category), with all other measures lumped into a "passthrough" category for each PA. To the extent that some of the evaluated measures (e.g. SDG&E process pump VFD claims) were also passed through, they are specified in Appendix AA under "ESPI category_passthrough."
29	SCG		Page 1-5	Ozone Laundry	The evaluation results prove the measures' effectiveness in energy and water savings. The first subsection does not contain any recommendations, but rather just a finding. SoCalGas suggests changing the title of 1-5 to be Conclusions and Recommendations or remove the first subsection entirely. The second subsection could benefit from a more explicit explanation of why the one project would benefit from participating in a custom program, e.g., custom programs have a higher degree of customer engagement/education, etc.	First the evaluation team would like to contest the statement that we concluded there was generally a reduction in combined hot and cold water use. In fact, a major primary source of prototypical laundry cycle information suggests that water use would generally increase. The evaluation team included a recommendation to continue offering ozone laundry and to increase participation using marketing and outreach. In the report we explain that custom program projects typically undergo a more rigorous verification of operating conditions that are in-turn incorporated within the project saving estimates.
30	SCG		Page 1-6	Ozone Laundry	The finding states that there was evidence that 2 sites out of 35 replaced existing ozone laundry equipment with new equipment. Will Quantum Energy Analytics provide SoCalGas with specific information of these sites so the program advisors can learn from the situation for future program implementations? In retrospect, although this measure has been sunset from SoCalGas deemed savings program, it is common to not have a pre-inspections in deemed measure offerings.	The CPUC has elected to not comply with this request. There is a desire to retain confidentiality of respondent reports. Regarding pre-inspection, we feel that is an important component of implementation that may actually be increasing in importance as measures move from downstream to midstream/upstream offerings, and perhaps as third-party implemention becomes more commonplace.
31	SCG		Page 3-12	Ozone Laundry	It says, under the second Implications, "… we created certainty stratum…" Can Quantum Energy Analytics explain what "certainty" consists of? Table 3-3 shows Certainty as a measure group, but its meaning is unclear. Also, SoCalGas completed sample points only include Nursing Homes measure group, and zero for Certainty. Would it be not represented enough since other IOUs have a least one for each stratum?	We changed the Table 3-3 heading to indicate strata instead of group. The certainty stratum consists of the largest projects for each PA. Attempts to achieve an SCG complete for the certainty stratum were unsuccessful. This means that the resulting SCG sample was not as representative as we would have hoped. Nursing homes in SCG territory account for 77% of total savings, and the completed sample indicates a GRR of 1.1. We felt that this was appropriate to apply to the entire population, rather than under-estimate achieved savings by passing through the claims for all sites other than nursing homes.
32	SCG		Page 3-24	Ozone Laundry	It mentions that the evaluation team conducted professional interviews among six distributors representing 83% of PY2019 savings. However, table 3-9 shows 7 distributors and 84% savings.	Assume this comment is actually for Tankless Water Heaters. We have corrected the text to be consistent with the table.

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33	SCG		Page 4-6	Ozone Laundry	The evaluation team accepts the workpaper-based EUL estimate of 10 years. Why does it require no further research to accept this? How was it accepted? Will the evaluators extend this proper EUL consideration for AEO equipment portfolio wide?	The evaluation team searched DEER and did not locate an EUL estimate for ozone laundry from that source; this incluced review of the DEER2014 EUL table update. Additional brief searches did not uncover other sources for an EUL estimate. The workpaper references a source that is no longer available online for inspection. For these reasons evaluators simply accepted the workpaper value, which is standard operating procedure in evaluation work, once other potential sources have been eliminated. The evaluation made an exception to CPUC EUL policy surrounding add-on equipment (AOE), whereby the EUL is set equal to one-third of the EUL of the host equipment. In this case the host equipment are laundry machines, which can be readily replaced without sustantially affecting ozone machine functionality and ability to deliver long-term savings. This special circumstance for ozone laundry machines may also be relevant to other AOE equipment, but such decisions should be made/applied on a case-by-case basis. The PAs might also be able to make a case for bypassing CPUC policy for certain measures under similar circumstances.
34	SCG		Page 5-9	Ozone Laundry	It is mentioned that hot water temperature reduction settings played a role in low realization rate, in conjunction with a low number of wash cycles per day. Do the evaluators explore the information from the customers to see what was the drive? Would it be either due to lack of knowledge of the new technology or being unaware of the issue?	In general a low reduction in hot water setpoint was due to the pre-installation setting being relatively low, for example 135 deg F; in general, for most points in the sample the post-installation setpoint temperature was somewhat, but not substantially lower than that. A low or high number of wash cycles is simply a matter of demand per laundry machine for linen washing. Therefore these drivers are not due to lack of awareness or knowledge.
35	SCG		Section 8-1	Ozone Laundry	See comment for Page 1-5 above.	First the evaluation team would like to contest the statement that we concluded there was generally a reduction in combined hot and cold water use. In fact, a major primary source of prototypical laundry cycle information suggests that water use would generally increase. The evaluation team included a recommendation to continue offering ozone laundry and to increase participation using marketing and outreach. In the report we explain that custom program projects typically undergo a more rigorous verification of operating conditions that are in-turn incorporated within the project saving estimates.
36	SCG		Page 1-8	Tankless Water Heater	“Three claimed projects occurred at facilities that have since permanently closed, and six projects were claimed at service addresses that had no evidence of recent tankless water installations.” SoCalGas is interested to learn about the details of these projects to identify where the gaps are. Furthermore, although this is a PY2019 evaluation, the survey and research were done during the COVID-19 pandemic. Why there is no indication whether COVID-19 has any influence? Could there be an impact on a business that was found to be closed or the survey results that, in turn, would influence the net-to-gross ratio? SoCalGas’s midstream program will also be sunset at the end of April 2021 and will be replaced with the new Statewide Midstream Heating program, which will encompass a more thorough and comprehensive review process, including onsite inspection, to ensure that incidents like this will not occur.	The CPUC has elected to not comply with this request for additional site-level information. There is a desire to retain confidentiality of respondent reports. Regarding the effects of COVID-19, we confirmed for the three closed businesses that the businesses were permanently closed, not temporarily due to the pandemic. For other projects, we asked the survey respondents to consider typical, pre-pandemic operating conditions. Many respondents indicated that the pandemic had not affected their DHW set-points or usage patterns, but for those that did indicate a COVID influence, we made sure to collect information related to pre-pandemic conditions.

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37	SCG		Page 3-21	Tankless Water Heater	As noted on page 3-21, the midstream delivery resulted in end use contact information (and possibly location) being a challenge. This is reinforced on pages 3-24 and 3-26. While it is possible these were initially at a service location in the tracking system, they may be moved to another location, use or out of state (among other explanations). Given this uncertainty, should it be agreed to leave them in to calculate a preliminary GRR. However, since there is uncertainty, the evaluator should use that same GRR to calculate a credit (it is understood that is the GRR applied to the (unknown with certainty) population. Thus the -20% negative effect on the GRR would become close to -4% if the preliminary GRR is 80%, and the final GRR for SCG would be 3% - figures not exact).	Since the tankless water heater measure is still being delivered in a midstream fashion, we believe the GRR--inclusive of the non-installs-- is representative of program performance and should be prospectively applied. Evaluation sampling is intended to ensure that the three SCG non-installs are representative of other unsampled SCG projects in the population. If any significant changes occur to program design, measure eligibility, or delivery method, we agree that the GRR could be reexamined to exclude the non-installs that are symptomatic of a midstream program.
38	SCG		Table 5-38	Tankless Water Heater	Table 5-38: The last 5 projects for SoCalGas show zero as the size of the installed equipment. Yet, ex-post savings and GRR are present. How were these evaluated? What baseline was used for these projects? Why couldn't the size of the equipment be identified? What do these zeros represent?	The capacities for the last 5 projects have been added to the table; apologies for the oversight.
39	SCG		Pages 5-50 and 5-51	Tankless Water Heater	The evaluation found that three projects installed systems with slightly different in size than the reported by the program and identified inconsistencies between workpaper-recommended UES and those reflected within the reported ex-ante savings claims. SoCalGas would like to know the detail of these projects. This should be part of SoCalGas' lessons-learned for future programs.	Please see response to comment 36.
40	SCG		Page 6-3	Tankless Water Heater	The PAI-2 score = N41/2, which discounts the importance of the program by 50% if the decision was made before. We expect the N41 score to be low anyway. Please consider removing this unsubstantiated score.	Thank you for the comment. The NTG scoring algorthim was developed by the Net-To-Gross working group several years ago and went through a considerable vetting process. A new working group was formed for the PY2018 evaluation and revisited and revised the algorithm, and decided to continue to use the N41 adjustment. Also, note that the effect of removing the adjustment based on the N41 score would only increase the NTGR by 0.02 for tankless water heaters.
41	SCG		Page 6-3	Tankless Water Heater	What is the use of the N42 score? Is it informative only? Would Quantum Energy Analytics consider using the PAI-N6 score only if it's valid instead of averaging with the PAI-1 and PAI-2 scores, as the same question is asked twice and some double counting results?	N42 is asked as a consistency check to make sure that N41 + N42 = 10. As mentioned above, the NTG alrogithm went under review for PY2018 and the N6 score was added to the approach. We feel this question complements the other PAI scores and is not duplicative.
42	SCG	Section 3-1-2		Other	Section 1-1: Program administrators were mentioned but readers are not clear who they are since no IOUs names are included.	Footnotes were added to the top of chapter 1 and 2 to list the names of the IOUs as program administrators.
43	SCG	Section 3-1-2			Section 3-1-2: PG&E and SCG were not spelled out prior to this point.	In the footnote referenced in the line above we also provide the acronym for each program administrator in chapter 2.
44	SCG	Section 5-4	Page 3-12		The word "Furthermore" was used twice two consecutive paragraphs.	We removed the second use of furthermore.
45	SCG				Section 5-4: DHW is not defined or spelled out prior to this point.	Thanks for the observation; we have defined the DHW abbreviation at its first appearance in Section 4.4.

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46	SCG	Overall			Overall: There is no in-depth discussion on the COVID-19 pandemic and how it impacted customer operations, usage levels, etc. How did the remote gross data collection vs. the on-site collection due to COVID-19 hinder or aid the accuracy of the evaluation results? What areas were most affected and how? SCE will also review how we have calculated EUL estimates for Pumping Process measures as identified in the report.	Evaluators do not believe it is necessary within the body of the report to include discussion of the impacts of COVID. Evaluators have communicated this verbally to the PCG and during webinars, and included substantial discussion within the workplan. Impacts of COVID on customer operations varied by measure and sample point -- there were some temporary closures, some increases in production levels, some decreases in production levels, etc.; there were also a substantial number of points that were unaffected -- especially for the two agricultural measures. COVID did hinder evaluation data collection in some ways; for example, not always being able to observe condtions, and thus there was a greater reliance on customer reports, but also use of remote data collection approaches to facilitate direct observations for equipment nameplates, settings, etc. We don't believe that COVID aided data collection in any way, but did allow for field data collection cost savings, and for NTG the collection of data for a larger number of participating projects and/or decision makers. Regarding EUL; we appreciate the follow-through.
47	SCG	Chapter 5	Pages 5-45 and 5-46	Tankless Water Heater	This is in response to Page 5-45 and 5-46 of the report. The report states that the inlet water temperature of the cool water in the larger systems was higher than the workpaper assumption due to municipal water mixing with warm water from the return of the loop. The water heater calculator that the workpaper is based off of doesn't consider loop losses from a DHW loop system, and only considers how much energy it will take to heat up the makeup water to raise to the setpoint. Using a weighted average of makeup plus return temperature is not really accurate because you would also have to consider the additional losses from the loop that the workpaper does not consider.	We have made a couple revisions to the latest version of the Small Commercial report to account for the 5 closed-loop TWH systems evaluated in PY2019. Table 5-36 presents average DHW temperature values weighted by equipment capacity. These values do not directly affect the GRRs and NRRs but are presented for informational purposes. We agree with SCG that the closed-loop temperatures should not be included in these weighted averages, as the programs are intended to exclude closed-loop systems from participating, per the workpapers (notwithstanding the difficulties for a midstream program to do so). We therefore have added a footnote to Table 5-36, and have revised the TWH recommendations in Sections 1 and 8, to differentiate closed-loop from open-loop temperature averages.
48	SCE			Overall scope of comments from SCE	SCE organizes our comments along the major recommendations of this draft that are associated with Process Pumping Installations, which represents the overwhelming majority of SCE's evaluated ex ante claims examined in this draft report. It should be noted that SCE's Deemed Program for Small and Medium Commercial will sunset at the end of PY 2021.	Thank you for your comments.

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49	SCE			Pump VFD -Project Screening, Application and Review (Conclusions and Recommendations are cited)	SCE has invested substantially in improving the quality of custom projects and has taken the statewide lead in codifying the qualification of custom project. On the deemed side, we work closely with Energy Division to revise workpapers that do not represent realistic estimates of measure savings. The study has highlighted gaps in the application of Measure Application Types which we will address for the Pumping Process measure and other deemed offerings as well. SCE will also review how we have calculated EUL estimates for Pumping Process measures as identified in the report. SCE supports the concept of enhancing deemed savings with existing customer data such as pump performance and meter data and expects that this idea will be examined by the program implementation team that takes these programs forward as they sunset.	We appreciate the follow-through on the evaluation-based recommendations.
50	SCE			Baseline Recommendations	As noted above, the idea of enhancing workpaper based savings with additional customer and project data makes sense for process pump measures and we expect these ideas to be implemented by third party programs going forward. The enhancement of our workpapers to account for pump type and size variations (and other parameters) makes sense to the extent that we do lose the benefits of low cost, deemed offerings versus a customized offering. Again, we expect these improvements to be studied closely by third party providers of small and medium programs as ours sunset.	We appreciate the follow-through on the evaluation-based recommendations.
51	SCE			Program Tracking Systems	SCE is updating or Customer Service system and we expect to implement these changes and improvements as identified in the Draft Report.	We appreciate the follow-through on the evaluation-based recommendations.
52	SCE			Workpaper Applications	SCE will integrate these results into our workpapers where appropriate. We anticipate that the statewide TRM process will reflect impact evaluation results as well as we transition to third-party programs.	We appreciate the follow-through on the evaluation-based recommendations.