FINAL IMPACT EVALUATION

Non-Residential Deemed Pump and Food Service

Program Year 2020

April 28, 2022

Submitted to:
California Public Utilities Commission

Prepared by:
Quantum Energy Analytics

In coordination with:
DNV

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SECTION 1:

EXECUTIVE SUMMARY

1-1 NEED FOR THE STUDY

This report presents the results of an evaluation of energy savings from selected technologies administered in commercial energy efficiency programs in program year 2020 (PY20) by four California Program Administrators (PAs): Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas (SCG), and San Diego Gas and Electric Company (SDG&E). This work was performed by Quantum Energy Analytics under contract to the California Public Utilities Commission (CPUC). The technologies were chosen because it is difficult to forecast the expected energy savings with a high level of certainty. The results are used to determine whether or not energy efficiency programs are meeting savings goals and helping meet the state's climate goals.

1-2 ENERGY EFFICIENCY TECHNOLOGIES STUDIED

This study evaluated the following three technologies offered to the commercial, industrial, and agricultural sector through energy efficiency programs:

- Agricultural pumping variable frequency drives (VFDs) – installation of supplemental motor controls that can adjust the motor speed on pumps downwards, resulting in more efficient operations of pumps used to irrigate farm crops.
- Energy efficient pumps – installation of high-efficiency water pumps for commercial applications other than wastewater treatment. Efficient pumps are designed to move a given volume of water using less energy than a market-standard alternative.
- Gas fryers – installation of ENERGY STAR®-qualified, gas-fired fryers in commercial food service businesses.

These three technologies were selected in-part due to the quantity of savings they represent in California's programs. Of all of the savings reported by the programs being evaluated the agricultural pump VFD technology and energy efficiency pump technology account for 32% and 18% of electric savings, respectively. While the gas fryer technology accounts for 15% of gas savings.

1-3 APPROACH

We conducted original research to verify the energy savings reported by the PAs and/or developed revised estimates of savings for each technology studied. Our study addressed both electric (MWh, MW) and gas (therm) savings provided over the lifetime of the technology. The primary mechanism for collecting data included telephone surveys, surveys conducted on-site, and online virtual visits,[1] which we conducted among a sample of customers who 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 each customer's energy consumption.

Our evaluation then compared the savings estimates developed using data collected from customers who participated in the programs 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, and is the fraction of reported savings realized at the conclusion of our evaluation.

We also examined how successful the programs were in influencing participants to install energy efficient equipment. Participants who would have installed the same energy efficient equipment in the absence of the program are referred to as free-riders because they are receiving program incentives for actions they already would have undertaken. 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.

---

[1] 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.

The 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[2]. Furthermore, evaluated net savings estimates include additional adjustments associated with measured free-ridership. The 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 was found to be the cause for all resulting savings, 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.

We investigated the effects of the ongoing COVID-19 pandemic on participant operations through telephone surveys and field interviews. Customers reported that operations for the technologies included in our study were not substantially impacted by the pandemic during data collection in late 2021 and early 2022. For example, farm operations and irrigation pump operation in general was found to be unaffected by the pandemic. Generally, this confirms that the data collected through this study is representative of typical operations, and that the resulting impact estimates should not be biased in response to the pandemic.

---

[2] Gross imact estimates are developed by our evaluation team using energy savings models that require measured inputs and other assumptions. Differences between our evaluation models, inputs and assumptions and how those compare and contrast with PA models, inputs and assumptions lead to difrerences in evaluation vs. PA results. Inputs and assumptions used in models, such as hours of equipment operation or equipment efficiency levels, are key variables that can lead to these differences.

1-4 RESULTS

The results of our evaluation establish the gross and net energy savings of the three 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 * Note that the market effects adder is not included in the NTGR.

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.[3] Just one of the three technologies showed much lower energy savings than reported, and therefore resulted in lower gross savings. For the energy efficient pump technology we found that the installed equipment efficiency was lower than expected in reported savings estimates, and some of the pumps were not yet installed or otherwise inoperable. Additionally, the agricultural pump VFD technology had lower than reported electric peak demand savings (MW) due to pumps infrequently operating during hours of the day when peak electric demand occurs – weekdays from 4 PM until 9 PM.

Furthermore, some technologies studied showed that the program had only a moderate-to-low 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 of the energy efficient equipment evaluated).

[3] Please note that all net savings include a 0.05 market effects adder. This market effects adder increases the net savings to account for the indirect effects of the programs in influencing additional high-efficiency installations beyond those accounted for directly by the program.

Table 1-1: Reported (PA) and Evaluated Lifecycle Therm Savings, Realization Rates, and NTGRs for the Evaluated Gas Technology

Technology	PY20 Evaluated Therm Savings			
	Reported	Evaluated	Realization Rate (Evaluated/Reported)	NTGR*
Lifecycle Gross Savings				
Gas Fryers	17,101,320	17,101,320	1.00	0.56
Lifecycle Net Savings				
Gas Fryers	11,122,068	10,447,771	0.94	0.56

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

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

Technology	PY20 Evaluated MWh Savings			PY20 Evaluated MW Savings			
	Reported	Evaluated	Realization Rate (Evaluated/ Reported)	Reported	Evaluated	Realization Rate (Evaluated/ Reported)	NTGR*
Lifecycle Gross Savings							
Agricultural Pump VFD	84,493	58,740	0.70	40.4	8.9	0.22	0.39
Energy Efficient Pumps	34,410	6,525	0.19	-	-	N/A	0.54
Lifecycle Net Savings							
Agricultural Pump VFD	54,920	26,746	0.49	26.2	4.0	0.15	0.39
Energy Efficient Pumps	30,969	3,935	0.13	-	-	N/A	0.54

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

In the next section, 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 Findings and Recommendations

1-5-1 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. For example, 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. Program eligibility requirements are that pumps must run 1,000 or more hours per year, which if typical for agricltural irrigation pump operations. Furthermore, out of a total sample size of 58 pumps, commonly observed reasons for failing eligibility requirements includes the installation of speed controls in the following cases: 13 pumps run fewer than 1,000 hours per year, 9 pumps pump well water into water storage reservoirs, and 13 pumps have settings that are at or near full-load.
  - 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. Interval billing data when used in our savings models dramatically improved the accuracy of our resulting savings estimates. Current PA models develop average savings estimates using a sample of project-specific calculations, and contributing inputs and assumptions is not available for review in calculation documentation. The resulting PA model accruacy is therefore unknown.
  - 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.
- **Tracking system improvements are needed to properly characterize the pumps on which the VFD controls are installed.** Pumps were mislabeled with respect to the tracking data-based pump description and pump size ratings. Mostly pumps were misclassified by the type of pumping being performed by a given pump (well pump versus booster pump). Reported savings differ across

these two pump types. Well pumps pump water to irigated fields from a groundwater source that is often hundreds of feet below ground, while booster pumps move water from in- or above-ground reservoirs to irrigated fields. Pumping from wells uses more energy to move an equivalent amount of water relative to booster pumps.

  - The program's VFD verification process should ensure that pump descriptions accurately represent each irrigation pumping system.

- 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. Other common reasons are that the VFD pump gives the farmer the ability to monitor and control the pump remotely, from a desk in their office, or that the VFD might serve to mitigate water table fluctuations. 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 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 program intervention. VFD flow controls may already be the most commonly installed approach for certain pump type and size combinations.

1-5-2 Energy Efficient Pumps

- **For many of the efficient pumps evaluated, program data did not provide sufficient information.** For approximately 55% of projects sponsored by PG&E in 2020, we did not have sufficient participant contact data to verify pump installations or evaluate savings. As a result, we expanded our evaluation recruitment pool to include all 2020 participants but ultimately did not reach ourtarget sample count[4].

[4] We designed the evaluation sample to include 34 pump installation projects to achieve a target statistical precision in results. Due to the customer recruitment difficulties summarized above, we ultimately completed 20 assessments. Nonetheless, the results are reasonably precise to support the findings and recommendations presented throughout this report.

  - We recommend that the PAs require participating distributors and partnering contractors to collaboratively collect and submit basic information for each customer who receives the equipment. This appears to be most challenging to accomplish for installed equipment that is delivered by the programs through retail or other equipment supplier sources, in contrast with equipment that is 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 ensure that program dollars are being spent prudently.

- **The reported savings are currently overestimated.** Overall, we found that the actual efficiency of the pumps was 69% lower than that reflected in program reported savings. This difference was the primary contributor to the measure's 13% lifecycle net impact realization rate[5] as indicated in Table 1-2.

  - We recommend that the reported efficient-pump impact calculations be revised to reflect the most granular and up-to-date PEI values available. Our evaluation team has been working with PG&E and the CPUC to refine the impact estimation approach[6], and this recommendation aligns with those ongoing efforts. We recommend that the resulting updated impact calculations reflect the characteristics of pumps (sizes, pump types, and controls) rebated in 2020.

- **We determined that six of the 20 evaluated projects have not saved energy.** Two projects occurred at newly constructed businesses that have not yet opened, two projects occurred at businesses that have not yet installed the rebated pumps, and two projects' pumps had efficiencies identical to baseline. These projects produced no savings and led to a 12% reduction in 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, photographs) to document measure installation, quantity, size, and efficiency. As noted above, this appears to be most challenging to accomplish for installed equipment that is delivered by the programs through retail or other equipment supplier

---

5 A 13% lifecycle net savings realization rate means that we determined 13% of the reported net savings over the life of the energy-efficient pump technology to be attributable to program rebates and support.

6 As part of this evaluation contract, we provide retrospective research, such as this report, as well as prospective assessments through collaboration with the CPUC and PAs. We have recently assessed the energy-efficient pump savings calculation approach used bg the PAs, and many of the retrospective findings presented in this report intersect with recent prospective efforts for this measure.

sources, in contrast with equipment that is installed directly by contractors, and should therefore be an area of focus for implementing this recommendation.

- Of the 20 evaluated projects, nine were found to have incorrect reported savings values or mischaracterizations of the rebated pumps. In these cases, we found that the reported savings submitted by PAs were incorrect. Correcting these errors resulted in a 1% decrease in realized savings.
  - We recommend that the PAs redouble efforts to ensure that reported savings estimates are based on the correct application of approved savings values. We primarily attribute these observed errors to mischaracterizations of pump horsepower, pump type, or pump controls.

1-5-3 Gas Fryers

- **For many of the evaulated gas fryer projects, program data did not provide sufficient information.** For approximately 83% of projects rebated in 2020, we did not have sufficient participant contact data to verify fryer installations or evaluate savings.[7] In addition, the ongoing COVID-19 pandemic further limited our ability to access food preparation areas for verification and measurement of the rebated fryers. As a result, we expanded our evaluation recruitment pool to include all 2020 participants but ultimately did not meet our target sample count.
  - 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. 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 ensure that program dollars are being spent prudently.
- **We verified the installation of all rebated fryers in the evaluation sample.** Similar to the energy efficient pump equipment, fryers are primarily delivered through retail or equipment supplier

[7] 83% of projects did not have customer contact data, including projects with contact data for the distributor or contractor only, and projects with outdated or erroneous customer contact information.

channels. But in contrast to the energy efficient pump equipment, we determined an installation rate of 100% after confirming fryer claims at 12 sampled participating facilities.

- **Measured operation differed from reported savings assumptions and led to reduced savings.** We deployed temperature measurement devices on rebated fryers installed at sampled businesses. The operational data showed that fryers operate more frequently than predicted by the reported savings calculations. Increased operation led to a corresponding increase in realized savings. We also determined higher energy usage rates than reported. We confirmed through phone surveys and in-person interviews that our evaluation data collection, which occurred between November 2021 and February 2022, reflected typical operation and was not affected by COVID-19 precautions.
- **The programs exhibit influence in increasing sales for high-efficiency fryers**. Participating suppliers indicated that the program has caused them to stock and sell more high-efficiency models than they would have absent the program. Suppliers also generally use the program rebates to discount the high-efficiency fryers. These discounts help convince businesses to choose a more efficient model than they otherwise would have.

1-6 Contact Information

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

Table 1-3: Contact Information

Firm	Lead	Contact Info
CPUC 505 Van Ness Avenue San Francisco, CA 94102	Yeshi Lemma Energy Division	Phone: (213) 576-7006 Email: Yeshi.Lemma@cpuc.ca.gov
Quantum Energy Analytics San Marcos, CA 92078	Kris Bradley Partner	Phone: (760) 237-8780 Email: krisb@quantum-ea.com

SECTION 2:

INTRODUCTION AND OVERVIEW OF THE STUDY

In this study we evaluate the energy savings from selected technologies administered in commercial energy efficiency programs in program year 2020 (PY20) by four California Program Administrators (PAs): Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas (SCG) and San Diego Gas and Electric Company (SDG&E). The overall goal of this study is to perform an impact evaluation on three measures for PY20: Agricultural Pumping VFDs, Clean Water Pump Upgrades, and Gas Fryers. The team we have assembled to complete this work consists of two lead firms – Quantum Energy Analytics and DNV GL.

This evaluation focuses on energy efficiency (EE) resource program savings – measured in net ex post lifecycle energy savings – realized by PA programs in PY20. Our evaluation team collected and analyzed primary data from PY20 participants to develop net ex post lifecycle savings estimates. 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 three researched measures.

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 the three researched measures. The impact parameters that were 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 in this report 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**

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 measures chosen for the PY20 Pump and Food Service Evaluation. 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: 2020 Measures Studied and Parameters Relevant to the Pump and Food Service Evaluation

Measure Group	PY20 Impact Evaluation Scope	
Agricultural Pumping VFD	G / N	Installation Rate, Unit Energy Savings (UES), Realization Rate (RR), Expected Useful Life (EUL)
Clean Water Pump Upgrades	G / N	Installation Rate, UES, RR, EUL
Gas Fryers	G / N	Installation Rate, UES, RR, EUL

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 investigated 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 during participant telephone and on-site surveys and through 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:

- **What is the installation rate?**
  - **We confirmed installations (verification) using telephone- and onsite-based verification of measure installations.**
- **What are key impact parameters that affect measure energy use?**
  - **We estimated key impact parameters for both the baseline (standard practice) 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.**
- **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.**
- **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.**
- **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.**
- **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 participation summary of PY20 electric researched measures that fall under the Pump and Food Service Impact Evaluation. We selected these measures because they comprise half of the PY20 non-residential and non-lighting/non-HVAC deemed measure electric savings PY. These measures include the agricultural pumping VFD and clean water pump upgrade measures.

Table 2-2: PY20 Participation Summary – Expected Net Lifecycle Electric Savings (GWh)

PY20 Pump and Food Service Measure	PY20 Tracking System Records*	PY20 Unique Applications by Measure Group**	Ex Ante Net Lifecycle GWh Savings***	Percent of Savings****
Agricultural Pumping VFD	275	239	55	32%
Clean Water Pump Upgrades	540	260	31	18%
Gas Fryers	-	-	-	-
Total	815	499	86	50%

* 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.
**** These savings represent non-residential deemed portfolio savings, excluding lighting and HVAC.

Similarly, Table 2-3 presents the PY20 gas-focused measure, including expected gas savings and associated participation statistics. The gas-focused measure that we selected for evaluation is gas fryers which we selected because it comprises a large portion of the non-residential non-lighting/non-HVAC deemed gas savings.

Table 2-3: PY20 Participation Summary – Expected Net Lifecycle Gas Savings (MMTherm)

PY20 Pump and Food Service Measure	PY20 Tracking System Records*	PY20 Unique Applications by Measure Group**	Ex Ante Net Lifecycle MMThm Savings***	Percent of Savings****
Agricultural Pumping VFD	-	-	-	-
Clean Water Pump Upgrades	-	-	-	-
Gas Fryers	2,389	2,105	11	15%
Total	2,389	2,105	11	15%

* 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.
**** These savings represent non-residential deemed portfolio savings, excluding lighting and HVAC..

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 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 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 Pump and Food Service 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, on-site data collection and 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 PY20 Measures

	Primary Data Sources		Ex Post Update	
2020 Measure	NTG Phone Surveys	Gross Impact Interviews / On-Site / Remote Data Collection	NTG Results	Gross Impact Results
Agricultural Pump VFDs	X	X	X	X
Clean Water Pump Upgrades	X	X	X	X
Gas Fryers	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 PY20 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 and AMI data in support of gross impact model calibration for the pump VFD and clean water pump upgrade measures.

3-1-2 Gross Impact Interviews / On-Site and Remote Data Collection

For this evaluation, we collected verification data using telephone interviews, on-site audits and various remote data collection approaches. Furthermore, for the gas fryer measure we collected metering data to support the development of equipment operating load profiles. 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 – Pump and Food Service Impact Evaluation

Parameter	Agricultural Pump VFDs	Clean Water Pump Upgrade	Gas Fryers
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 SCADA or energy management system. Where we were unable to directly observe the schedules, then we queried facility personnel for the schedules, and obtained metering data in support of load profiles. We obtained equipment use schedules, 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. The effect on operations due to COVID, the drought and other factors have also be examined and where possible, quantified.		
Specific Parameters of Interest	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, pump type, pump size (hp) and rated PEI, rated speed (RPM), pump control type, and seasonality-based variability in operating hours	Facility hours of operation, food types, fryer specifications, pre-existing fryer age and size, rated fryer gas consumption by stage, fryer operating hours by stage
Industry Sources	Motor efficiency, pump load factor default, pump performance curves.	Northwest Regional Technical Forum (RTF) database to establish granular baseline parameter values.	Food Service Technology Center (FSTC), manufacturer specifications
Billing Data	AMI/ dedicated billing meter for model calibration.	AMI/ dedicated billing meter.	Utility gas meter readings and billing data for model corroboration.

Agricultural Pumping VFD

The pumping VFD measures included in the PY20 tracking data accounts for 32% of non-residential non-lighting/non-HVAC deemed electric savings. All of the measure descriptions selected for evaluation indicate they are agricultural pumps used in both booster and well pumping applications. Of the well and booster pumps records, 0.7% are tier 2 booster pumps, 7% are tier 3 booster pumps, and 4% are tier 3 well pumps, and these enhanced VFD measures are described in the statewide workpaper SWWP005-02. The remaining measures are tier 1 booster and well pump measures, constituting 27% and 62% of records, respectively, and are described in the statewide workpaper SWWP002-02. The measure descriptions describe the pump capacity in horsepower. PG&E reported 14% of tracking data claims as being add-on equipment (AOE) applications and 86% of claims as new construction (NC) applications. SCE reported that 37.5% of records are AOE and 62.5% of records being NC. The only SDG&E record is reported as being AOE. During evaluation data collection, our field staff has independently determined the application type, as this has important implications for the evaluation 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 those two resulting model-based results to estimate savings. The impact evaluation assessed a sample of 57 pumps installed in PY20.

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 2021 through February 2022. Our evaluation team obtained AMI records for a period of nearly three years, ending in September or October of 2021. 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 in conjunction with various remote data collection approaches:

- **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-installation crop types**
- **Pre- and post-installation crop ages**
- **Preexisting conditions: irrigation system, pumping and irrigation pumping patterns, operability, pressure setpoint, sets**
- **Age and condition of the existing pump**

Clean Water Pump Upgrades

This measure involves installation of clean water pumps with a high-efficiency pump energy index (PEI). Per the measure workpaper[8], measure offerings and impacts vary by load type (constant or variable) and by pump horsepower range. The clean water pump upgrade measure comprises 18% of kWh savings across all nonresidential non-lighting/non-HVAC deemed measures in PY20. As determined from 2020 program tracking data, approximately 87% of water pump upgrade kWh savings in PY20 are attributable to constant load pumps, which comprises 498 of 540 claims under two programs. Both programs are offered by PG&E and involve midstream delivery (i.e., through distributor incentives) to commercial customers.[9]

For this evaluation we developed gross impact results using remote verification and telephone interviews. We conducted remote verification using videoconference or a phone call with visual measure confirmation via photographs. During each remote verification, our engineers confirmed measure installation and operability and collected the following information:

[8] Workpaper SWWP004-01 Water Pump Upgrade. Accessed online at https://www.caetrm.com/measure/SWWP004/01/

[9] A single pump installation was rebated by SCE in 2020. We excluded this project from the evaluation.

- **Project characteristics: Installation date, quantity of pumps installed**
- **Facility type**
- **Installed make and model (gathered nameplate pictures)**
- **Nameplate information: pump size (hp), pump nominal speed, pump type**
- **Pump control type (constant speed/variable speed)**
- **Pump operating hours and possible seasonal fluctuations**
- **Baseline conditions: new construction vs. normal replacement, existing equipment characteristics (pump make/model, control strategy, pump size, pump type and application type)**
- **Impact of COVID on pump usage vs. typical, pre-COVID conditions**
- **AMI meter presence and makeup of other electric equipment sharing the meter with the pump**

Commercial Gas Fryers

This food service measure involves installation of a commercial gas fryer, both standard and large vat types, that meets or exceeds ENERGY STAR certification requirements. The gas fryer measure comprised the majority of statewide food service savings in 2020: 62% of source MMBtu and 67% of therms. This measure was last evaluated in PY2017.

Our gross data collection approach for gas fryers started with telephone interviews with project decision-makers to recruit on-site visits of the installed fryers. The telephone survey collected information on the following gross parameters:

- **Facility characteristics – confirmation of installation address, business type**
- **Project characteristics – installation date, quantity of fryers**
- **Facility operation – hours of operation, fryer food types and production estimates**
- **Effects of COVID on sales and food preparation patterns**
- **Availability for future site visit and arrangement of details**

Our engineers scheduled on-site visits with customers willing to participate. During each on-site visit, we collected the following:

- **Nameplate information for installed equipment: make/model, capacity, other relevant information**
  - **Based on equipment nameplate, via online research: FSTC and EnergyStar resources or other manufacturer specifications such as burner input ratings and preheat times.**
- **Confirmation of phone survey responses on facility and project characteristics and baseline conditions**
- **Confirmation of equipment operating hours by week, seasonality, food types and volumes**
- **Spot-reading of utility gas meter in ccf**

As a proxy for fryer operation by stage and subsequent gas consumption, field engineers deployed high-temperature Type-K thermocouples within the fryer's exhaust flue stack; thermocouples collected exhaust temperature readings at a 10-second interval. From a previous evaluation in PY17, we have learned that there is a strong correlation between exhaust temperatures and the fryer's various stages: cooking, idle, preheat, and off. The exhaust flue temperature data, used in conjunction with the equipment's rated Btu/h capacity at each stage, provided a reliable source of gas usage for the post-installation condition, as further detailed in Chapter 4.

3-1-3 Participant NTG Data Collection

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 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 used measure-specific data collection instruments and protocols and asked a standard battery of NTG questions of all participant decision makers.

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. 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 Clean Water Pump

Upgrade and Gas Fryer measures. 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 populated in the tracking system using unit energy savings values that are derived using these sources.

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 data sources, augmented for site-specific conditions, to derive savings estimates**
- **Use of manufacturer equipment specifications to establish parameters**
- **Use of PA technical data sources**

3-2 SAMPLE DESIGN AND DISPOSITION

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 data to derive independent estimates of ex post gross impact estimates 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 possible ex ante 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 contact information and/or AMI data was available, a sample was pulled for gross impact participant recruitment and subsequent impact evaluation, where insufficient a census was performed.

Agricultural Pumping VFD

The agricultural pumping VFD measure group is an important contributor to electric savings within the measures included in this evaluation, contributing 32% of non-residential non-lighting/non-HVAC deemed electric savings. Furthermore, we note the following important observations:

- **PG&E and SCE contribute the largest share of savings for the agricultural pump VFD measure being evaluated, at 83% and 17%, 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.**

- Standard well and standard booster pumps make up 70% of savings and 88% of records for the agricultural pump VFD measure group, where 30% of savings and 12% of records comprise Tier 2 Booster, Tier 3 Booster, and Tier 3 Well Pumps:
    - The enhanced measures were introduced in the programs in recent years and are a new area of research for the PY20 evaluation.
    - Implication: Our sampling approach is to learn about these pumps as individual case studies where needed, but there are too few enhanced pumps to yield statistically significant sample estimates. These points will are pooled with tier 1 booster pumps and well pumps to derive utility and pump type results for a statistically representative sample supporting each segment.
- Following the sample pull, our evaluation team created additional stratification within the design as follows:
    - The agricultural pumping VFD measure consists of VFDs installed in agricultural pumping applications – consisting of a mix of booster pumps used for irrigation with district or reservoir water (34% of tracking system records and 33% of savings) and well pumps used to draw water to the surface to irrigate fields directly (66% of tracking system records and 67% of savings).
    - 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.
    - We found that PGE has 91 unique decision makers spanning 195 well and booster pump records, while SCE has 54 unique decision makers spanning 80 well and booster pump records.
    - Implication: Customers with multiple applications were a limiting factor in gross data collection, because participating customers did not always cooperate with our requests to complete data collection for more than one or two pumps.

- **Our impact model approach relies on complete and reliable AMI data for model calibration. Furthermore, the presence of PV and other forms of generation on a given AMI meter will not yield reliable model results.**
  - Records without complete and reliable AMI data, or where PV/generation is present, were removed from the gross sample pull. This accounts for 33% of PG&E records and 35% of PG&E savings, as well as 23% of SCE records and 23% of SCE savings.
  - Implication: Removal of records without complete and reliable AMI data, or with PV/generation is another limiting factor to gross impact data collection.
- **A mixture of pump types found on the same meter is found for 12% of PG&E records and 22% of PG&E savings, as well as 10% of SCE records and 16% of SCE savings.**
  - Implication: Farms with mixed pump types are still included in data collection efforts but represented another limiting factor during analysis where distinct pump loads in the AMI data must be separated.

The sampling approach is a census, where we prioritized points with the most desirable attributes, such as good AMI data. Table 3-3 and Table 3-4 present the sample limitations discussed above for PG&E and SCE respectively. The tables show the unique decision makers, farms, and records in the population. A decision maker is defined as the unique customer contact, and can have more than one farm or record. A farm is defined as the unique premise or site pertaining to one or more applications or records, where each record represents a single pump. Each sample point in the tables is assigned a category to indicate the likelihood of collecting data for that point. The categories include: poor AMI/PV/generation; presence of mixed pump types on the same meter; sample exceeding two pumps per decision maker; and remaining sample. The remaining sample is the most desirable sample supporting gross impact evaluation objectives and is the sample that is prioritized for data collection. However, sample with mixed pump types on the same meter, or sample with more than two pumps per decision maker were still included in our data collection efforts. Records with poor AMI data or PV/generation were removed from the gross impact sample, since gross impacts rely so heavily on AMI data to estimate pump loads. The sample that was prioritized for data collection consists of 69 decision makers with 93 pumps for PG&E sample, and 39 decision makers with 47 pumps for SCE sample, assuming data collection for a maximum of two pumps per phone interview. In some cases, we found that there were multiple technical experts involved or a participating customer was very cooperative, where we obtained information for more than two pumps per decision maker sample point.

Table 3-3: PG&E Agricultural Pump VFD Gross Sample Limitations

PG&E Agricultural Pump VFD Sample Limitations	PY20 Tracking System Records and Sites			Sum of Ex Ante Net Lifecycle Electric Savings	
	Records	Farms*	Decision Makers*	kWh	Percent
Poor AMI Data or PV/Generation Present					
Well Pumps	51	48	36	13,071,256	29%
Booster Pumps	13	13	12	2,920,377	6%
Subtotal	**64**	**61**	**48**	**15,991,633**	**35%**
Mix of Pump Types on Same Meter					
Both Well and Booster	24	20	9	9,936,518	22%
Subtotal	**24**	**20**	**9**	**9,936,518**	**22%**
Already Sampled 2 Pumps per DM					
Well Pumps	12	10	5	2,486,046	5%
Booster Pumps	2	2	2	662,350	1%
Subtotal	**14**	**12**	**7**	**3,148,396**	**7%**
Remaining Sample					
Well Pumps	59	51	43	10,562,683	23%
Booster Pumps	34	33	26	6,186,696	14%
Subtotal	**93**	**84**	**69**	**16,749,379**	**37%**
Total	**195**	**171***	**91***	**45,825,926**	**100%**

* Indicates more than one farm or DM across strata. Overall total may not be the sum of strata totals.

Table 3-4: SCE Agricultural Pump VFD Gross Sample Limitations

SCE Agricultural Pump VFD Sample Limitations	PY20 Tracking System Records and Sites			Sum of Ex Ante Net Lifecycle Electric Savings	
	Records	Farms*	Decision Makers*	kWh	Percent
Poor AMI Data or PV/Generation Present					
Well Pumps	10	10	10	1,352,081	15%
Booster Pumps	8	8	6	695,846	8%
Subtotal	**18**	**18**	**16**	**2,047,927**	**23%**
Mix of Pump Types on Same Meter					
Both Well and Booster	8	7	6	1,432,730	16%
Subtotal	**8**	**7**	**6**	**1,432,730**	**16%**
Already Sampled 2 Pumps per DM					
Well Pumps	7	7	3	343,785	4%
Booster Pumps	0	0	0	-	0%
Subtotal	**7**	**7**	**3**	**343,785**	**4%**
Remaining Sample					
Well Pumps	29	29	25	3,991,595	44%
Booster Pumps	18	17	14	1,278,373	14%
Subtotal	**47**	**46**	**39**	**5,269,969**	**58%**
Total	**80**	**74***	**54***	**9,094,411**	**100%**

* Indicates more than 1 farm or DM across strata. Overall total may not be the sum of strata totals.

Table 3-5 presents a summary of information surrounding the agricultural pump VFD measure and the resulting M&V gross impact sample design and completed M&V points. The records represented by the sample frame in the table account for the most desirable sample, or sample that was most successful in data collection efforts that includes good AMI data and a maximum of two pumps per decision maker, which is 40% of the pump VFD population. Although we conducted a census, targets in the table were set to track completes by segment, defined by PA and pump type. This also allowed us to put emphasis on obtaining the necessary completion rates to meet those targets and ensured that we obtained desirable precision for results in each segment. We targeted 50 completes, resulting in 18% relative precision at the 90% confidence interval. We completed data collection on 57 pumps, exceeding our targets. Overall, our completes represent 40% of savings, and 40% of pumps from the sample frame.

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

Agricultural Pumping VFD Measure	PY20 Sample Frame*		Sample Design Targets and Actual Pumps Surveyed (Records)		Achieved Data Collection (% of Sample Frame)	
	Records**	Ex Ante Net Lifecycle Savings (GWh)***	Target	Actual	% Records	% GWh
PG&E						
Well	59	10.6	20	20	34%	51%
Booster	34	6.2	10	12	35%	21%
Subtotal	**93**	**16.7**	**30**	**32**	**34%**	**40%**
SCE						
Well	29	4.0	12	12	41%	36%
Booster	18	1.3	8	13	72%	56%
Subtotal	**47**	**5.3**	**20**	**25**	**53%**	**41%**
Total	**140**	**22.0**	**50**	**57**	**41%**	**40%**

* Sample frame includes most viable population records with good AMI data, and decision makers with no more than 2 pumps.
** Count of records of non-zero savings; both positive and negative.
*** The 0.05 market effects adder is not included in the net savings values.

It is notable that our net impact sample design did not have the limitations seen in the M&V sample design. This is due to the fact that unlike the M&V sample, the sampling unit for net was the decision maker. Farmers were typically the decision makers who elected to acquire VFD flow controls and their decision making normally did not vary substantially from pump-to-pump. In addition, we found that other factors such as quality of AMI data, or PV presence is not important in determining NTGRs.

Table 3-6 presents a summary of participation and the resulting telephone survey sample design and quantity of decision makers surveyed for the agricultural pump VFD measure. We targeted a total of 28

NTG interviews, which resulted in 10% relative precision at the 90% confidence interval. We completed a total of 69 net surveys, exceeding our targets. We surveyed 42% of decision makers, representing 60% of savings.

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

Agricultural Pumping VFD Measure	PY20 Population		Sample Design Targets and Actual Surveyed (Decision Makers)		Achieved Data Collection	
	Decision Makers*	Ex Ante Net Lifecycle Savings (GWh)**	Target	Actual	% Decision Makers	% GWh
PG&E						
Well Pumps	70	30.1	14	32	46%	60%
Booster Pumps	35	15.7	7	14	40%	70%
Subtotal	**105**	**45.8**	**21**	**46**	**44%**	**63%**
SCE						
Well Pumps	36	6.6	7	15	42%	39%
Booster Pumps	22	2.5	4	8	36%	57%
Subtotal	**58**	**9.1**	**11**	**23**	**40%**	**44%**
Total	**163**	**54.9**	**32**	**69**	**42%**	**60%**

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

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

Clean Water Pump Upgrades

The clean water pump upgrade measure is an important contributor to electric energy savings within uncertain measures in 2020, contributing 18% of kWh savings across all nonresidential non-lighting/non-HVAC deemed measures. PG&E exclusively delivered the measure through midstream channels in 2020. We note the following observations that affected our original sample design for clean water pump evaluation. The sample design is presented in Table 3-7.

- Aside from a single SCE installation that was excluded from the evaluation, the clean water pump measure was exclusively rebated by PG&E in 2020.
  - Implication: The sample design did not segment by PA, as only PG&E projects were included in the sample frame.
- The clean water pump measure was exclusively delivered through midstream channels (i.e., incentives among participating distributors).
  - Implication: The sample design did not segment by delivery method, as only midstream projects were included in the sample frame.
- The measure produces kWh savings as a result of higher pump energy index (PEI) values as compared with comparable baseline models. Through data request with PG&E, we obtained baseline and installed PEI information for all 540 installations in 2020. We therefore did not require a sample design for PEI assessment, as we analyzed the full population of pumps using a census approach.
  - Implication: For the assessment of other relevant measure parameters, including installation rate, horsepower, operating hours, and load factor (each of which is further described in Section 4.2), we utilized a sample design as described in the following bullets.
- Two clean water upgrade measure descriptions comprised 87% of measure group kWh savings in 2020: constant-volume upgrades between 3 hp and 50 hp, and constant-volume upgrades between 50 hp and 200 hp.
  - Implication: The above two measure descriptions were the focus of PY2020 evaluation. Lower-impact measure types, such as those involving smaller pumps or variable-volume pumps, were excluded from the PY2020 sample frame.
- Due to the measure's midstream design, end-user contact information as supplied by PG&E is limited.
  - Implication: During the evaluation planning phase, we requested that PG&E attempt to link end-user contact information with 2020 installations based on any relevant customer

identifying information such as physical address or account number.[10] PG&E ultimately provided credible end-user contact information for 55% of the PY20 population of clean water pump installations. We excluded the remaining 45% from the evaluation sample frame. During initial interviews with the evaluation team, PG&E program administrators suspected no bias between projects with end-user contact information and those without. Of the 55% of projects with credible contact information, evaluators faced difficulties in recruiting customers to participate in the evaluation study, as detailed later in this section.

- Ex-ante unit energy savings are normalized to pump horsepower and vary between the two tiers being evaluated: 3 hp to 50 hp (designated as "small" in this evaluation), and 50 hp to 200 hp (large).
  - Implication: To ensure results for both evaluated pump descriptions, the original sample design attempted to stratify by pump size between large and small tiers.

[10] Through our assessment of similar midstream measures in prior cycles, such as Tankless Water Heater (PY18 and PY19), we found that physical address and account number are most viable end-user fields for linking with customer information databases. The PY20 Clean Water Pump Upgrade tracking data otherwise did not include any additonal information that could possibly link to the recipients of the rebated pumps.

Table 3-7: Clean Water Pump Measure Gross and Net (End-User) Impact Sample Design

Pump Size	Stratum	Claims	Installed Qty.	Reported Lifecycle Net kWh	Savings Share	Gross & Net Sample Targets	Assumed COV	Relative Precision @ 90% CI**	Achieved Gross Sites
PG&E									
Large		6	40	5,563,771	38%	6	0.5	0.0%	0
Large w/ Small		7	21	3,932,088	27%	7	0.5	0.0%	1
Large Subtotal		**13**	**61**	**9,495,860**	**64%**	**13**	**0.5**	**0.0%**	**1**
Small	2	23	61	2,661,516	18%	11	0.5	18.3%	5
Small	1	87	108	2,498,347	17%	10	0.5	25.0%	14
Small	0	13	13	104,321	1%	0	N/A	N/A	0
Small Subtotal		**123**	**182**	**5,264,184**	**36%**	**21**	**0.5**	**9.9%**	**19**
Total		**136***	**243**	**1,476,0043**	**100%**	**34**	**0.5**	**5.4%**	**20**

* These totals do not match the total claims value in Table 2-2 as Table 3-7 reflects totals from projects with viable contact data.
** These precision estimates do not incorporate the population-wide PEI analysis discussed earlier in this section, which improved the statistical stability of results as discussed in Section 5.

The M&V data collection design included a sample of 34 telephone surveys with end-users that received PA-rebated clean water pumps through participating distributors in PY20. We experienced significant difficulties in recruiting end-users to participate in the evaluation study. Of the 136 projects with initially viable contact data, we found that 54 reflected the contact information of the participating distributor or contractor, not the end-user ultimately receiving the pump.[11] We expanded our data collection pool to encompass the 123 projects with substantial savings (excluding the 13 smallest savers in the Small – 0 stratum, which comprised 1% of kWh savings). Representatives of 10 projects declined to participate in

[11] Distributors in this and prior cycles of midstream measure evaluation declined to provide additional end-user contact information beyond what was originally required by the utility for rebate payout, citing confidentiality and personal information protection sensitivities.

the study, and 45 project representatives could not be reached.[12] We ultimately completed 20 virtual verifications and 4 net surveys.

Commercial Gas Fryers

The commercial gas fryer measure is an important contributor to gas savings in 2020, contributing 15% of therm savings across all nonresidential non-lighting/non-HVAC deemed measures. PG&E, SCG, and SDG&E delivered the measure through a combination of downstream and midstream channels in 2020. We note the following observations that affected our original sample design for gas fryer evaluation. Table 3-8 presents the sample design.

- **The gas fryer measure was rebated by PG&E, SCG, and SDG&E programs in 2020.**
  - Implication: The sample design stratified by PG&E and SCG programs, which comprised over 99% of PY20 savings. SDG&E was excluded from the sample frame due to relatively low savings claims and identical savings-per-fryer claims with other PAs.
- **The gas fryer measure was delivered through downstream and midstream channels in PY20.**
  - Implication: We investigated the need to stratify by delivery method but determined identical ex-ante savings-per-fryer between downstream and midstream claims. The sample therefore does not differentiate between the two delivery methods.
- **Due to the measure's midstream design, end-user contact information as supplied by PG&E and SCG is limited.**
  - Implication: We requested that PG&E and SCG attempt to link end-user contact information with 2020 installations based on customer identifying information such as physical address or account number. PG&E and SCG provided credible end-user contact information for 55% of the population of PY20 gas fryer installations. The remaining 45% was excluded from the

[12] Assigned engineers attempted to contact customers at least six times, using a combination of telephone calls (at varying times of day and days of the week) and emails (if available).

evaluation sample frame. During initial interviews with the evaluation team, PG&E and SCG program administrators suspected no anticipated bias between projects with end-user contact information and those without. Of the 55% of projects with credible contact data, we encountered further difficulties in recruiting customers to participate in the evaluation study, as detailed later in this section.

- Ex-ante savings scale proportionally with the number of fryers installed per project. Installation quantities varied between 1 and 10 fryers per project.
  - Implication: We found that projects with more than 1 installed fryer comprised 62% of total savings in the sample frame. Projects with only 1 installed fryer comprised 38%. We hypothesized potential differences between the two groups—multi-fryer projects are more likely to occur at larger restaurants or chains, while one-fryer projects are more likely to occur at smaller and/or independently-owned restaurants. Additionally, multi-fryer facilities could exhibit different frying patterns than those with only one fryer. For these reasons, we stratified between multi-fryer and single-fryer groups for each of the two PAs evaluated.

Table 3-8: Commercial Gas Fryer Measure Gross and Net (End-User) Impact Sample Design

Fryers per Project	Claims	Installed Qty.	Reported Lifecycle Net Therms	Savings Share	Gross & Net Sample Targets	Assumed COV	Target Relative Precision @ 90% CI	Achieved Gross Sample
PG&E								
Single	228	228	736,258	13%	10	0.5	±26.0%	10
Multi	129	403	1,304,503	22%	10	0.5	±25.5%	0
PG&E Subtotal	**357**	**631**	**2,040,761**	**35%**	**20**	**0.5**	**±13.7%**	**10**
SCG								
Single	466	466	1,504,807	26%	10	0.5	±26.3%	2
Multi	233	712	2,301,674	39%	10	0.5	±26.0%	0
SCG Subtotal	**699**	**1,178**	**3,806,482**	**65%**	**20**	**0.5**	**±14.3%**	**2**
Total	**1,056***	**1,809**	**5,847,242**	**100%**	**40**	**0.5**	**±13.9%**	**12**

* These totals do not match the total claims value in Table 2-3 as Table 3-8 reflects totals from projects with viable contact data.

We initially designed an evaluation sample to collect representative results from 40 participating facilities. However, due to sensitivities in accessing food preparation areas during the COVID-19 pandemic, as detailed in the next paragraph, we experienced significant difficulties in recruiting end-users to participate in the evaluation study. We also were limited in the quality of contact data. Of the 1,056 projects with initially viable contact data, we found that 211 reflected the contact information of the participating distributor or contractor, not the end-user ultimately receiving the fryer. [13] We expanded our data collection pool to encompass all 1,056 claims with viable data. Representatives of 124 projects declined to participate in the evaluation study and 681 project representatives could not be reached. [14] We ultimately completed 40 net surveys, meeting the initial sample target.

Of the 40 net survey respondents, 31 initially agreed to host an on-site visit at the recipient address. However, as the Omicron wave of the COVID-19 pandemic intensified in late 2021 and early 2022, 19 facility representatives could not provide access to their food preparation areas for gross savings assessment.[15] 4 customers cancelled the site visit when we showed up at the facility. Ultimately, we completed 12 site visits for measurement and verification of gross impacts.

[13] Distributors in this and prior cycles of midstream measure evaluation declined to provide additional end-user contact information beyond what was originally required by the utility for rebate payout, citing confidentiality and personal information protection sensitivities.

[14] Assigned engineers attempted to contact customers at least six times, using a combination of telephone calls (at varying times of day and days of the week) and emails (if available).

[15] Such customers either reneged and declined to participate (6), could not be reached to confirm site visit date/time (11), or agreed to the visit but only during dates beyond the data collection period (2).

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 PY20 measures.

It is notable that for each of the measures we investigated the effects of the ongoing COVID-19 pandemic on participant operations through telephone surveys and field interviews. Customers reported that operations for the technologies included in our study were not substantially impacted by the pandemic during data collection in late 2021 and early 2022. Generally, this confirms that the data collected through this study is representative of typical operations, and that the resulting impact estimates should not be biased in response to the pandemic.

4-1 Agricultural 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 agricultural pumping VFD measures and to contribute method and parameter findings in support of ex ante workpaper revisions. The majority of PY20 savings claims for the agricultural pumping VFD measure are associated with agricultural pumps, with a minority of glycol pumps serving industrial processes. The agricultural pumping applications that were evaluated consist of pumps used to irrigate fields/crops – both booster pumps and well pumps.

In Table 4-1 we display the claimed measures and their ex ante unit energy savings.

Table 4-1: 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)	0.1207	256.6	Rated HP
IR017	PGE	VARIABLE FREQUENCY DRIVE ON AG WELL PUMPS >75HP TO <=300HP (TIER 1)	0.12	258	Rated HP
IR022	PGE	TIER 2 MID-TIER SPECIFICATION VFD ON AG BOOSTER PUMPS <=75HP	0.1	264	Rated HP
IR007	PGE	VARIABLE FREQUENCY DRIVE ON AGRICULTURAL BOOSTER PUMPS (<=150HP)	0.122	226.65	Rated HP
IR019	PGE	VARIABLE FREQUENCY DRIVE ON AG BOOSTER PUMPS >75HP TO <=150HP (TIER 1)	0.12	227	Rated HP
IR027	PGE	TIER 3 ENHANCED SPECIFICATION VFD ON AG BOOSTER PUMPS >75HP TO <=150HP	0.108	257	Rated HP
IR026	PGE	TIER 3 ENHANCED SPECIFICATION VFD ON AG BOOSTER PUMPS <=75HP	0.1	264.00	Rated HP
IR025	PGE	TIER 3 ENHANCED SPECIFICATION VFD ON AG WELL PUMPS >75HP TO <=600HP	0.177	276.00	Rated HP
PM-21051	SCE	EFFICIENT VFD AG PUMPS WELL NC	0.12	258.00	Rated HP
PM-21052	SCE	EFFICIENT VFD AG PUMPS BOOSTER NC	0.12	227	Rated HP
PM-21284	SCE	EFFICIENT VFD AG PUMPS WELL AOE	0.12	258	Rated HP
PM-21285	SCE	EFFICIENT VFD AG PUMPS BOOSTER AOE	0.12	227	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.

4-1-1 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,[16] and is downloadable from their website under TRM spreadsheet number 401.[17]

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.[18] 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 4-2 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

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

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

18 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.

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 50 hp.

Table 4-2: Evaluation-Based BIN/Impact Model Example for Agricultural Pumping VFD Measures

Annual Hours of Operation:						2,568
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
42	38.88	541	1.00	39.07	0.18	99
38.5	37.72	882	0.99	38.72	1.01	889
35	33.50	412	0.92	37.37	3.87	1,594
31.5	30.11	336	0.87	36.14	6.03	2,022
28	26.54	335	0.84	34.80	8.27	2,767
24.5	23.27	62	0.81	33.63	10.37	640
21	-	-	-	-	-	-
17.5	-	-	-	-	-	-
14	-	-	-	-	-	-
10.5	-	-	-	-	-	-
7	-	-	-	-	-	-
3.5	-	-	-	-	-	-
TOTALS					NA	8,012

In this table we see that the model breaks up the pump load into 12 bins; from 42 kW, the max seen in the AMI data, to 0 kW, in increments of 3.5 kW. This pump using AMI data on a dedicated meter allows the evaluation team 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 58% of full input power at 81% VFD speed, while the throttle valve will use 84% of full input power for that same load category. Out of a total of 2,568 hours of operation for this pump, 2% of loads fall around this load bin, resulting in a kW load reduction of 10.37 for a full hour of operation and 640.07 kWh of savings for all of the hours having that load combined (roughly 62 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.[19]

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 used a best fit line of the motor efficiencies obtained from the US DOE Advanced Manufacturing Office's Premium Efficiency Motor Selection and Application Guide to determine the efficiency based on the motor hp[20] The VFD efficiency is always assumed to be 97% based upon guidance from Water Management Technical Note No. 1, September 2014.[21]

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

---

[19] https://www.pge.com/pge_global/common/pdfs/save-energy-money/facility-improvements/custom-retrofit/Statewide-Customized-Offering-Procedures-Manual-for-Business-2021.pdf; page 20

[20] 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

[21] 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

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 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 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.

4-1-2 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 motor (which is one-third of a new pump motor EUL) in order to account for the fact that that VFD operations may cease at the time of motor 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 motor), or one-third of the motor EUL – an industry accepted default

RUL value. We find that a higher efficiency motor EUL is 15 years, which results in an RUL of 5 years based on DEER.[22]

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).[23]

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

- **PG&E EULs are set to 10 years for new pumps and 3.33 years for add-on equipment (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 add-on equipment are set to 3.3 years**

4-2 CLEAN WATER PUMP UPGRADES

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 the clean water pump upgrade measures. Clean water pumps include pumps used for a variety of applications at commercial, industrial, or agricultural facilities but exclude those used for wastewater treatment. The impact evaluation supports the March 2022 Bus Stop with both gross and net results, using remote verification and telephone interviews with end-users and market actors. The clean water pump upgrade measure was not previously studied as part of recent evaluations.

Pump upgrades lead to electric energy savings by delivering water more efficiently than a market-standard alternative pump. Pump efficiency is measured using a metric developed by the DOE and Hydraulic Institute (HI) in 2011, pump energy index (PEI). PEI is the weighted average performance of

22 https://www.caetrm.com/cpuc/table/effusefullife/; EUL ID: Motors-HiEff; applicable: 1/1/2013

23 https://www.caetrm.com/cpuc/table/effusefullife/; EUL ID: Agr-VSDWellPmp; applicable: 1/1/2013

the rated pump at specific load points, normalized with respect to the performance of a minimally compliant pump. The lower the PEI, the more efficient the pump.

The water pump upgrade workpaper SWWP004-01 quantifies unit energy savings (UES) in using a PEI differential between baseline and installed cases as shown in the equation below:

$$UES = HP \times H \times Load\ Factor \times (PEI_{baseline} - PEI_{measure}) \times C$$

where,

HP	= Nominal pump horsepower (hp)
H	= Annual operating hours (hours/year)
$Load\ Factor$	= Load factor
PEI	= Pump energy index, baseline or measure case
C	= Conversion factor, constant, 0.746 kW/hp

We quantified pump upgrade ex post gross kWh savings by independently assessing algorithm parameters wherever possible, using a two-pronged approach described below. As assumed in the measure workpaper, the clean water pump upgrade measure does not produce peak demand impacts.

- For all 540 records claimed by PG&E in 2020, we collected PEI information from the Hydraulic Institute's pump rating database[24]. For baseline PEI estimation, we referenced the values recommended in the RTF baseline PEI database[25] as a function of size, pump type, pump nominal speed, pump control strategy and pump application type. This information refined savings parameters $PEI_{baseline}$ and $PEI_{measure}$ for the full population of projects by adjusting the workpaper-compliant PEI assumptions embedded within ex ante savings claims with the actual PEI values of claimed pumps in 2020. PEI assessment therefore did not require a sample design.

24 http://er.pumps.org/ratings/search

25 Northwest Regional Technical Forum (RTF). 2015. "CIP_FR_LCC_2015-09-21_VL_baselinePEI_V2.xlsm."

- We virtually verified clean water pump installation and operation at 20 sampled participant facilities. During each virtual verification, evaluation engineers confirmed measure installation and operability and collected information on the installed make and model, nameplate information, facility type, pump end use, hours of operation, possible seasonal fluctuations, and preexisting conditions (pump type, age, operating condition). This collected data informed savings parameters $\boldsymbol{HP}$, $\boldsymbol{H}$, and $\boldsymbol{PEI_{measure}}$ for sampled projects and was extrapolated to the population using techniques described in Chapter 7. For projects that included multiple pumps with different size tiers, we conducted analysis at the record level, not the project level.
  - This analysis further refined $PEI_{measure}$ by adjusting for isolated differences between installed pumps and claimed pumps.
  - We generally used the workpaper-recommended sector-specific pump annual operating hours as the default $\boldsymbol{H}$ value in the measure savings algorithm. For each site, we also estimated the pump annual operating hours based on the customer's self-reported site-specific estimates of hours of operation and seasonality. We used this estimated pump annual operating hours to support and adjust the ex-ante reported annual operating hours values, whenever applicable.
  - For the $\boldsymbol{Load\ Factor}$ parameter, we referenced the values recommended in the RTF load factor database as a function of pump type (ESCC/ESFM/IL/VT-S) and pump speed.

We quantified the ex post gross kWh savings using the above formula and refined parameters. We quantified the gross realization rate as ex post gross kWh savings divided by ex ante gross kWh savings. Per the applicable workpaper, the clean water pump upgrade measure has an effective useful life (EUL) of 15 years. Our collected data corroborated that assumption; therefore, the ex post lifetime gross kWh savings are the product of ex post first-year gross kWh savings and the EUL. The GRRs are identical in both cases.

4-3 COMMERCIAL GAS FRYERS

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 commercial gas fryer replacement measures. Our impact evaluation supports the March 2022 Bus Stop with both gross and net results, using measurement and verification data, telephone surveys, and in-depth interviews with market actors.

Our 2020 study group includes commercial gas fryer upgrades as rebated by PG&E, SCG, and SDG&E. The gas fryer measure accounts for 15% of net lifecycle therm savings across all nonresidential non-lighting/non-HVAC deemed measures and 67% of net lifecycle therm savings across all foodservice measures in 2020.

Our gross impact methodology involved initial engagements with all end-users receiving fryers claimed by PG&E or SCG in 2020. As detailed in Section 3-2, we attempted to reach facility representatives for all 1,056 claims with initially viable contact data. The available tracking data allowed successful contact with 164 customers.[26] Ultimately, 40 such customers responded to the telephone survey that addressed decision-making (for net savings assessment as covered in Section 6). 31 of those customers indicated a willingness to participate in the on-site portion of the study; however, due to spikes in COVID-19 cases during late 2021 and early 2022, 12 customers ultimately hosted our engineers for site visits.

During the site visits, our engineers executed the data collection strategies detailed in Section 3.1.2, with a focus on measuring fryer operation using equipment monitoring devices. As a proxy for fryer operation by stage and subsequent gas consumption, field engineers deployed high-temperature Type-K thermocouples within the fryer's exhaust flue stack. Thermocouples collected temperature readings at a 10-second interval. Our prior experience with this measure (e.g., PY2017 evaluation) has shown strong correlation between exhaust temperatures and the fryer's various stages: cooking, idle, preheat, and off. The exhaust flue temperature data, used in conjunction with the equipment's rated Btu/h capacity at each stage, provided a reliable source of gas usage for the post-installation condition. Due to relatively consistent usage of food service equipment, we conducted short-term metering equipment deployment, with approximately 1-2 weeks of data collection. Our engineers revisited the participant facilities to

[26] Otherwise, contact data was not sufficient or accurate for successful contact (211), the facility contact was unreachable after at least six attempts (681), or the facility contact refused to participate in the study (124).

collect the metering devices, ensure all equipment was functioning properly, and download the metered exhaust temperature data.

We quantified gas fryer measure savings by correlating the thermocouple metered data with fryer operating modes to determine annual operating hours by mode over a typical year, reflecting any seasonal variability in store hours or fryer usage. The equation below summarizes how the gas consumptions by operating mode led to annual savings estimates.

$$Gas\ Savings = (CookingBtu + IdleBtu + PreheatBtu)_{base} - (CookingBtu + IdleBtu + PreheatBtu)_{eff}$$

To quantify annualized Btu by mode, we multiplied the annualized operation estimates (in hours per year) with rated fryer gas usage (in Btu/h). This value represented the efficient case usage designated by the right-hand side of the equation.

To quantify baseline consumption, we first determined the efficiency of comparable standard units. As food service equipment baselines are not governed by CA Title 24, we examined secondary sources in order to verify baseline efficiencies. We primarily relied on reference data from the Food Service Technology Center (FSTC), which has developed industry standards for commercial cooking equipment, including fryers. This data is also mined in the derivation of workpaper baseline values.

The difference between baseline and installed energy use represents the ex post, first-year gross therm savings. We quantified the gross realization rate as ex post gross therm savings divided by ex ante gross therm savings. Per the applicable workpaper, the fryer upgrade measure corresponds to an effective useful life (EUL) of 12 years.[27] Our collected data corroborated that assumption; therefore, the ex post lifetime gross therm savings are the product of ex post first-year gross therm savings and the 12-year EUL. The GRRs are identical in both cases.

[27] Starting in January 2022, workpaper SWFS011-04 was revised to reflect a gas fryer EUL of 11 years.

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 AGRICULTURAL 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. 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 two SDG&E claims from the sample frame since there were so few records, and they made up such 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 32 pumps evaluated in PG&E, of those, it was determined that 12 of them were booster pumps, and 20 were well pumps. Six 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 and 4 claimed to be well pumps but were verified to be booster pumps. We evaluated 25 pumps in SCE comprised of 13 booster pumps and 12 well pumps and 4 were misclassified in the tracking data as well pumps when they were verified to be booster pumps.

The horsepower (HP) was verified at the time of the phone survey, and was corrected for one pump resulting in a slightly lower overall HP. The only change to tracking data-based HP was located in PG&E service territory, changing from a 20 HP to 15 HP pump.

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 represent all PG&E and SCE agricultural pump VFDs in the population, 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.

5-1-1 First Year Gross Impact Results

In Table 5-1 we present first year gross impact results for PG&E well pump M&V sample points and Table 5-2 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 hours 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 5-1: First Year Ex Post Gross Impact Results for Well Pump Sample Points – PG&E

Sample Point Identifier	Ex Post	Ex Ante	kWh Results	Ex Post	Ex Ante	kW 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
PGE_Well_1	2,776	32,250	0.09	1.59	15.00	0.11
PGE_Well_2	-8,969	64,150	-0.14	0.00	30.18	0.00
PGE_Well_3	163	64,500	0.00	0.00	30.00	0.00
PGE_Well_4a	0	19,350	0.00	0.00	9.00	0.00
PGE_Well_4b	0	32,250	0.00	0.00	15.00	0.00
PGE_Well_4c	0	38,700	0.00	0.00	18.00	0.00
PGE_Well_5	18,998	38,700	0.49	0.00	18.00	0.00
PGE_Well_6	0	51,600	0.00	0.00	24.00	0.00
PGE_Well_7	-335	7,740	-0.04	-0.20	3.60	-0.06
PGE_Well_8a	43,646	105,600	0.41	1.95	40.00	0.05
PGE_Well_8b	43,646	105,600	0.41	1.95	40.00	0.05
PGE_Well_9	1,637	5,160	0.32	0.07	2.40	0.03
PGE_Well_10	17,970	19,350	0.93	0.55	9.00	0.06
PGE_Well_11	66,158	82,800	0.80	4.19	53.10	0.08
PGE_Well_12	0	51,600	0.00	0.00	24.00	0.00
PGE_Well_13	-1,126	12,900	-0.09	0.00	6.00	0.00
PGE_Well_14	8,184	19,350	0.42	0.37	9.00	0.04
PGE_Well_15a	19,894	32,250	0.62	0.38	15.00	0.03
PGE_Well_15b	23,219	32,250	0.72	0.00	15.00	0.00
PGE_Well_16	44,566	51,600	0.86	1.71	24.00	0.07
Total	**280,427**	**867,700**	**0.32**	**12.56**	**400.28**	**0.03**

Table 5-2: 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 Well but Claim is a Booster	Applied Mean Modeled Result from Sample	Applied Result from Other Point at Same Farm	Other**
		Up	Dn	Dn	Up	Dn	Dn	Dn	-	-	-	Dn
PGE Well 1	0.09	0	0	1	0	0	1	1	0	0	0	0
PGE Well 2	-0.14	1	0	1	0	0	0	1	0	0	0	1
PGE Well 3	0.00	0	1	1	0	0	1	1	0	0	0	0
PGE Well 4a	0.00	0	0	0	0	0	0	0	0	0	0	1
PGE Well 4b	0.00	0	0	0	0	0	0	0	0	0	0	1
PGE Well 4c	0.00	0	0	0	0	0	0	0	0	0	0	1
PGE Well 5	0.49	1	0	0	0	0	0	1	0	0	0	0
PGE Well 6	0.00	0	0	0	0	0	0	0	0	0	0	1
PGE Well 7	-0.04	0	0	1	0	0	0	1	0	0	0	0
PGE Well 8a	0.41	0	0	0	0	0	0	0	1	1	0	0
PGE Well 8b	0.41	0	0	0	0	0	1	1	1	1	0	0
PGE Well 9	0.32	0	0	0	0	0	0	0	0	1	0	1
PGE Well 10	0.93	1	0	0	0	1	1	1	0	0	0	0
PGE Well 11	0.80	1	0	1	0	0	0	1	0	0	0	0
PGE Well 12	0.00	0	0	0	0	0	0	0	0	0	0	1
PGE Well 13	-0.09	1	0	1	0	0	0	1	0	0	0	0
PGE Well 14	0.42	0	0	0	0	0	0	0	0	1	0	0
PGE Well 15a	0.62	1	0	0	0	0	1	1	0	0	0	0
PGE Well 15b	0.72	1	0	0	0	0	1	1	0	0	0	0
PGE Well 16	0.86	1	0	1	0	0	0	1	0	0	0	0
Total	0.32	8	1	7	0	1	6	12	2	4	0	7

* Discrepancy factors can have a downward or upward effect on the gross realization rate as labeled under discrepancy factor heading
** Other: farmer uses flood irrigation, farmer uses pump to fill reservoir, pump HP less than claim

PG&E ex post gross first year annual impact results per well pump sample point range from -8,969 to 66,158 kWh, with gross impact realization rates (GRRs) ranging from -0.14 to 0.93 and yielding a sample-based weighted mean GRR of 0.32. Ex post gross first year peak demand results per point are also presented and range from -0.2 to 4.19 kW, with realization rates ranging from -0.06 to 0.11; yielding a sample-based weighted mean GRR of 0.03. Highlights to point out include the following:

- **Eight sample points out of a total sample size of 20 well pumps do not save energy.**
  - Five well pumps were being used to fill a reservoir and so the energy savings was set to zero. VFDs used for filling reservoirs 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.28 Systems such as these are detrimental to the pump affinity law exponent for a VFD, as discussed in Section 4.2.
  - In addition, three pumps operate 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, 11 well pumps do not save peak demand; the pumps were not observed to operate at the time of coincident peak, as defined by DEER.[29]**
- **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 three points in the ex post sample have annual hours of runtime below 1000 hours with one pump below 500 hours per year. Some 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 at high speed/loads and flow should not be eligible for program VFD incentives. We see 7 sample points that 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*

[28] 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

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

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.

- **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 eight 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. None of the PG&E well pumps were observed to operate most of the time at relatively low speeds.
- **Models were developed for 16 of the 20 well pumps evaluated.**
- **For the other four 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 14, 8a, 8b, and 9.
  - It is notable that this mean excludes well pump 4a, 4b, 4c, 6, and 12 where the savings were set to zero due to eligibility considerations, as outlined above.
  - The rationale for excluding those points from the mean result is that well pumps 14, 8a, 8b, and 9 were all determined to be eligible for participation.

Of the 20 pumps, only 3 had an annual energy GRR greater than 0.75, and 15 pumps had an annual energy GRR less than 0.50. For demand savings, the GRR was less than 0.10 for all but one pump. *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 5-3 we present first year gross impact results for SCE well pump M&V sample points and

Table 5-4 includes a listing of discrepancy factors that collectively influence the savings results in a meaningful way.

Table 5-3: First Year Ex Post Gross Impact Results for Well Pump Sample Points – SCE

Sample Point Identifier	Ex Post	Ex Ante	kWh Results	Ex Post	Ex Ante	kW 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	8,012	12,900	0.62	0.00	6.00	0.00
SCE_Well_2	5,747	15,480	0.37	0.00	7.20	0.00
SCE_Well_3	11,412	51,600	0.22	0.00	24.00	0.00
SCE_Well_4	0	77,400	0.00	0.00	36.00	0.00
SCE_Well_5	7,000	12,900	0.54	1.80	6.00	0.30
SCE_Well_6	26,730	51,600	0.52	0.00	24.00	0.00
SCE_Well_7	8,369	10,320	0.81	4.57	4.80	0.95
SCE_Well_8	6,566	7,740	0.85	0.85	3.60	0.24
SCE_Well_9	5,952	3,870	1.54	1.37	1.80	0.76
SCE_Well_10	5,759	19,350	0.30	0.00	9.00	0.00
SCE_Well_11	49,858	51,600	0.97	9.20	24.00	0.38
SCE_Well_12	45,938	51,600	0.89	0.00	24.00	0.00
Total	**181,344**	**366,360**	**0.49**	**17.80**	**170.40**	**0.10**

Table 5-4: 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	-	-	-	Dn
SCE_Well_1	0.62	1	0	1	0	0	0	1	0	0	0	0
SCE_Well_2	0.37	0	0	0	0	0	0	1	0	0	0	0
SCE_Well_3	0.22	1	0	1	0	0	0	1	0	0	0	0
SCE_Well_4	0.00	0	0	0	0	0	0	0	0	0	0	1
SCE_Well_5	0.54	1	0	1	0	0	0	1	0	0	0	0
SCE_Well_6	0.52	1	0	1	0	0	0	1	0	0	0	0
SCE_Well_7	0.81	0	0	0	1	1	1	0	0	0	0	0
SCE_Well_8	0.85	0	0	0	0	0	0	1	0	0	0	0
SCE_Well_9	1.54	1	0	0	0	0	1	0	0	0	0	0
SCE_Well_10	0.30	1	0	1	0	0	0	1	0	0	0	0
SCE_Well_11	0.97	1	0	0	0	0	1	0	0	0	0	0
SCE_Well_12	0.89	0	0	0	1	0	0	1	0	0	0	0
Total	**0.49**	**7**	**0**	**5**	**2**	**1**	**3**	**8**	**0**	**0**	**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 pump to fill reservoir.

SCE ex post gross first year annual impact results per well pump sample point range from 49,858 kWh to zero, with gross impact realization rates (GRRs) ranging from 0.00 to 1.54 and yielding a sample-based weighted mean GRR of 0.49. We also present ex post gross first year peak demand results per point, ranging from zero to 9.20 kW, with realization rates ranging from 0.00 to 0.95, and yielding a sample-based weighted mean GRR of 0.10. Highlights to point out include the following:

- **Only one sample points out of a total sample size of 12 well pumps did not save energy.**
  - That one well pump was being used to fill a reservoir 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.[30] Systems such as these are detrimental to the pump affinity law exponent for a VFD, as discussed in Section 4.2.

- **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.[31]**
- **SCE well pumps typically met the pump run hour requirements of 1000 hours per year, with only one pump operating less than that.**
  - 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.
- **It is notable that for SCE well pumps, while 7 sample points operate for more than 1,500 hours and none operate for less than 500 hours, those same pumps also tend to operate at high speed/loads and flow. We see 5 such sample points that operate at more than 89% of full speed most of the time, which counteracts the level of savings due to long run hours, since pumps running near full speed can only achieve limited levels of savings.**
- **Models were developed for all of the 12 SCE well pumps evaluated.**

Of the 12 SCE well pumps, 5 had an annual energy GRR greater than 0.75, and 4 pumps had an annual energy GRR less than 0.50. For demand savings, the GRR was greater than zero for only five 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.*

30 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

31 See Chapter 4 for details on DEER Peak definition.

In Table 5-5 we present first year gross impact results for PG&E booster pump M&V sample points and Table 5-6 includes a listing of discrepancy factors that collectively influence the savings results in a meaningful way.

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

Sample Point Identifier	Ex Post	Ex Ante	kWh Results	Ex Post	Ex Ante	kW 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
PGE_Booster_1a	7,197	15,396	0.47	3.85	7.24	0.53
PGE_Booster_1b	7,197	15,396	0.47	3.85	7.24	0.53
PGE_Booster_1c	14,993	32,075	0.47	8.03	15.09	0.53
PGE_Booster_1d	5,997	12,830	0.47	3.21	6.04	0.53
PGE_Booster_2	20,415	13,620	1.50	9.29	7.20	1.29
PGE_Booster_3a	0	22,700	0.00	0.00	12.00	0.00
PGE_Booster_3b	0	22,700	0.00	0.00	12.00	0.00
PGE_Booster_4	19,279	13,620	1.42	5.25	7.20	0.73
PGE_Booster_5a	34,963	34,050	1.03	9.73	18.00	0.54
PGE_Booster_5b	29,136	28,375	1.03	8.10	15.00	0.54
PGE_Booster_6	27,573	15,480	1.78	6.78	7.20	0.94
PGE_Booster_7	77,992	22,700	3.44	9.98	12.00	0.83
Total	**244,743**	**248,942**	**0.98**	**68.08**	**126.21**	**0.54**

Table 5-6: 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	0.47	0	0	0	0	0	1	0	1	0	0	0
PGE_Booster_1b	0.47	0	0	0	0	0	1	0	1	0	0	0
PGE_Booster_1c	0.47	0	0	0	0	0	0	0	1	0	1	0
PGE_Booster_1d	0.47	0	0	0	0	0	0	0	1	0	1	0
PGE_Booster_2	1.50	1	0	0	0	0	1	0	0	0	0	0
PGE_Booster_3a	0.00	0	0	0	0	0	1	1	0	0	0	0
PGE_Booster_3b	0.00	0	0	0	0	0	1	1	0	0	0	0
PGE_Booster_4	1.42	1	0	0	0	0	1	0	0	0	0	0
PGE_Booster_5a	1.03	0	0	0	0	0	0	0	0	1	0	0
PGE_Booster_5b	1.03	0	0	0	0	0	0	0	0	1	0	0
PGE_Booster_6	1.78	0	0	0	1	0	1	1	1	0	0	0
PGE_Booster_7	3.44	1	0	0	1	0	1	0	0	0	0	0
Total	**0.98**	**3**	**0**	**0**	**2**	**0**	**8**	**3**	**5**	**2**	**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 zero to 77,992 kWh, with gross impact realization rates (GRRs) ranging from 0.00 to 3.44 and yielding a sample-based weighted mean GRR of 0.98. We also present ex post gross first year peak demand results per sample point, ranging from 0 kW to 9.98 kW, with realization rates ranging from zero to 1.29, and yielding a sample-based weighted mean GRR of 0.54. All 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:

- **Two sample points out of a total sample size of 12 booster pumps did not save energy. These pumps did not operate in 2021 so there are no savings for these pumps.**

- **PGE_Booster_7 has an annual energy GRR of 3.44 due to run hours exceeding 1,500 and the pump running at a relatively low speed.**
  - Two of the 12 PG&E Booster pumps sampled have pumps speeds that operate relatively low, while three pumps operate more than 1500 hours per year. Both reasons for discrepancy cause a higher-than-expected energy savings and a high GRR.
- **Additionally, 2 booster pumps do not save peak demand; the pumps were not observed to operate at the time of coincident peak, as defined by DEER.[32].**
- **Models were developed for 8 of the booster pumps, and for the remaining 4 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 sample mean saving metrics for energy (kWh/HP) and demand (kW/HP), were derived from the 10 points that were deemed eligible. The sample mean was applied to booster pumps 5a and 5b with a site mean applied to 1c and 1d.**
- **Five of the booster pumps sampled in PG&E were misclassified as well pumps in the tracking data.**

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 5-7 we present first year gross impact results for SCE booster pump M&V sample points, and in Table 5-8 we present a listing of discrepancy factors that collectively influence the savings results in a meaningful way.

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

Table 5-7: First Year Ex Post Gross Impact Results for Booster Pump Sample Points – SCE

Sample Point Identifier	Ex Post	Ex Ante	kWh Results	Ex Post	Ex Ante	kW 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	-1,530	22,700	-0.07	-1.02	12.00	-0.08
SCE_Booster_2	59,670	13,620	4.38	12.10	7.20	1.68
SCE_Booster_3a	5,493	3,405	1.61	0.67	1.80	0.37
SCE_Booster_3b	7,324	4,540	1.61	0.89	2.40	0.37
SCE_Booster_3c	0	2,270	0.00	0.00	1.20	0.00
SCE_Booster_3d	0	3,405	0.00	0.00	1.80	0.00
SCE_Booster_4	27,466	17,025	1.61	3.33	9.00	0.37
SCE_Booster_5	27,466	17,025	1.61	3.33	9.00	0.37
SCE_Booster_6a	1,150	2,580	0.45	0.00	1.20	0.00
SCE_Booster_6b	30,222	12,900	2.34	0.00	6.00	0.00
SCE_Booster_6c	0	10,320	0.00	0.00	4.80	0.00
SCE_Booster_6d	2,042	7,740	0.26	0.00	3.60	0.00
SCE_Booster_7	21,973	15,480	1.42	2.66	7.20	0.37
Total	**181,278**	**133,010**	**1.36**	**21.95**	**67.20**	**0.33**

Table 5-8: 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	-	-	-	Dn
SCE_Booster_1	-0.07	1	0	1	0	0	0	0	0	0	0	0
SCE_Booster_2	4.38	1	0	0	1	0	1	0	0	0	0	0
SCE_Booster_3a	1.61	0	0	0	0	0	1	0	0	1	0	0
SCE_Booster_3b	1.61	0	0	0	0	0	1	0	0	1	0	0
SCE_Booster_3c	0.00	0	0	0	0	0	0	0	0	0	0	1
SCE_Booster_3d	0.00	0	0	0	0	0	0	0	0	0	0	1
SCE_Booster_4	1.61	0	0	0	0	0	0	0	0	1	0	0
SCE_Booster_5	1.61	0	0	0	0	0	1	0	0	1	0	0
SCE_Booster_6a	0.45	0	0	0	0	0	0	1	1	0	0	0
SCE_Booster_6b	2.34	1	0	0	0	0	1	1	1	0	0	0
SCE_Booster_6c	0.00	0	0	0	0	0	0	0	1	0	0	1
SCE_Booster_6d	0.26	0	1	0	1	0	0	1	1	0	0	0
SCE_Booster_7	1.42	0	0	0	0	0	0	0	0	1	0	0
Total	**1.36**	**2**	**1**	**0**	**2**	**0**	**5**	**3**	**4**	**5**	**0**	**3**

* Discrepancy factors can have a downward or upward effect on the gross realization rate as labeled under discrepancy factor headings.
** Other: Farmer uses pump to fill reservoir.

SCE ex post gross first year annual impact results per booster pump sample point range from -1,530 kWh to 59,670 kWh, with gross impact realization rates (GRRs) ranging from -0.07 to 4.38 and yielding a sample-based weighted mean GRR of 1.36. We also present ex post gross first year peak demand results per point, ranging from -1.02 kW to 12.10 kW, with realization rates ranging from -0.08 to 1.68, and yielding a sample-based weighted mean GRR of 0.33. 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:

- Three sample points out of a total sample size of 13 booster pumps do not save energy.

  - For 3c, 3d, and 6c our field staff determined that the booster pumps fill reservoirs or tanks and are therefore ineligible. As discussed in section 4, there are no energy savings associated with filling reservoirs, therefore the energy savings for these points were set to zero.

- SCE_Booster_2 has an annual energy GRR of 4.38 due to run hours exceeding 3,500 and the pump running at a relatively low speed. Both of these factors tend to lead to higher than expected savings.
- Models were developed for 5 of the 10 eligible booster pumps evaluated, and for the remaining points a sample mean saving metric for energy (kWh/HP) and demand (kW/HP) was applied.

The evaluation results show that on an overall GRR basis that SCE booster pumps perform better than the expectations and claims than do well pumps. One important note is that the SCE booster pump sample does include three ineligible pumps, but their reduction in savings is offset by higher than expected savings for several of the other pumps.

5-1-2 Effective Useful Life Evaluation Results

In Table 5-9 and Table 5-10 we present effective useful life (EUL) results for the PG&E and SCE well pump sample points, respectively. In Table 5-11 and Table 5-12 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.

For 17 out of 57 pump sample points, the ex post EUL estimates differed from the ex ante values, both in instances involving new pumps (where ex post EULs are set equal to 10 years) and instances involving add-on of VFD controls to an existing pump motor. There were four instances where the phone survey determined that the VFD was installed on an existing pump so the EUL was reduced to 1/3 the EUL of the pump motor. In addition there were 13 records that the utilities recorded as existing pumps but the our evaluation staff found that they were new pumps. For these 13 add-on pumps the EUL is set equal to 1/3 of the EUL of a new high efficiency pump motor. The EUL is dependent on whether or not the VFD add-on is installed on an existing pump or a new or replacement pump; refer to Section 4.2.2 for more details on the values applied by the evaluation team. SCE and PG&E are correctly applying an EUL of 10 years when there is a new pump installed. Both utilities are also consistently reporting an

EUL of 3.3 years when the existing pump is used. *We recommended that the PAs more carefully and accurately apply EUL to tracking system measure claims, consistent with CPUC policy.*

Table 5-9: 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	10	10
PGE_Well_2	10	3.3
PGE_Well_3	5	10
PGE_Well_4a	10	10
PGE_Well_4b	10	10
PGE_Well_4c	10	10
PGE_Well_5	10	10
PGE_Well_6	10	10
PGE_Well_7	10	10
PGE_Well_8a	10	10
PGE_Well_8b	10	10
PGE_Well_9	5	10
PGE_Well_10	10	10
PGE_Well_11	10	10
PGE_Well_12	10	10
PGE_Well_13	10	10
PGE_Well_14	5	10
PGE_Well_15a	10	10
PGE_Well_15b	10	10
PGE_Well_16	10	10
Average	**9.9**	**9.5**

Table 5-10: 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	10
SCE_Well_2	10	3.3
SCE_Well_3	10	10
SCE_Well_4	10	3.3
SCE_Well_5	10	3.3
SCE_Well_6	10	3.3
SCE_Well_7	10	10
SCE_Well_8	10	3.3
SCE_Well_9	5	10
SCE_Well_10	10	10
SCE_Well_11	10	3.3
SCE_Well_12	10	10
Average	**9.8**	**6.0**

Table 5-11: 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	3.3
PGE_Booster_1b	10	3.3
PGE_Booster_1c	10	3.3
PGE_Booster_1d	10	3.3
PGE_Booster_2	10	10
PGE_Booster_3a	10	10
PGE_Booster_3b	10	10
PGE_Booster_4	10	10
PGE_Booster_5a	10	10
PGE_Booster_5b	10	10
PGE_Booster_6	10	10
PGE_Booster_7	10	10
Average	**10.0**	**8.0**

Table 5-12: 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	10
SCE_Booster_2	10	10
SCE_Booster_3a	10	10
SCE_Booster_3b	10	10
SCE_Booster_3c	10	10
SCE_Booster_3d	10	10
SCE_Booster_4	10	3.3
SCE_Booster_5	10	3.3
SCE_Booster_6a	10	10
SCE_Booster_6b	10	10
SCE_Booster_6c	10	10
SCE_Booster_6d	10	10
SCE_Booster_7	10	10
Average	**10.0**	**8.3**

5-1-3 *Lifecycle Gross Impact Results*

In Table 5-13 and Table 5-14 we present lifecycle gross impact results for the PG&E and SCE well pump on-site sample points, respectively. In Table 5-15 and Table 5-16 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 sample-weighted lifecycle energy (kWh) realization rates of 0.33 for PG&E well pumps, 0.81 for SCE well pumps, 1.23 for PG&E booster pumps, and 1.65 for SCE booster pumps. Peak demand (kW) lifecycle realization rates are 0.03 for PG&E well pumps, 0.17 for SCE well pumps, 0.67 for PG&E booster pumps and 0.40 for SCE booster pumps. Our adjustments to gross first year savings estimates using EUL estimates leads to slightly 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 5-1-2. Otherwise, the same discrepancy factors we discussed in Section 5-1-1 remain in effect.

Table 5-13: Lifecycle Ex Post Gross Impact Results for Well Pump Sample Points – PG&E

Sample Point Identifier	Ex Post	Ex Ante	kWh Results	Ex Post	Ex Ante	kW 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	27,765	322,500	0.09	15.87	150.00	0.11
PGE_Well_2	-89,692	211,695	-0.42	0.00	99.58	0.00
PGE_Well_3	814	645,000	0.00	0.00	300.00	0.00
PGE_Well_4a	0	193,500	0.00	0.00	90.00	0.00
PGE_Well_4b	0	322,500	0.00	0.00	150.00	0.00
PGE_Well_4c	0	387,000	0.00	0.00	180.00	0.00
PGE_Well_5	189,979	387,000	0.49	0.00	180.00	0.00
PGE_Well_6	0	516,000	0.00	0.00	240.00	0.00
PGE_Well_7	-3,345	77,400	-0.04	-1.99	36.00	-0.06
PGE_Well_8a	436,462	1,056,000	0.41	19.55	400.00	0.05
PGE_Well_8b	436,462	1,056,000	0.41	19.55	400.00	0.05
PGE_Well_9	8,184	51,600	0.16	0.37	24.00	0.02
PGE_Well_10	179,699	193,500	0.93	5.46	90.00	0.06
PGE_Well_11	661,576	828,000	0.80	41.95	531.00	0.08
PGE_Well_12	0	516,000	0.00	0.00	240.00	0.00
PGE_Well_13	-11,257	129,000	-0.09	0.00	60.00	0.00
PGE_Well_14	40,918	193,500	0.21	1.83	90.00	0.02
PGE_Well_15a	198,944	322,500	0.62	3.76	150.00	0.03
PGE_Well_15b	232,188	322,500	0.72	0.00	150.00	0.00
PGE_Well_16	445,658	516,000	0.86	17.05	240.00	0.07
Total	**2,754,355**	**8,247,195**	**0.33**	**123.39**	**3,800.58**	**0.03**

Table 5-14: Lifecycle Ex Post Gross Impact Results for Well Pump Sample Points – SCE

Sample Point Identifier	Ex Post	Ex Ante	kWh Results	Ex Post	Ex Ante	kW 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	80,120	129,000	0.62	0.00	60.00	0.00
SCE_Well_2	57,475	51,084	1.13	0.00	23.76	0.00
SCE_Well_3	114,120	516,000	0.22	0.00	240.00	0.00
SCE_Well_4	0	255,420	0.00	0.00	118.80	0.00
SCE_Well_5	69,999	42,570	1.64	18.04	19.80	0.91
SCE_Well_6	267,299	170,280	1.57	0.00	79.20	0.00
SCE_Well_7	83,693	103,200	0.81	45.74	48.00	0.95
SCE_Well_8	65,663	25,542	2.57	8.55	11.88	0.72
SCE_Well_9	29,761	38,700	0.77	6.84	18.00	0.38
SCE_Well_10	57,595	193,500	0.30	0.00	90.00	0.00
SCE_Well_11	498,579	170,280	2.93	92.01	79.20	1.16
SCE_Well_12	459,377	516,000	0.89	0.00	240.00	0.00
Total	**1,783,681**	**2,211,576**	**0.81**	**171.18**	**1,028.64**	**0.17**

Table 5-15: Lifecycle Ex Post Gross Impact Results for Booster Pump Sample Points – PG&E

Sample Point Identifier	Ex Post	Ex Ante	kWh Results	Ex Post	Ex Ante	kW 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	71,967	50,807	1.42	38.55	23.90	1.61
PGE_Booster_1b	71,967	50,807	1.42	38.55	23.90	1.61
PGE_Booster_1c	149,932	105,848	1.42	80.31	49.79	1.61
PGE_Booster_1d	59,973	42,339	1.42	32.12	19.92	1.61
PGE_Booster_2	204,154	136,200	1.50	92.92	72.00	1.29
PGE_Booster_3a	0	227,000	0.00	0.00	120.00	0.00
PGE_Booster_3b	0	227,000	0.00	0.00	120.00	0.00
PGE_Booster_4	192,788	136,200	1.42	52.49	72.00	0.73
PGE_Booster_5a	349,633	340,500	1.03	97.26	180.00	0.54
PGE_Booster_5b	291,361	283,750	1.03	81.05	150.00	0.54
PGE_Booster_6	275,733	154,800	1.78	67.79	72.00	0.94
PGE_Booster_7	779,924	227,000	3.44	99.78	120.00	0.83
Total	**2,447,432**	**1,982,250**	**1.23**	**680.82**	**1,023.50**	**0.67**

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

Sample Point Identifier	Ex Post Lifecycle Gross Impact Savings (kWh)	Ex Ante Lifecycle Gross Impact Claim (kWh)	kWh Results Lifecycle Gross Impact Realization Rate	Ex Post Lifecycle Gross Impact Savings (kW)	Ex Ante Lifecycle Gross Peak Demand Claim (kW)	kW Results Lifecycle Gross Impact Realization Rate
SCE_Booster_1	-15,298	227,000	-0.07	-10.15	120.00	-0.08
SCE_Booster_2	596,701	136,200	4.38	120.99	72.00	1.68
SCE_Booster_3a	54,933	34,050	1.61	6.65	18.00	0.37
SCE_Booster_3b	73,244	45,400	1.61	8.87	24.00	0.37
SCE_Booster_3c	0	22,700	0.00	0.00	12.00	0.00
SCE_Booster_3d	0	34,050	0.00	0.00	18.00	0.00
SCE_Booster_4	274,664	56,183	4.89	33.25	29.70	1.12
SCE_Booster_5	274,664	56,183	4.89	33.25	29.70	1.12
SCE_Booster_6a	11,502	25,800	0.45	0.00	12.00	0.00
SCE_Booster_6b	302,225	129,000	2.34	0.00	60.00	0.00
SCE_Booster_6c	0	103,200	0.00	0.00	48.00	0.00
SCE_Booster_6d	20,416	77,400	0.26	0.00	36.00	0.00
SCE_Booster_7	219,731	154,800	1.42	26.60	72.00	0.37
Total	**1,812,780**	**1,101,965**	**1.65**	**219.47**	**551.40**	**0.40**

5-1-4 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 5-17 and Table 5-18 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 5-19 and Table 5-20 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 5-17: 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	Walnuts and Cherries	2-40	250	615	22	0.0127
PGE_Well_2	250	Almonds and Grapes	Almonds - 6 Grapes - Old	160	2,269	-36	0.0000
PGE_Well_3	250	Almonds	5	150	8	1	0.0000
PGE_Well_4a	75	Grapes	21	1,020	Unknown	0	0.0000
PGE_Well_4b	125	Grapes	21	1,020	Unknown	0	0.0000
PGE_Well_4c	150	Grapes	21	1,020	Unknown	0	0.0000
PGE_Well_5	150	Walnuts	4-7	66	1,555	127	0.0000
PGE_Well_6	200	Almonds	4	294	Unknown	0	0.0000
PGE_Well_7	30	Mandarins	2	38	959	-11	-0.0066
PGE_Well_8a	400	Vegetables	Biannually	160	NA	109	0.0049
PGE_Well_8b	400	Vegetables	Biannually	160	Unknown	109	0.0049
PGE_Well_9	15	Grapes and Pistachio	44	45	1,022	109	0.0049
PGE_Well_10	75	Lemons	1	70	1,554	240	0.0073
PGE_Well_11	300	Almonds and Pistachios	6	635	3,500	221	0.0140
PGE_Well_12	200	Almonds	14	630	Unknown	0	0.0000
PGE_Well_13	50	Nectarines, peaches and plums	2-15	75	1,568	-23	0.0000
PGE_Well_14	75	Almonds	2.5	126	Unknown	109	0.0049
PGE_Well_15a	125	Walnuts and Pistachios	Pistachio - 1 Walnuts - 20	350	1,771	159	0.0030
PGE_Well_15b	125	Pistachios and Walnuts	Pistachio - 1 Walnuts - 20	350	1,638	186	0.0000
PGE_Well_16	200	Almonds and Walnuts	1	150	1,740	223	0.0085
Weighted Average*			**7**	**336**	**1736**	**75**	**0.0034**
Predominant Ex Ante Metrics						**261**	**0.1204**

* Weighted average uses pump horsepower as a weight.

Table 5-18: 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	50	Pistachios	14	100	2,568	160	0.0000
SCE_Well_2	60	Almonds	5	38	1,016	96	0.0000
SCE_Well_3	200	Alfalfa and Walnuts	Annual	120	1,114	57	0.0000
SCE_Well_4	300	Almonds	4	309	2,323	0	0.0000
SCE_Well_5	50	Almonds	10-25	25	2,666	140	0.0361
SCE_Well_6	200	Alfalfa	4	200	2,123	134	0.0000
SCE_Well_7	40	Citrus	12-30	20	1,096	209	0.1144
SCE_Well_8	30	NA - Cemetary	NA	10	1,087	219	0.0285
SCE_Well_9	15	Oranges	20	40	2,783	397	0.0911
SCE_Well_10	75	Almonds	1	60	1,537	77	0.0000
SCE_Well_11	200	Grapes	1-10	300	2,935	249	0.0460
SCE_Well_12	200	Almonds	1	100	702	230	0.0000
Weighted Average*			**5**	**177**	**1,851**	**128**	**0.0125**
Predominant Ex Ante Metrics						**258**	**0.1200**

* Weighted average uses pump horsepower as a weight.

Table 5-19: 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	60	Almonds	10-17	250	888	120	0.0642
PGE_Booster_1b	60	Almonds	10-17	250	888	120	0.0642
PGE_Booster_1c	125	Almonds	10-17	250	888	120	0.0642
PGE_Booster_1d	50	Almonds	10-17	250	888	120	0.0642
PGE_Booster_2	60	Almonds	4	294	2,659	340	0.1549
PGE_Booster_3a	100	Pistachios and Almonds	Pistachios - 3-18, Almonds - 15-18	Unknown	0	0	0.0000
PGE_Booster_3b	100	Pistachios and Almonds	Pistachios - 3-18, Almonds - 15-18	Unknown	0	0	0.0000
PGE_Booster_4	60	Grapes	1 year	400	2,503	321	0.0875
PGE_Booster_5a	150	Almonds	14	630	3,303	233	0.0648
PGE_Booster_5b	125	Almonds	14	630	3,303	233	0.0648
PGE_Booster_6	60	Citrus	15	500	1,163	460	0.1130
PGE_Booster_7	100	Pistachios	12	Unknown	4,926	780	0.0998
Weighted Average*			**12**	**425**	**1,945**	**233**	**0.0648**
Predominant Ex Ante Metrics						**237**	**0.1202**

* Weighted average uses pump horsepower as a weight.

Table 5-20: 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	100	Almonds	2	130	3321	-15	-0.0102
SCE_Booster_2	60	Lemons and Avocados	1-40	100	3891	995	0.2017
SCE_Booster_3a	15	Walnuts/Cherries	1-60	115	NA	291	0.0352
SCE_Booster_3b	20	Walnuts/Cherries	1-60	115	NA	291	0.0352
SCE_Booster_3c	10	Walnuts/Cherries	1-60	115	NA	0	0.0000
SCE_Booster_3d	15	Walnuts/Cherries	1-60	115	NA	0	0.0000
SCE_Booster_4	75	Walnuts/Pistachios	Unknown, but mature	70	NA	291	0.0352
SCE_Booster_5	75	Almonds	1	160	1,071	291	0.0352
SCE_Booster_6a	10	Lemons and Avocados	15	6	629	115	0.0000
SCE_Booster_6b	50	Lemons and Avocados	15	225	2905	604	0.0000
SCE_Booster_6c	40	Lemons, Avocados and Coffee	15	50	350	0	0.0000
SCE_Booster_6d	30	Lemons	12-50	14	457	68	0.0000
SCE_Booster_7	60	Grass	Old	20	746	291	0.0352
Weighted Average*			**17**	**104**	**2,047**	**291**	**0.0352**
Predominant Ex Ante Metrics						**238**	**0.1200**

* Weighted average uses pump horsepower as a weight.

5-2 Clean Water Pump Upgrade Measure

Below we present the gross impact evaluation results for the clean water pump upgrade measure administered by PG&E in PY20.[33] In addition, we provide results for each individual impact parameter, including installation rate, pump energy index (PEI), and operating hours. Site-specific results and program-level GRRs follow. The section concludes with an examination of the key contributors to the GRRs. The clean water pump upgrade measure has not been previously evaluated, and its associated workpaper was introduced in January 2020.

Installation Rate

The installation rate is defined as the ratio of the installed pump capacity (in horsepower), as virtually verified by our evaluation team, versus the pump capacity reported by the program administrator (PA). We estimated the installation rate for each site based on data gathered for each sampled end-user receiving the claimed pumps. As part of the virtual verifications, we sought to identify and assess the quantity, characteristics, and operating status of all installed pumps.

From the PY20 evaluation sample of 20 projects, we determined **an installation rate of 43%**.[34]

Pump horsepower is the key measure characteristic on which savings are based. It therefore served as the basis of our installation rate assessment. We used a combination of interview questions, virtual inspection, and review of project invoices to confirm the pump characteristics and verify whether or not pumps are installed and operational. The installation rate was calculated directly from this measurement.

$$IR_{hp} = \frac{hp_V}{hp_R}$$

Where:

[33] SCE rebated a single clean water pump upgrade in 2020. Due to relatively low contribution to statewide savings, we excluded it from the evaluation.

[34] Using pump quantity as the metric for installation rate, we determined an IR of 80%. One of the four non-install projects involved a 170-horsepower pump in storage that significantly affected the IR_{hp} calculation.

IR_{hp} = Installation Rate based on horsepower

hp_V = Installed pump capacity (in horsepower) verified by our team

hp_R = Pump capacity (in horsepower) reported in program tracking system

The resulting 43% installation rate is primarily due to 4 instances of pumps received at the claimed address but not installed or not operational. In addition, we found comparatively minor differences in pump capacity as compared with program claims. Otherwise, we confirmed that all installed pumps are properly functioning (i.e., no installed systems were failed or removed).

In Table 5-21 we break down the installation rate by category.

Table 5-21: Disposition of Clean Water Pump Upgrade Verification

Measure	Sites	Received Rate	Failure Rate	Storage Rate	Removal Rate	Installation Rate
Clean Water Pump Upgrade	20	92.3%	0.0%	49.4%	0.0%	42.9%

Pump Energy Index (PEI)

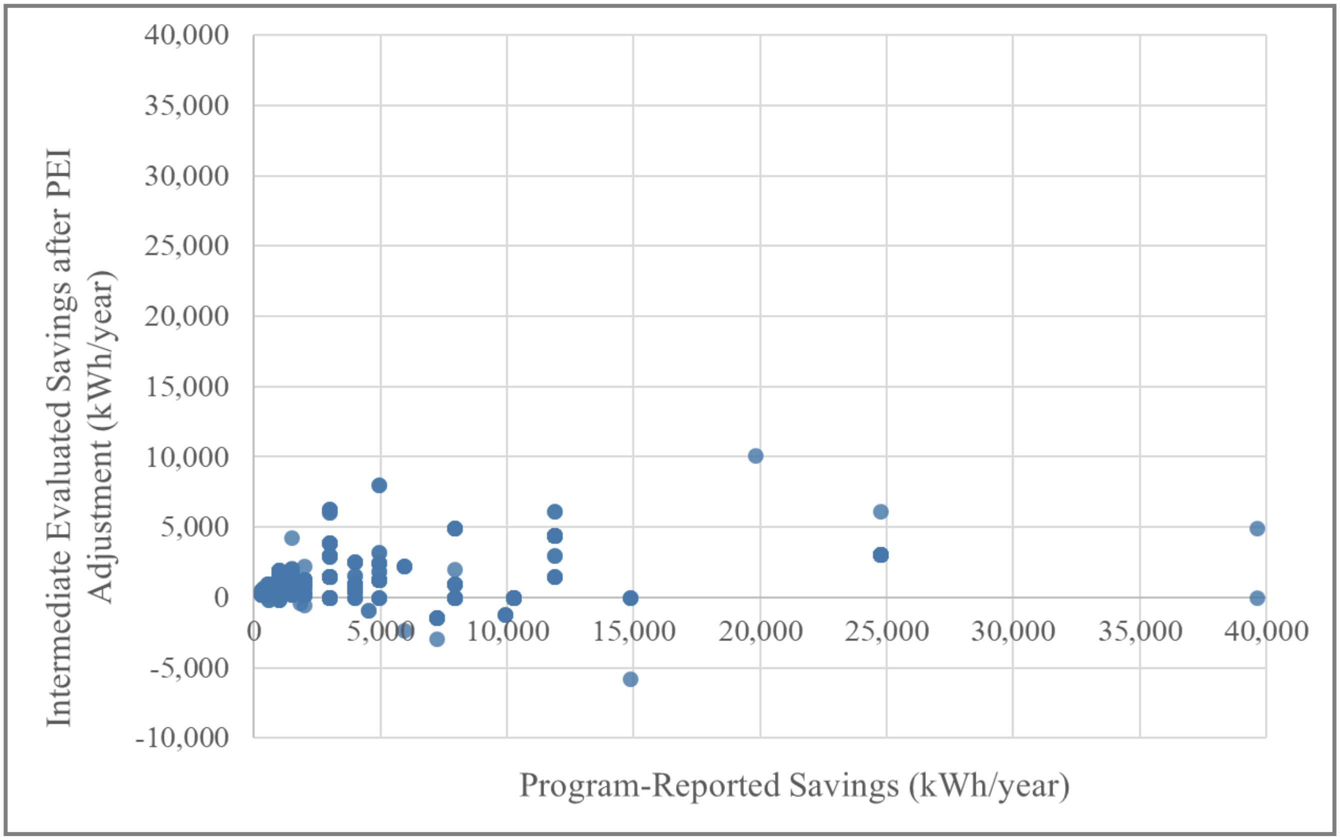
Measure savings are based on improvement in pump efficiency as measured by the pump energy index (PEI). The program-reported savings claims are based on blended PEI values for installed and baseline scenarios that reflect an assumed distribution of pumps among different pump sizes and use cases. The initial workpaper for this measure, introduced in January 2020, referenced a detailed database of pump performance data collected from manufacturers and the Hydraulic Institute (HI), as reported by the Northwest Regional Technical Forum (RTF).[35] The initial workpaper referenced version 1 of the

[35] Northwest Regional Technical Forum. 2015. https://www.caetrm.com/media/reference-documents/CIP_FR_LCC_2015-09-21_VL_baselinePEI_v2.xlsm

database, but the CPUC, evaluation team, and PG&E revised the workpaper in June 2020 to reference version 2. Version 2 of the database included more up-to-date and comprehensive PEI data reflective of the market in 2020.

This workpaper update occurred prior to any pumps being claimed by PG&E. We therefore quantified ex-post savings using RTF database version 2 as the basis of PEI values. As a first analysis step in the evaluation, we quantified the installed and baseline PEIs for all pumps claimed by PG&E in 2020. Overall, we determined an evaluated delta-PEI of 0.025 as compared with the blended delta-PEI of 0.078 reflected in savings claims. Among the 540 pumps claimed by PG&E in 2020, differences in delta-PEI led to differences between evaluated kWh savings (y-axis) and program-reported savings (x-axis) as illustrated in Figure 5-1. For a small number of installations, we found that the installed PEI led to negative savings as compared with the applicable baseline.

Figure 5-1: Comparison of Intermediate Evaluated Savings and Program-Reported Savings after PEI Adjustment



Pump Operation

Through virtual verifications, we collected information on typical pump operation throughout the year, including any seasonal variation. The measure workpaper recommends 4,000 annual operating hours for end users classified as commercial, which comprises all 20 projects in the evaluation sample. We generally verified that 4,000 annual operating hours was a reasonable estimate of typical pump operation. For 5 projects, the facility representative confirmed that the installed pumps operate continuously throughout the year (8,760 annual operating hours). These 5 projects increased the overall average ex-post annual operating hours to 5,132 when weighted by installed horsepower.

The workpaper savings algorithm accounts for pump cycling with a load factor (LF) presumed to be 0.846 for nearly all constant-speed pump applications. Using the detailed RTF database's LFs by pump size and type, we determined an average LF of 0.833 when weighted by installed horsepower.

Site-Specific Results

Table 5-22 presents ex post and ex ante first-year gross saving results for the 20 projects sampled for the evaluation, and the resulting GRRs for annual energy savings. Program-level GRRs and analysis of key contributors are presented in subsequent sections.

Table 5-22: Site-Specific Water Pump Upgrade Evaluation Results – PG&E

Evaluation ID	PA	Stratum	Ex Ante First-Year Savings (kWh)	Ex Post First-Year Savings (kWh)	kWh GRR
PEI4005	PGE	Both	33,684	0	0.00
PEI4017	PGE	Small	12,879	0	0.00
PEI4020	PGE	Small	8,916	7,434	0.83
PEI4025	PGE	Small	6,935	0	0.00
PEI4043	PGE	Small	3,963	423	0.11
PEI4044	PGE	Small	3,963	985	0.25
PEI4045	PGE	Small	3,963	493	0.12
PEI4046	PGE	Small	2,972	3,859	1.30
PEI4057	PGE	Small	2,972	0	0.00
PEI4074	PGE	Small	1,981	419	0.21
PEI4083	PGE	Small	1,486	2,032	1.37
PEI4085	PGE	Small	1,486	2,427	1.63
PEI4090	PGE	Small	1,486	1,968	1.32
PEI4108	PGE	Small	1,486	0	0.00
PEI4110	PGE	Small	1,189	443	0.37
PEI4116	PGE	Small	991	886	0.89
PEI4047	PGE	Small	2,972	2,511	0.84
PEI4031	PGE	Small	5,944	6,046	1.02
PEI4060	PGE	Small	2,972	2,511	0.84
PEI4021	PGE	Small	7,926	0	0.00
Total			**110,166**	**32,437**	**0.29**

5-2-1 First Year Gross Impact Results

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 5-23 below presents the population-level first year gross kWh and kW realization rates for the pump upgrade 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 19% with a corresponding relative precision of 43% at the 90% confidence interval.[36] Evaluators confirmed the workpaper assumption that pump upgrades do not result in peak demand savings. Below we examine the reasons behind the low kWh GRR.

Table 5-23: First Year Gross kWh and kW Realization Rates for Water Pump Upgrade 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	2,281,323	422,321	19%	43%	0	0	N/A	N/A
SCE*	12,673	12,673	100%	NA	0	0	N/A	N/A
Total	**2,293,995**	**434,994**	**19%**	**43%**	**0**	**0**	**N/A**	**N/A**

* SCE rebated a single installation in 2020. Due to its relatively low savings, we excluded it from the evaluation and assigned it a 100% GRR.

In the PY20 data collection and sampling plan, we targeted results within ±5% relative precision at the 90% confidence interval. The achieved relative precision is slightly poorer due to three main reasons: 1) we were unable to meet the sample target of 34 virtual verifications, 2) we determined wide variability

[36] The overall GRR differs from that in Table 5-22, as the overall GRR reflects savings reductions due to PEI differences for the full population of 540 pumps, whereas Table 5-22 reflects only sampled projects.

in site-specific results due to 4 zero-saver projects, and 3) relative precision is proportional to the inverse of the GRR, meaning the lower the GRR value, the poorer the relative precision.

Population wide analysis of PEI strengthened the relative precision. The relative precision between the sample's ex post and ex ante savings yields a GRR of 0.29 and relative precision around 70%. However, due to the PEI analysis, the GRR resulted in 0.19, with a relative precision of 43%. As shown in Table 5-24 below, differences in PEI ratings accounted for over two-thirds of the difference between ex post and ex ante savings. Since we analyzed PEI ratings for the full population of 540 records, its savings difference corresponds to a sampling precision of 0%. Despite the lower sample target than desired, we are confident that the results presented in this report are representative of clean water pump upgrade savings in PY20.

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.

- For all pumps claimed in 2020, we determined significant differences in pump energy index (PEI) between values reflected in program-reported savings and applicable PEI ratings based on pump size, application type, and controls system. These differences caused a 69% reduction in kWh GRR.
- We found that 4 of the sampled projects involved pumps that were not installed or not operational, resulting in zero savings. These 4 projects reduced the GRR by 12%.
- For 6 sampled projects, we determined that the installed pumps operate more often than assumed within program-reported savings, increasing the GRR by 3%.

The key discrepancies and their relative contribution to the overall program-level kWh GRR are illustrated in Table 5-24. We note that the table presents discrepancies in the order of our analysis approach, with the population-wide PEI assessment occurring first. Differences in PEI reduced savings by 69%; therefore, subsequent reductions are lower than they would have been if presented in a different order.

Table 5-24: Key Discrepancy Categories and Contributions to kWh GRR – Water Pump Upgrade

Discrepancy Category	Negative		Positive	
	Frequency	RR Impact	RR Impact	Frequency
Differences in PEI ratings*	399	-74%	5%	141
Pumps not installed	4	-12%	0%	0
Difference in installed pump size	5	-4%	0%	2
Difference in annual operating hours	0	0%	3%	6
Difference in pump load factor	9	0%	0%	5
Claimed savings do not match workpaper	0	0%	0%	1
Residual	5	0%	0%	5
Total	**422**	**-90%**	**8%**	**160**

* Evaluators assessed all PY20 claims for PEI correctness. The frequencies in this row reflect observed PEI differences among the full population of records. Frequencies in other rows reflect counts within the 20-site sample.

5-2-2 Lifecycle Gross Impact Results

Table 5-25 presents the population-level gross lifecycle kWh and kW realization rates for the evaluated water pump upgrade 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. We collected data on the age of replaced pumps, but due to low sample count and variability in results, we could not conduct a representative effective useful life (EUL) analysis for the measure. Several installations occurred in newly constructed facilities that c cannot contribute to information on the age of the replaced pumps. We referenced the workpaper's recommended EUL of 15 years in the calculation of lifecycle ex post savings, and the first-year and lifecycle GRRs are therefore identical.

Table 5-25: Lifecycle Gross kWh and kW Realization Rates for Water Pump Upgrade Measures

PA	Lifecycle Gross kWh Savings				Lifecycle Gross kW Savings			
	Ex Ante	Ex Post	GRR	RP	Ex Ante	Ex Post	GRR	RP
PG&E	34,219,838	6,334,821	19%	43%	0	0	N/A	N/A
SCE*	190,092	190,092	100%	0%	0	0	N/A	N/A
Total	**34,409,930**	**6,524,913**	**19%**	**43%**	**0**	**0**	**N/A**	**N/A**

* SCE rebated a single installation in 2020. Due to its relatively low savings, we excluded it from the evaluation and assigned it a 100% GRR.

5-3 Gas Fryers

Below we discuss the detailed approach for estimating each individual impact parameter, including the gas fryer installation rate and operating profile. 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 gas fryer measure, we define installation rate as the ratio of evaluator-verified installed fryer quantity to the installed quantity as reported by the program administrator (PA). We quantified installation rate for each of the 12 evaluated sites based on data gathered during on-site visits. During each site visit, evaluation engineers worked with knowledgeable facility staff to confirm the installation, operability, and nameplate characteristics of each rebated fryer through M&V.

Our evaluation team conducted physical inspections of fryer installations at 12 participating facilities and determined **a fryer installation rate (ISR) of 100%**[37] as indicated in Table 5-26.

[37] As discussed below, the evaluators determined that one sampled project was ineligible because the installed fryer was not ENERGY STAR-qualified and therefore ineligible for the program. This project is nonetheless included in the installation rate, as the rebated equipment was properly installed and functioning.

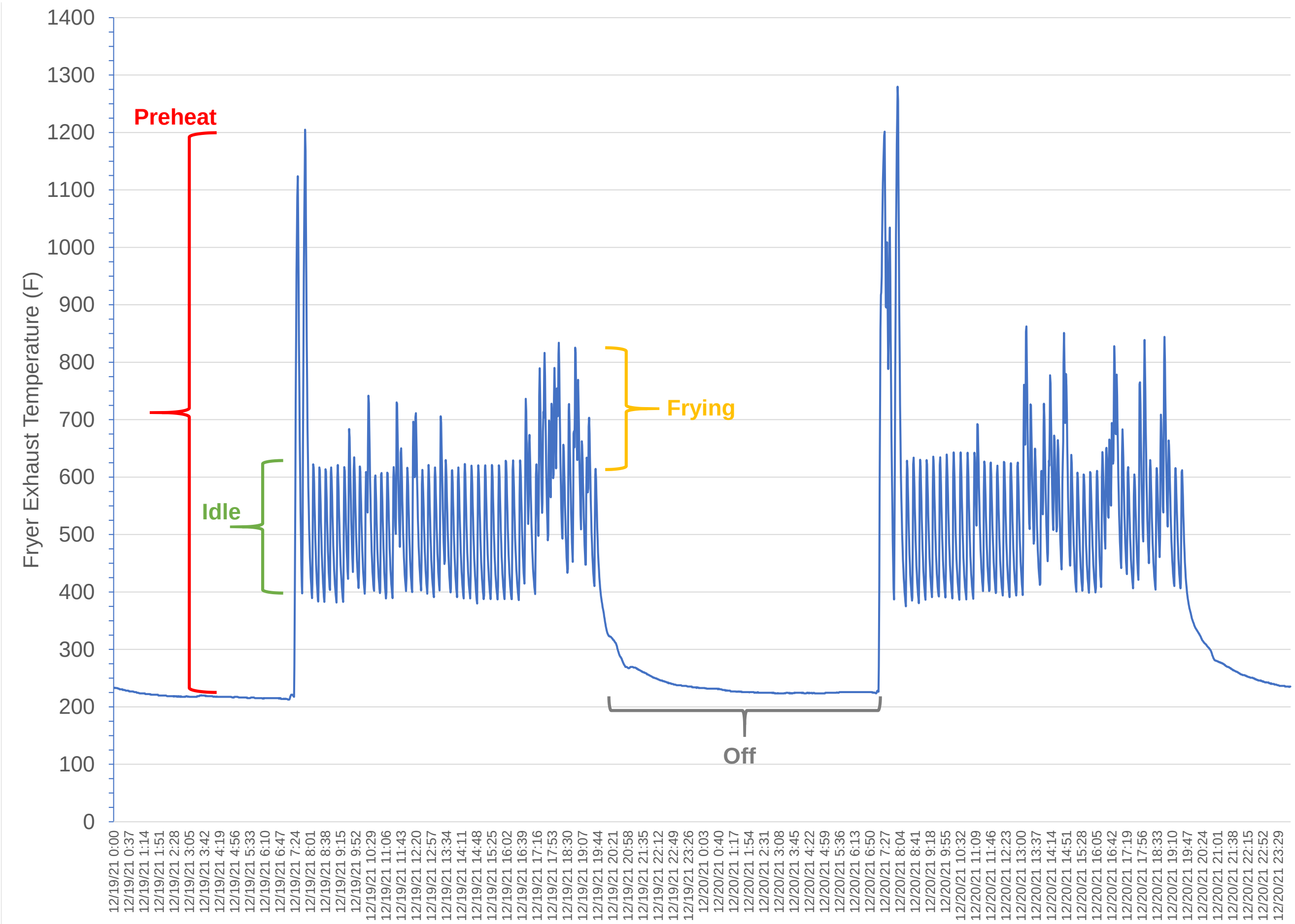
Table 5-26: Disposition of Commercial Gas Fryer Verification

Measure	Sites	Received Rate	Failure Rate	Storage Rate	Removal or Closure Rate	Installation Rate
Gas Fryer	12	100.0%	0.0%	0.0%	0.0%	100.0%

Operating Profile

Using M&V data on fryer exhaust temperature, we developed operating profiles for each sampled fryer. M&V data allowed us to classify each interval of fryer operation into one of four modes: off, preheat, idle, and frying. Figure 5-2 illustrates an example operating profile that distinguishes among the four modes.

Figure 5-2: Example Fryer Exhaust Temperature Profile



We next extrapolated M&V data over a full year to determine installed and baseline annual gas consumption values, the difference of which constitutes the evaluated savings. The M&V data also allowed us to compute fryer metrics considered in Food Service Technology Center performance ratings. Table 5-27 compares such metrics between the values recommended by the applicable workpaper in 2020 and the ex-post average values weighted by installed fryer capacity. In addition, the gas fryer measure workpaper was recently updated in January 2022; we have also compared evaluation results with the recommended values in the current workpaper. The rightmost column values are provided purely for informational purposes and do not affect the ex-post results in this report.

Table 5-27: Comparison of Fryer Operating Metrics between Evaluation M&V and Workpaper Recommendations

Metric	PY20 Workpaper Recommendation	Ex Post Weighted Average	Current Workpaper Recommendation
Preheat duration (minutes)	7.0	7.7	7.0
Preheat energy (Btu)	10,169	9,814	10,278
Idle energy rate (Btu/h)	6,769	9,759	7,571
Efficiency	53.3%	51.8%	51.8%
Production capacity (lbs/h)	64.0	65.6	62.9
Operating hours per day (h)	12.0	13.9*	12.0
Operating days per year	351.4	353.1	351.4

* This value includes significantly higher fryer operation from two fast-food restaurants open 24/7. The value is 12.3 if the two 24/7 customers are excluded.

We found that installed fryers, on average, require 10% more preheat time but 4% less preheat energy than assumed within the workpaper applicable in PY20. Additionally, fryers consume 44% more energy during idle periods. Installed fryers operated at slightly lower cooking efficiency than assumed with the applicable workpaper.

Site-Specific Results

Table 5-28 illustrates key characteristics and results of the 12 projects sampled for evaluation. In subsequent sections we present program-level GRRs and an analysis of key contributors to GRR results.

Table 5-28: Site-Specific Gas Fryer Evaluation Results (Unweighted)

Evaluation ID	PA	Stratum	Ex Ante First-Year Savings (therm)	Ex Post First-Year Savings (therm)	Therm GRR
FRY40071	PGE	PGEMulti	1,242	3,096	2.49
FRY40026	PGE	PGEMulti	1,656	1,285	0.78
FRY40215	PGE	PGESingle	414	400	0.97
FRY40228	PGE	PGESingle	414	401	0.97
FRY40251	PGE	PGESingle	414	244	0.59
FRY40312	PGE	PGESingle	414	361	0.87
FRY40355	PGE	PGESingle	414	0	0.00
FRY40236	PGE	PGESingle	414	327	0.79
FRY40014	PGE	PGEMulti	2,070	2,217	1.07
FRY40580	SCG	SCGMulti	828	688	0.83
FRY41004	SCG	SCGSingle	414	440	1.06
FRY40996	SCG	SCGSingle	414	356	0.86
Total			**9,108**	**9,813**	**1.08**

5-3-1 First Year Gross Impact Results

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 5-29 below presents the first-year gross Therm realization rates for the gas fryer measure for PG&E and SCG. We also present the corresponding relative precision. Due to low sample sizes, Table 5-29 represents an unweighted sample-based mean GRR. The first year Therm GRR is 108% with a corresponding relative precision of 36% at the 90% confidence interval, where the lower bound of the confidence interval is 69% and the upper bound of the confidence interval is 147% Further below we examine the reasons behind the GRR and precision results derived.

Table 5-29: Measured First Year Gross Therm Realization Rate for PG&E and SCG Gas Fryer Measures

PA	First Year Gross Realization Rate			
	GRR	RP at 90% Confidence	GRR Lower Bound	GRR Upper Bound
PG&E and SCG	**108%**	**36%**	69%	147%

* Due to relatively low contributions to statewide savings, SDG&E projects were excluded from study.

Due to the relatively small sample size and wide confidence interval around the resulting gas fryer gross impact realization rate of 108%, we can't be confident that that result represents the true mean. For this reason we have elected to pass through PY20 ex ante gross impacts for the gas fryer measure, as demonstrated in Table 5-30.

Table 5-30: First Year Gross Therm Realization Rate Applied for Gas Fryer Measures

PA	Lifecycle Gross Therm Savings			
	Ex Ante Savings	Ex Post Savings	GRR	RP at 90% Confidence
Statewide	1,425,110	1,425,110	100%	NA

As discussed in Section 3-2-1, our evaluation team experienced challenges in recruiting customers for participation in the study, primarily due to incomplete end-user contact data, high rates of COVID-19 transmission during the evaluation data collection period, and associated sensitivities with accessing food preparation areas. Ultimately 9 PG&E and 3 SCG customers participated in the evaluation. Despite lower-than-expected participation, we determined relatively consistent results across the 12-site sample, aside from the ineligible project and high-saving project that occurred at a 24/7 facility. This consistency in results led to a slightly better relative precision than targeted, notably for SCG projects.

Overall, our evaluation results show that fryer projects realize 108% of PG&E and SCG-claimed savings. Our evaluation team identified the following key contributors to the GRR that led to slightly lower ex post savings than ex ante.

- **We determined one sampled PG&E project to be ineligible, as the installed fryer was not ENERGY STAR-qualified.**
    - Ineligibility reduced the overall GRR by 9%.
- **Differences in measured fryer operation as compared with workpaper assumptions generally balanced each other out and led to a 3% increase in GRR. We note that lower-than-desired sample size likely contributed to higher uncertainty in parameter-level results.**
    - As indicated in Table 5-27, we found that installed fryers required more preheat time and idle energy than assumed in the applicable workpaper. Notably, differences in idle energy significantly decreased the GRR by 40%.
    - On the other hand, we found that fryers operate for more hours per day than assumed within savings claims, increasing the GRR by 42%. The evaluation sample included two projects at 24/7 fast food restaurants.
    - Installed fryers operate at slightly lower cooking efficiency than assumed in the workpaper. We found slightly higher production capacity than assumed in the workpaper. These two differences essentially cancelled each other out.

A comprehensive analysis of discrepancy reasons, frequencies, and relative contributions to program-level Therm GRR is illustrated in Table 5-31.

Table 5-31: Discrepancy Categories and Contributions to Overall Therm GRR – Gas Fryer Measure

Discrepancy Category	Negative		Positive	
	Frequency	RR Impact	RR Impact	Frequency
Ineligible equipment	1	-9%	0%	0
Difference in installed quantity	0	0%	0%	0
Difference in equipment efficiency	8	-3%	2%	3
Difference in operating hours	0	0%	42%	5
Difference in preheat energy	9	-2%	5%	2
Difference in idle energy rate	9	-56%	16%	2
Reduced production capacity	8	-3%	3%	1
Residual differences/interactivity	0	0%	0%	0
Total	35	-73%	67%	13

5-3-2 Lifecycle Gross Impact Results

Table 5-32 presents the population-level gross lifecycle Therm realization rates for the evaluated commercial gas fryer measure, along with the aggregate ex ante and ex post lifecycle Therm savings. The corresponding relative precision estimates are also presented. Due to low sample sizes, the applied lifecycle gross statewide GRR is 100%, since the first year sample based unweighted mean GRR in Table 5-29 is not representative of the population.

Table 5-32: Lifecycle Gross Therm Realization Rate for Gas Fryer Measures

PA	Lifecycle Gross Therm Savings			
	Ex Ante Savings	Ex Post Savings	GRR	RP at 90% Confidence
Statewide	17,101,320	17,101,320	100%	NA

Through interviews with participating customers on the age and condition of preexisting fryers, we determined that 10 of the 12 sampled projects involved replacement of preexisting fryers; 2 projects involved installations at newly constructed facilities. Customers provided a range of ages and operating conditions of the replaced fryers, from good condition (1 customer) to fair condition (3) to poor condition (4). Replaced equipment ages generally ranged between 5 years and 15 years. Customers were motivated to replace the preexisting fryers because the "equipment was not functioning adequately" (4), they "wanted improved performance or functionality" (3), or because the fryers "were purchased as part of a facility renovation" (1). Based on customer perspectives on preexisting equipment age and condition, additional research on fryer EUL could be warranted.

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.[38]

Over the last several evaluation cycles, Net-to-Gross (NTG) analysis for Nonresidential programs used a standardized Self-Report Approach (SRA)[39] 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 PY2020 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

[38] 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.

[39] 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.[40] 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

40 For a detailed discussion on the reasoning for replacing this index, please refer to the PY2018 report: https://pda.energydataweb.com/api/view/2361/2018_Small%20Medium%20Com%20ESPI_Evaluation_Final_with_Appendices.pdf

had already made their decision to install the specific program qualifying measure before they 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**

$$\boldsymbol{if}\ N2 = Before$$

$$\boldsymbol{then}\ PAI2 = \frac{N41}{2}$$

$$\boldsymbol{else}\ PAI2 = N41$$

- **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*
$\boldsymbol{if}\ N6 = 1$	$\boldsymbol{then}\ PAIN6 = 10 * \%\ units\ installed\ due\ to\ program\ (N6a)$	*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.

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.

6-2-1 Downstream Sample Sizes: PG&E and SCE Agricultural Pumping VFDs, PG&E and SCG Gas Fryers

Table 6-1 and Table 6-2 summarize the sample we obtained for the PG&E and SCE Agricultural Pumping VFD and PG&E and SCG Gas Fryer Downstream measures. The Agricultural Pumping VFD measure survey data collection captures between 41%-68% of lifecycle savings across PA and pump type, as seen in Table 6-1.The downstream gas fryers on the other hand, capture between 4%-9% of lifecycle savings, seen in Table 6-2.

Table 6-1: Customer Sample Sizes for PG&E and SCE Agricultural Pumping VFDs

PA	Delivery Type	Pump Type	Responses	Applications	Life Cycle Gross Savings kWh		% of Lifecycle Savings Surveyed
			n	#	Sample	Pop.	
PG&E	Downstream	Booster	14	29	16,744,646	24,571,432	68%
PG&E	Downstream	Well	32	61	27,231,636	45,929,992	59%
SCE	Downstream	Booster	38	90	2,203,483	4,390,060	50%
SCE	Downstream	Well	8	10	3,906,636	9,601,341	41%

Table 6-2: Customer Sample Sizes for PG&E & SCG Gas Fryers

PA	Delivery Type	Measure	Responses	Applications	Life Cycle Gross Savings Therms		% of Lifecycle Savings Surveyed
			n	#	Sample	Pop.	
PG&E	Downstream	Gas Fryers	24	24	273,240	3,169,440	9%
SCG	Downstream	Gas Fryers	8	8	89,424	2,116,368	4%

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 Clean Water Pump Upgrade and Gas Fryer 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 Pump and Food Service Programs

For this evaluation, Clean Water Pump Upgrades and SCG Gas Fryers are the only measures where we utilized the Midstream A NTG Methodology, where we developed both customer and distributor results of program influence. In order to develop the ex post NTGR, we combined the results of the customer and distributor analyses. In cases where there were customer surveys completed that were associated with a specific distributor, we combined 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[41], 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 contractors/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?

  - 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 contractors/customers.**
  - Relative Importance Score Question Bank

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

A5a Now, if you were given 10 points to award in total, how many points would you 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 Midstream: Clean Water Pump Upgrade and SCG Gas Fryer Sample Sizes

Table 6-3 and Table 6-4 summarize the sample we obtained for the Clean Water Pump Upgrade and SCG Gas Fryer Midstream measures. As seen in Table 6-3 and Table 6-4, the number of customer and distributor surveys are small, however the savings represented by the Clean Water Pump distributor survey is a large portion of the population. Nonetheless, regardless of the large amount of savings captured, the sample size is too small to have a representative estimate for the population. For Clean Water Pump Upgrades, we interviewed one distributor, which represents 97% of savings and one customer that represents less than 1%. Additionally, for SCG Midstream Gas Fryers, we interviewed 8 customers and 3 distributors, which represents 50% of SCG midstream savings.

Table 6-3: Customer Sample Sizes for Clean Water Pump Upgrades and SCG Midstream Gas Fryers

PA	Delivery Type	Measure	Responses	Applications	Life Cycle Gross Savings		% of Lifecycle Savings Surveyed
			n	#	Sample	Pop.	
PG&E	Mid-stream	Clean Water Pump Upgrades	1	1	44,582	34,219,838	0.13%
SCG	Mid-stream	Gas Fryers	8	8	109,296	11,704,608	0.93%

Table 6-4: Distributor Sample Sizes for Clean Water Pump Upgrades and SCG Midstream Gas Fryers

PA	Delivery Type	Measure	Responses	Applications	Life Cycle Gross Savings		% of Lifecycle Savings Surveyed
			n	#	Sample	Pop.	
PG&E	Mid-stream	Clean Water Pump Upgrades	1	245	33,069,794	34,219,838	96.64%
SCG	Mid-stream	Gas Fryers	3	920	5,857,272	11,704,608	50.04%

6-4-4 Combined NTGR

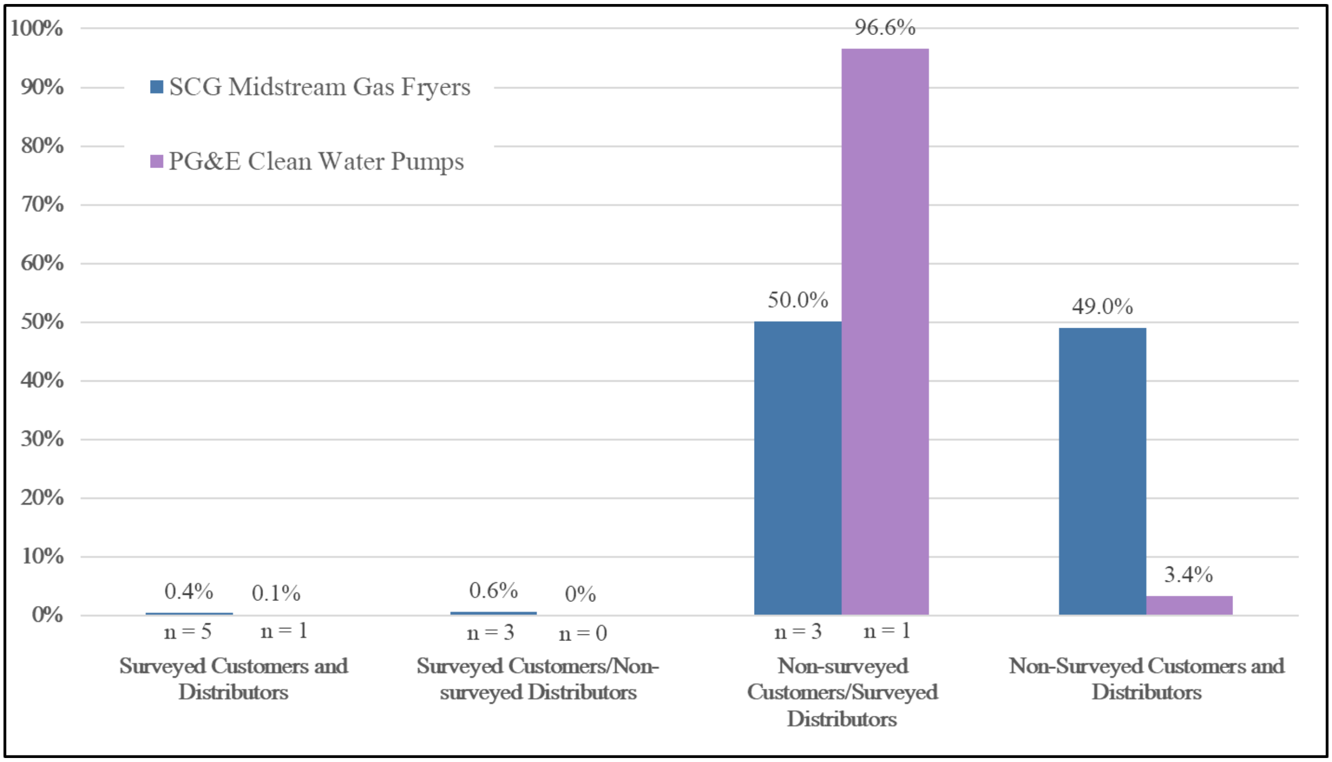
Once we calculate the distributor and customer scores, ex post NTGR is determined from a combination of findings from the participating customer and participating distributor surveys as discussed below.

To develop the ex post 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 savings.**
  - **The total weight associated with these (surveyed customers and distributors) values equaled 0.1% and 0.4% of Clean Water Pump Upgrade and SCG's Midstream Gas Fryer 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 0% and 0.6% of Clean Water Pump Upgrade and SCG's Midstream Gas Fryer 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 96.5% and 50.4% of Clean Water Pump Upgrade and SCG's Midstream Gas Fryer savings, respectively.**

Figure 6-1 summarizes these values, and also shows the number of distributor and customer surveys associated with each of these weights for PG&E's Clean Water Pump and SCG's Gas Fryer Midstream measure. 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 49.0% of SCG's Gas Fryer Midstream savings, and 3.4% of Clean Water Pump savings.

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



To develop the overall NTGR for each midstream measure mentioned above, 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 larger portion of the weight (as shown in Figure 6-1). This is justifiable considering that the distributors we interviewed represented 97% of the Clean Water Pump Upgrade measure's population savings and 50% of SCG's Gas Fryer Midstream population savings. The ex ante NTGR is applied to the unsurveyed group, as shown in the last set of bars in Figure 6-1.

When we are able to survey a robust sample of customers, we apply our sample NTGRs to the full population of participants. For this evaluation, we applied customer sample-based NTGR estimates to the population of Agricultural Pump VFD measures, and for the PG&E Downstream strata for Gas Fryers. However, for the Clean Water Pump Upgrade and SCG Midstream Gas Fryer measures, we were unable to complete data collection on a robust sample of customers. Because these measures utilized the Midstream A NTG Methodology, we also relied on the completion of distributor interviews. Because there were so few interviews, we did not apply the results from our surveyed sample to the rest of the population. Instead, for those measures, 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.

6-5 NTG RESULTS

Table 6-5 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 6-5 presents these results for the Agricultural Pumping VFD measures.

Table 6-5 : Agricultural Pumping VFD – Ex Ante and Ex Post Net-To-Gross Ratios and PAI Scores

PA	Pump Type	Surveyed Responses	Surveyed Applications	NTGR*			PAI Score		
		n	#	Ex Ante	Ex Post	RP	PAI2	PAI3	PAI N6
PG&E	Booster	14	29	0.6	0.29	17%	3.34	2.49	2.57
	Well	32	61	0.6	0.41	10%	4.23	3.95	3.93
	Overall	38	90	0.6	0.37	10%	3.92	3.44	3.42
SCE	Booster	8	10	0.6	0.35	24%	4.03	3.22	2.42
	Well	15	17	0.6	0.60	10%	5.27	5.15	7.67
	Overall	22	27	0.6	0.52	10%	4.88	4.55	6.15

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

Table 6-6 and Table 6-7 present the results for the Clean Water Pump and Gas Fryer measures, respectively. Recall from above that these PG&E Clean Water Pump and SCG's Midstream Gas Fryer measures had very small sample sizes and that we did not use the survey 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. It is also important to note that we passed through the ex ante NTGR for SDG&E's Ag Pump VFD and Gas Fryer measures, since a smaller number of customers participated in these programs and they were not a part of the sample design.

Table 6-6: Clean Water Pump Upgrades – Ex Ante and Ex Post Net-To-Gross Ratios and PAI Scores

PA	Delivery Type	Surveyed Responses *	Surveyed Applica-tions	NTGR**			Customer PAI Score			Distributor Score		
		n	#	Ex Ante	Ex Post	RP	PAI 2	PAI 3	PAI N6	Score 1	Score 2	Score 3
PG&E	Mid-stream	2	245	0.85	0.54 [42]	NA	7	7	NA	10	6	0

*Note that these survey responses represent one customer and one distributor survey.
**Please note that the market effects adder is not included in the NTGR.

Table 6-7: Gas Fryers – Ex Ante and Ex Post Net-To-Gross Ratios and PAI Scores

PA	Delivery Type	Surveyed Responses *	Surveyed Applica-tions	NTGR**			Customer PAI Score			Distributor Score		
		n	#	Ex Ante	Ex Post	RP	PAI 2	PAI 3	PAI N6	Score 1	Score 2	Score 3
PG&E, SCG	Down-stream	32	32	0.60	0.34	6%	4.8	2.0	3.1	NA	NA	NA
SCG	Mid-stream	11	928	0.60	0.66 [43]	NA	5.4	4.5	8	9.8	7.2	4.7

*Note that these SCG Midstream survey responses represent seven customer and one distributor survey.
**Please note that the market effects adder is not included in the NTGR.

---

[42] As mentioned in the report, this PG&E Midstream Clean Water Pump Upgrade NTGR is not a sample based estimate, but a weighted average of the ex ante NTGR and two survey based NTGRs, weighted by lifecycle gross expost savings. For this reason there is no RP. 3% of the weight is based on the ex ante result.

[43] As mentioned in the report, this SCG Midstream Gas Fryer NTGR is not a sample based estimate, but a weighted average of the ex ante NTGR and eight survey based NTGRs, weighted by lifecycle gross expost savings. For this reason there is no RP. 80% of the weight is based on the ex ante result.

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 Clean Water Pumps and Midstream Gas Fryers, we do not provide results for this measure.

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

Measure Type	Deemed Downstream	Deemed Midstream
Agricultural Pumping VFDs	0.39	---
Gas Fryers	0.34	--

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

In comparison to previous years, recommended DEER value for agricultural pumping VFDs was 0.39 in 2018 and 0.34 in 2019. Therefore, the 2020 recommended deemed downstream value is comparable to previous years.

6-5-1 Agricultural Pumping VFD

PG&E NTGR Results

- **The ex post NTGRs associated with Booster Pumps and Well Pumps are 0.29 and 0.41, respectively.**
    - **We created separate sampling strata for PG&E Agricultural Pump VFD applications -- Booster pumps and Well pumps**. For Booster pumps, we completed 14 interviews representing 29 applications, and we completed 32 interviews covering 61 applications for Well pumps.
- **These values are lower than the assumed ex ante value of 0.60 and indicates moderate-low program influence for booster pumps, and moderate program influence for well pumps.**

- For booster pumps, average PAI scores range from 2.49 to 3.34, and for well pumps, average PAI scores range from 3.93 to 4.23. The PAI score range is overall within a narrow range, indicating consistency across scores.

SCE NTGR Results

- The overall ex post NTGR associated with Booster Pumps and Well Pumps are 0.35 and 0.60, respectively.
  - We created separate sampling strata for SCE Agricultural Pump VFD applications -- Booster pumps and Well pumps. For Booster pumps, we completed a total of 8 interviews representing 10 applications, and we completed 15 interviews covering 17 applications for Well pumps.
- **The SCE NTGR demonstrates a moderate-low level of program influence for Booster Pumps at 0.35, and a moderate level of program influence for Well Pumps at 0.59.**
  - The ex post NTGR for Booster Pumps fell short of the 0.60 ex ante NTGR, while the ex post NTGR for Well Pumps is on par with the ex ante NTGR.
  - **It is interesting to note that SCE's PAI scores showed more variation than what we see for PG&E's PAI scores.** For booster pumps, the smallest PAI score is at 2.42, while the largest PAI score is at 4.03. For wells, we see that the smallest PAI score is at 5.27, while the largest PAI score is at 7.67. In general, we see more of a difference in NTGRs in SCE's pump types, than observed in PG&E's NTGRs by pump type.

6-5-2 Clean Water Pump Upgrades

The Clean Water Pump measure offered by PG&E is delivered through a Midstream program. The midstream program falls under the Midstream A approach.

PG&E NTGR Results

- **The overall ex post NTGR for PG&E is 0.54.**
  - For the PG&E Clean Water Pump Upgrade measure, we completed 1 customer NTG survey, representing just 1 application, and 1 distributor survey, representing 244 applications.

  - Although this one distributor represents 97% of lifecycle gross savings, 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 0.85 was passed through for the remaining projects.

- **The PG&E NTGR is based primarily on the evaluated NTGR.**
  - The 3% of unrepresented savings utilized the ex ante NTGR of 0.85, and had little impact on the overall NTGR. Therefore, the overall NTGR is very close to the NTGR of the 1 distributor surveyed.
  - **This distributor had a NTGR of 0.53, reflected by the three vendor scores: Score 1 of 10.0, Score 2 of 6.0, and Score 3 of 0**. These responses indicate that this distributor felt the program was influential, however this distributor still would recommend the program-qualifying clean water pump equipment to customers regardless of the program.
  - The 1 customer interviewed had little impact on the overall NTGR, with a NTGR of 0.7, reflected by the PAI scores: PAI-2 of 7.0, PAI-3 of 7.0, and PAI-N6 is NA.

6-5-3 Gas Fryers

The Gas Fryer measure offered by PG&E and SCG is delivered through Downstream and Midstream programs. The midstream program falls under the Midstream A approach.

PG&E & SCG Downstream NTGR Results

- **The overall ex post NTGR for PG&E and SCG is 0.34.**
  - The NTGR for PG&E Downstream Gas Fryers is based on the results of the surveys completed by 24 PG&E and 8 SCG Downstream customers.
  - It is important to note that PG&E and SCG Downstream results were pooled because both PAs independently had the same NTGR of 0.34. Even though these 32 customer surveys only represented 7% of PG&E and SCG's downstream savings, there was not a lot of variability in the 32 NTGRs resulting in a relative precision of only 6% at the 90% confidence level.
- **This NTGR is lower than the ex ante NTGR of 0.60. The downstream weighted average customer PAI scores show a range from the lowest value of 2.0 to the highest value of 4.8.**

SCG Midstream NTGR Results

- **The overall ex post NTGR for SCG is 0.66.**
  - For the SCG Midstream Gas Fryer measure, we completed 8 customer NTG surveys, representing 8 applications, and 3 distributor surveys, representing 920 applications.
  - These three distributors and 8 customers represent 50% of lifecycle gross savings, and the sample sizes were not sufficient to generate population based NTGR estimates.
  - **The NTGR based on these 11 surveys was 0.72.** This value was only applied to projects that completed an interview, and the ex ante NTGR of 0.60 was passed through for the remaining projects, which comprised 80% of lifecycle gross savings.
- **The overall SCG Midstream NTGR is close to the evaluated and ex ante NTGR. Interestingly enough, the evaluated NTGR is 0.66, which is close to the ex ante NTGR of 0.60.**
  - **The evaluated NTGR represents 20% of savings**, while the ex ante NTGR represents the other 80% of savings.
  - This distributor had a NTGR of 0.72, reflected by the three average vendor scores: Score 1 of 9.8, Score 2 of 7.2 and Score 3 of 4.7. These responses indicate that distributors felt the program was influential, however they still would recommend the program-qualifying gas fryer equipment to customers regardless of the program.
  - **The 8 customers interviewed also had a similar NTGR of 0.56**, reflected by the PAI scores: PAI-2 of 5.4, PAI-3 of 4.5, and PAI-N6 is 8.0.

SECTION 7:

EVALUATION RESULTS

This section of the report presents the gross and net realization rates that our evaluation team developed for the 2020 Agricultural and Food Service 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 (GRRs) 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 each measures' final results. Our measure-level 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.[44]

Table 7-1: Population First Year Gross Therm Realization Rates for Evaluated Gas Measures

Measure	First Year Gross Therm Savings			
	Ex Ante Savings	Ex Post Savings	GRR	RP
Gas Fryers	1,425,110	1,425,110	1.00	NA

Table 7-2: Population First Year Gross MWh and MW Realization Rates for Evaluated Electric Measures

Measure	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 Pumping VFDs	9,589	5,454	0.57	23%	4.58	0.80	0.17	22%
Clean Water Pump Upgrades	2,294	435	0.19	43%	0	0	N/A	N/A

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 measures along with the aggregate ex ante and ex post lifecycle savings. We also present the corresponding relative precision at the 90% confidence interval.

44 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

Measure	Lifecycle Gross Therm Savings			
	Ex Ante Savings	Ex Post Savings	GRR	RP
Gas Fryers	17,101,320	17,101,320	1.00	NA

Table 7-4: Population Lifecycle Gross MWh and MW Realization Rates for Evaluated Electric Measures

Measure	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 Pumping VFDs	84,493	58,740	0.70	24%	40.37	8.93	0.22	26%
Clean Water Pump Upgrades	34,410	6,525	0.19	43%	0	0	N/A	N/A

7-3 NET FIRST YEAR REALIZATION RATES

Our evaluation team estimated the ex post net 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 (NRRs) 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-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 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

Measure	First Year Net Therm Savings*			
	Ex Ante Savings	Ex Post Savings	NRR	RP
Gas Fryers	926,839	870,648	0.94	NA

* 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

Measure	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 Pumping VFDs	6,233	2,494	0.40	24%	2.98	0.36	0.12	23%
Clean Water Pump Upgrades	2,065	262	0.13	43%	0	0	NA	NA

* 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 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

Measure	Lifecycle Net Therm Savings*			
	Ex Ante Savings	Ex Post Savings	NRR	RP
Gas Fryers	11,122,068	10,447,771	0.94	NA

* 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

Measure	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 Pumping VFDs	54,920	26,746	0.49	25%	26.24	3.97	0.15	27%
Clean Water Pump Upgrades	30,969	3,935	0.13	43%	0	0	NA	NA

* 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 AGRICULTURAL PUMPING VFD MEASURES

Conclusion APVFD1 [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 57 pumps, commonly observed reasons for failing eligibility requirements includes the installation of speed controls in the following cases:

- 14 pumps run fewer than 1,000 hours per year
- 9 pumps pump well water into water storage reservoirs
- 13 pumps have settings that are at or near full-load

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 APVFD1 [PG&E and SCE]: The program's application and review process should be enhanced to better screen projects against eligibility requirements and exclusions.**

Conclusion APVFD2 [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 APVFD2a [PG&E and SCE]: 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 APVFD2b [PG&E and SCE]: 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 installations, 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 APVFD3 [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. Other common reasons are that the VFD pump gives the farmer the ability to monitor and control the pump remotely, from a desk in their office, or that the VFD might serve to mitigate water table fluctuations. 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 APVFD3 [PG&E and SCE]: 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 APVFD4 [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, motor efficiency, VFD efficiency, 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 APVFD4a [PG&E and SCE]: 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 APVFD4b [PG&E and SCE]: 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 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 APVFD4c [PG&E and SCE]: 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 APVFD5 [Section 5]: Tracking system improvements are needed to properly characterize the pumps on which the VFD controls are installed. Pumps are mis-labeled, including proper classification by motor size (horsepower) and type of pumping being performed by each pump (well pump versus booster pump).

> **Recommendation APVFD5a [PG&E and SCE]: The program's verification process should ensure that pump VFD installations are both valid and accurately represent the associated irrigation system.**

8-2 Clean Water Pump Upgrades

Conclusion CWP1 [Section 5]: For the majority of water pump upgrades evaluated, program tracking data did not provide sufficient information. For approximately 70% of projects sponsored by PG&E in 2020, we did not have sufficient participant contact data to verify pump installations or evaluate savings. As a result, we expanded our evaluation recruitment pool to include all participants in 2020 but ultimately fell short of the target sample count.

> **Recommendation CWP1 [PG&E]: The PAs should require participating distributors and partnering contractors to collaboratively collect and submit basic information for each customer ultimately receiving the equipment.** 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 CWP2 [Section 5]: The reported savings were overestimated primarily due to differences in pump efficiency indices (PEIs). For all pumps rebated in 2020, we compared the installed pump efficiency indices (PEIs) with corresponding baseline PEIs as a function of pump size, application, and controls system. Overall, we found that the achieved efficiency increase was 69% lower than that reflected in program savings claims. This difference was the primary contributor to the measure's 19% GRR.

Recommendation CWP2 [PG&E]: The Water Pump Upgrade workpaper should be revised to reflect the most accurate and up-to-date PEI values available. Our evaluation team has been working with PG&E and the CPUC to refine this measure's workpaper, and this recommendation aligns with those ongoing efforts. Should PG&E prefer that the workpaper incorporates blended PEI values for installed and/or baseline pumps, we recommend that the revised workpaper reflects the characteristics of pumps (sizes, applications, and controls types) rebated in 2020.

Conclusion CWP3 [Section 5]: We determined that 6 of the 20 evaluated projects have not saved energy. 2 projects occurred at newly constructed facilities that have not yet opened, 2 projects occurred at facilities that have not yet installed the rebated pumps, and 2 projects involved pumps with rated PEIs identical to baseline. These projects resulted in zero savings and reduced the realized program savings by 12%.

Recommendation CWP3 [PG&E]: PAs should require participating distributors and partnering contractors to submit more comprehensive installation documentation (e.g., invoices, commissioning reports, photographs) to prove measure installation, quantity, size, and efficiency. 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.

Conclusion CWP4 [Section 5]: 9 of the 20 evaluated projects involved incorrect per-unit savings values or mischaracterizations of the rebated pumps. Correcting these errors resulted in a 1% decrease in realized savings.

Recommendation CWP4 [PG&E]: PAs should redouble efforts to ensure that reported savings estimates are based on the correct application of per-unit savings values. We primarily attribute these observed errors to mischaracterizations of pump horsepower, pump application, or pump controls. This recommendation coincides with recommendations to collect more comprehensive installation data from contractors for all claimed installations.

8-3 Gas Fryers

Conclusion FRY1 [Section 5]: For many of the gas fryer projects evaluated, program tracking data did not provide sufficient information. For approximately 83% of projects rebated in 2020, we did not have sufficient participant contact data to verify fryer installations or evaluate savings.[45] In addition, the ongoing COVID-19 pandemic further limited our ability to access food preparation areas for verification and measurement of the rebated fryers. As a result, we expanded our evaluation recruitment pool to include all 2020 participants but ultimately fell short of the target sample count.

> **Recommendation FRY1 [PG&E, SCG, and SDG&E]: We recommend that 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.** This appears to be most challenging to accomplish for installed equipment that are delivered by the programs through midstream 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 FRY2 [Section 5]: We verified the installation of all rebated fryers in the evaluation sample. However, we determined one fryer to be ineligible for program rebates, as it was not ENERGY STAR-qualified. Similar to the clean water pump measure, fryers are primarily delivered through retail or equipment supplier channels. But in contrast to the clean water pump measure, we determined an installation rate of 100% after confirming fryer claims at 12 sampled participating facilities. We did not consider the lone ineligible fryer in the installation rate calculation.

> **Recommendation FRY2 [PG&E, SCG, and SDG&E]: PAs should continually update eligible products lists to reflect the most up-to-date ENERGY STAR qualified product list.** PAs should

[45] 83% of projects did not have customer contact data, including projects with contact data for the distributor or contractor only, and projects with outdated or erroneous customer contact information.

continually disseminate eligible product lists to participating distributors to ensure that rebates exclusively support high-efficiency equipment.

Conclusion FRY3 [Section 5]: Measured operation differed from workpaper assumptions and led to slightly reduced savings. We deployed temperature measurement devices on rebated fryers installed at sampled facilities. The operational data showed that fryers operate more frequently than predicted by the reported savings calculations. Increased operation led to a corresponding increase in realized savings. On the other hand, we determined higher energy usage rates than predicted, counterbalancing the operation increase. We confirmed through phone surveys and in-person interviews that our evaluation data collection, which occurred between November 2021 and February 2022, reflected typical operation and was not affected by COVID-19 precautions.

Recommendation FRY3 [PG&E, SCG, and SDG&E]: The measure workpaper should be revised to incorporate operational data from this evaluation study as well as the PY2017 evaluation cycle. The metered dataset now represents a combined sample of 55 projects. This real-world data can inform workpaper assumptions on operating hours per year among idle, preheat, and frying modes.

Conclusion FRY4 [Section 6]: The programs exhibit influence in making high-efficiency fryers cost-competitive. Participating midstream distributors indicated that the program has caused them to stock and sell more high-efficiency models than they would have absent the program. Distributors generally use the program rebates to discount the high-efficiency fryers. These point-of-sale discounts help convince end-users to choose a more efficient model than they otherwise would have. Overall, we observed net-to-gross ratios from distributors to be slightly above that predicted in the measure workpaper.

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	PGE - AGRICULTURAL PUMPING VFD	70,501	43,775	0.62	0.0%	0.62
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0			
PGE	PGE - CLEAN WATER PUMP UPGRADES	34,220	6,335	0.19	0.0%	0.19
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0			
PGE	PGE - FOOD SERVICE - PASSTHROUGH	4,601	4,601	1.00	100.0%	
PGE	PGE - GAS FRYERS - DOWNSTREAM	0	0			
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	323	323	1.00	100.0%	
PGE	**Total**	**109,646**	**55,034**	**0.50**	**4.5%**	**0.48**
SCE	SCE - AGRICULTURAL PUMPING VFD	13,991	14,966	1.07	0.0%	1.07
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	190	190	1.00	100.0%	
SCE	SCE - FOOD SERVICE - PASSTHROUGH	5,897	5,897	1.00	100.0%	
SCE	**Total**	**20,079**	**21,053**	**1.05**	**30.3%**	**1.07**
SCG	SCG - FOOD SERVICE - PASSTHROUGH	488	488	1.00	100.0%	
SCG	SCG - GAS FRYERS - DOWNSTREAM	0	0			
SCG	SCG - GAS FRYERS - MIDSTREAM	0	0			
SCG	**Total**	**488**	**488**	**1.00**	**100.0%**	
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	19	19	1.00	100.0%	
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	523	523	1.00	100.0%	
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	0	0			
SDGE	**Total**	**542**	**542**	**1.00**	**100.0%**	
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	328	328	1.00	100.0%	
MCE	**Total**	**328**	**328**	**1.00**	**100.0%**	
	Statewide	***131,083***	***77,446***	***0.59***	***9.4%***	***0.55***

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	PGE - AGRICULTURAL PUMPING VFD	45,826	18,209	0.40	0.0%	0.65	0.42	0.65	0.42
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0						
PGE	PGE - CLEAN WATER PUMP UPGRADES	30,798	3,763	0.12	0.0%	0.90	0.59	0.90	0.59
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	2,999	2,999	1.00	100.0%	0.65	0.65		
PGE	PGE - GAS FRYERS - DOWNSTREAM	0	0						
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	210	210	1.00	100.0%	0.65	0.65		
PGE	**Total**	**79,833**	**25,181**	**0.32**	**4.0%**	**0.73**	**0.46**	**0.73**	**0.44**
SCE	SCE - AGRICULTURAL PUMPING VFD	9,094	8,537	0.94	0.0%	0.65	0.57	0.65	0.57
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	171	171	1.00	100.0%	0.90	0.90		
SCE	SCE - FOOD SERVICE - PASSTHROUGH	3,833	3,833	1.00	100.0%	0.65	0.65		
SCE	**Total**	**13,099**	**12,541**	**0.96**	**30.6%**	**0.65**	**0.60**	**0.65**	**0.57**
SCG	SCG - FOOD SERVICE - PASSTHROUGH	348	348	1.00	100.0%	0.71	0.71		
SCG	SCG - GAS FRYERS - DOWNSTREAM	0	0						
SCG	SCG - GAS FRYERS - MIDSTREAM	0	0						
SCG	**Total**	**348**	**348**	**1.00**	**100.0%**	**0.71**	**0.71**		
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	13	13	1.00	100.0%	0.65	0.65		
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	340	340	1.00	100.0%	0.65	0.65		
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	0	0						
SDGE	**Total**	**352**	**352**	**1.00**	**100.0%**	**0.65**	**0.65**		
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	345	345	1.00	100.0%	1.05	1.05		
MCE	**Total**	**345**	**345**	**1.00**	**100.0%**	**1.05**	**1.05**		
	Statewide	***93,977***	***38,768***	***0.41***	***8.8%***	***0.72***	***0.50***	***0.72***	***0.47***

Gross Lifecycle Savings (MW)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PGE - AGRICULTURAL PUMPING VFD	33.6	7.3	0.22	0.0%	0.22
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0.0	0.0			
PGE	PGE - CLEAN WATER PUMP UPGRADES	0.0	0.0			
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0.0	0.0			
PGE	PGE - FOOD SERVICE - PASSTHROUGH	0.9	0.9	1.00	100.0%	
PGE	PGE - GAS FRYERS - DOWNSTREAM	0.0	0.0			
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	0.0	0.0			
PGE	**Total**	**34.5**	**8.1**	**0.24**	**2.5%**	**0.22**
SCE	SCE - AGRICULTURAL PUMPING VFD	6.8	1.7	0.24	0.0%	0.24
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0.0	0.0			
SCE	SCE - FOOD SERVICE - PASSTHROUGH	1.3	1.3	1.00	100.0%	
SCE	**Total**	**8.1**	**2.9**	**0.37**	**16.1%**	**0.24**
SCG	SCG - FOOD SERVICE - PASSTHROUGH	0.1	0.1	1.00	100.0%	
SCG	SCG - GAS FRYERS - DOWNSTREAM	0.0	0.0			
SCG	SCG - GAS FRYERS - MIDSTREAM	0.0	0.0			
SCG	**Total**	**0.1**	**0.1**	**1.00**	**100.0%**	
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0.0	0.0	1.00	100.0%	
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	0.1	0.1	1.00	100.0%	
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	0.0	0.0			
SDGE	**Total**	**0.1**	**0.1**	**1.00**	**100.0%**	
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	0.0	0.0			
MCE	**Total**	**0.0**	**0.0**			
	Statewide	***42.7***	***11.3***	***0.26***	***5.5%***	***0.22***

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	PGE - AGRICULTURAL PUMPING VFD	21.9	3.0	0.14	0.0%	0.65	0.42	0.65	0.42
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0.0	0.0						
PGE	PGE - CLEAN WATER PUMP UPGRADES	0.0	0.0						
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0.0	0.0						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	0.6	0.6	1.00	100.0%	0.65	0.65		
PGE	PGE - GAS FRYERS - DOWNSTREAM	0.0	0.0						
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	0.0	0.0						
PGE	**Total**	**22.4**	**3.6**	**0.16**	**2.5%**	**0.65**	**0.44**	**0.65**	**0.42**
SCE	SCE - AGRICULTURAL PUMPING VFD	4.4	0.9	0.21	0.0%	0.65	0.57	0.65	0.57
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0.0	0.0						
SCE	SCE - FOOD SERVICE - PASSTHROUGH	0.8	0.8	1.00	100.0%	0.65	0.65		
SCE	**Total**	**5.2**	**1.8**	**0.34**	**16.1%**	**0.65**	**0.61**	**0.65**	**0.57**
SCG	SCG - FOOD SERVICE - PASSTHROUGH	0.1	0.1	1.00	100.0%	0.70	0.70		
SCG	SCG - GAS FRYERS - DOWNSTREAM	0.0	0.0						
SCG	SCG - GAS FRYERS - MIDSTREAM	0.0	0.0						
SCG	**Total**	**0.1**	**0.1**	**1.00**	**100.0%**	**0.70**	**0.70**		
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0.0	0.0	1.00	100.0%	0.65	0.65		
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	0.1	0.1	1.00	100.0%	0.65	0.65		
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	0.0	0.0						
SDGE	**Total**	**0.1**	**0.1**	**1.00**	**100.0%**	**0.65**	**0.65**		
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	0.0	0.0						
MCE	**Total**	**0.0**	**0.0**						
	Statewide	***27.8***	***5.5***	***0.20***	***5.5%***	***0.65***	***0.49***	***0.65***	***0.44***

Gross Lifecycle Savings (MTherms)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PGE - AGRICULTURAL PUMPING VFD	0	0			
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0			
PGE	PGE - CLEAN WATER PUMP UPGRADES	0	0			
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0			
PGE	PGE - FOOD SERVICE - PASSTHROUGH	1,434	1,434	1.00	100.0%	
PGE	PGE - GAS FRYERS - DOWNSTREAM	3,169	3,169	1.00	0.0%	1.00
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	0	0			
PGE	**Total**	**4,604**	**4,604**	**1.00**	**31.2%**	**1.00**
SCE	SCE - AGRICULTURAL PUMPING VFD	0	0			
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0			
SCE	SCE - FOOD SERVICE - PASSTHROUGH	0	0			
SCE	**Total**	**0**	**0**			
SCG	SCG - FOOD SERVICE - PASSTHROUGH	4,488	4,488	1.00	100.0%	
SCG	SCG - GAS FRYERS - DOWNSTREAM	2,116	2,116	1.00	0.0%	1.00
SCG	SCG - GAS FRYERS - MIDSTREAM	11,705	11,705	1.00	0.0%	1.00
SCG	**Total**	**18,309**	**18,309**	**1.00**	**24.5%**	**1.00**
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0			
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	50	50	1.00	100.0%	
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	111	111	1.00	100.0%	
SDGE	**Total**	**161**	**161**	**1.00**	**100.0%**	
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	0	0			
MCE	**Total**	**0**	**0**			
	Statewide	***23,074***	***23,074***	***1.00***	***26.4%***	***1.00***

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	PGE - AGRICULTURAL PUMPING VFD	0	0						
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0						
PGE	PGE - CLEAN WATER PUMP UPGRADES	0	0						
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	972	972	1.00	100.0%	0.68	0.68		
PGE	PGE - GAS FRYERS - DOWNSTREAM	2,060	1,228	0.60	0.0%	0.65	0.39	0.65	0.39
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	0	0						
PGE	**Total**	**3,032**	**2,200**	**0.73**	**32.1%**	**0.66**	**0.48**	**0.65**	**0.39**
SCE	SCE - AGRICULTURAL PUMPING VFD	0	0						
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0						
SCE	SCE - FOOD SERVICE - PASSTHROUGH	0	0						
SCE	**Total**	**0**	**0**						
SCG	SCG - FOOD SERVICE - PASSTHROUGH	3,020	3,020	1.00	100.0%	0.67	0.67		
SCG	SCG - GAS FRYERS - DOWNSTREAM	1,378	820	0.59	0.0%	0.65	0.39	0.65	0.39
SCG	SCG - GAS FRYERS - MIDSTREAM	7,612	8,328	1.09	0.0%	0.65	0.71	0.65	0.71
SCG	**Total**	**12,010**	**12,168**	**1.01**	**25.1%**	**0.66**	**0.66**	**0.65**	**0.66**
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0						
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	32	32	1.00	100.0%	0.65	0.65		
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	72	72	1.00	100.0%	0.65	0.65		
SDGE	**Total**	**105**	**105**	**1.00**	**100.0%**	**0.65**	**0.65**		
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	0	0						
MCE	**Total**	**0**	**0**						
	Statewide	***15,147***	***14,472***	***0.96***	***27.0%***	***0.66***	***0.63***	***0.65***	***0.61***

Gross First Year Savings (MWh)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PGE - AGRICULTURAL PUMPING VFD	7,568	3,994	0.53	0.0%	0.53
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0			
PGE	PGE - CLEAN WATER PUMP UPGRADES	2,281	422	0.19	0.0%	0.19
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0			
PGE	PGE - FOOD SERVICE - PASSTHROUGH	387	387	1.00	100.0%	
PGE	PGE - GAS FRYERS - DOWNSTREAM	0	0			
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	65	65	1.00	100.0%	
PGE	**Total**	**10,301**	**4,868**	**0.47**	**4.4%**	**0.45**
SCE	SCE - AGRICULTURAL PUMPING VFD	2,020	1,460	0.72	0.0%	0.72
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	13	13	1.00	100.0%	
SCE	SCE - FOOD SERVICE - PASSTHROUGH	495	495	1.00	100.0%	
SCE	**Total**	**2,528**	**1,968**	**0.78**	**20.1%**	**0.72**
SCG	SCG - FOOD SERVICE - PASSTHROUGH	38	38	1.00	100.0%	
SCG	SCG - GAS FRYERS - DOWNSTREAM	0	0			
SCG	SCG - GAS FRYERS - MIDSTREAM	0	0			
SCG	**Total**	**38**	**38**	**1.00**	**100.0%**	
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	2	2	1.00	100.0%	
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	40	40	1.00	100.0%	
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	0	0			
SDGE	**Total**	**42**	**42**	**1.00**	**100.0%**	
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	22	22	1.00	100.0%	
MCE	**Total**	**22**	**22**	**1.00**	**100.0%**	
	Statewide	***12,931***	***6,938***	***0.54***	***8.2%***	***0.50***

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	PGE - AGRICULTURAL PUMPING VFD	4,919	1,661	0.34	0.0%	0.65	0.42	0.65	0.42
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0						
PGE	PGE - CLEAN WATER PUMP UPGRADES	2,053	251	0.12	0.0%	0.90	0.59	0.90	0.59
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	252	252	1.00	100.0%	0.65	0.65		
PGE	PGE - GAS FRYERS - DOWNSTREAM	0	0						
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	42	42	1.00	100.0%	0.65	0.65		
PGE	**Total**	**7,267**	**2,206**	**0.30**	**4.0%**	**0.71**	**0.45**	**0.71**	**0.43**
SCE	SCE - AGRICULTURAL PUMPING VFD	1,313	833	0.63	0.0%	0.65	0.57	0.65	0.57
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	11	11	1.00	100.0%	0.90	0.90		
SCE	SCE - FOOD SERVICE - PASSTHROUGH	322	322	1.00	100.0%	0.65	0.65		
SCE	**Total**	**1,646**	**1,166**	**0.71**	**20.2%**	**0.65**	**0.59**	**0.65**	**0.57**
SCG	SCG - FOOD SERVICE - PASSTHROUGH	27	27	1.00	100.0%	0.72	0.72		
SCG	SCG - GAS FRYERS - DOWNSTREAM	0	0						
SCG	SCG - GAS FRYERS - MIDSTREAM	0	0						
SCG	**Total**	**27**	**27**	**1.00**	**100.0%**	**0.72**	**0.72**		
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	1	1	1.00	100.0%	0.65	0.65		
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	26	26	1.00	100.0%	0.65	0.65		
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	0	0						
SDGE	**Total**	**27**	**27**	**1.00**	**100.0%**	**0.65**	**0.65**		
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	23	23	1.00	100.0%	1.05	1.05		
MCE	**Total**	**23**	**23**	**1.00**	**100.0%**	**1.05**	**1.05**		
	Statewide	***8,991***	***3,450***	***0.38***	***7.8%***	***0.70***	***0.50***	***0.70***	***0.47***

Gross First Year Savings (MW)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PGE - AGRICULTURAL PUMPING VFD	3.6	0.6	0.18	0.0%	0.18
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0.0	0.0			
PGE	PGE - CLEAN WATER PUMP UPGRADES	0.0	0.0			
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0.0	0.0			
PGE	PGE - FOOD SERVICE - PASSTHROUGH	0.1	0.1	1.00	100.0%	
PGE	PGE - GAS FRYERS - DOWNSTREAM	0.0	0.0			
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	0.0	0.0			
PGE	**Total**	**3.7**	**0.7**	**0.19**	**2.0%**	**0.18**
SCE	SCE - AGRICULTURAL PUMPING VFD	1.0	0.2	0.17	0.0%	0.17
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0.0	0.0			
SCE	SCE - FOOD SERVICE - PASSTHROUGH	0.1	0.1	1.00	100.0%	
SCE	**Total**	**1.1**	**0.3**	**0.25**	**10.0%**	**0.17**
SCG	SCG - FOOD SERVICE - PASSTHROUGH	0.0	0.0	1.00	100.0%	
SCG	SCG - GAS FRYERS - DOWNSTREAM	0.0	0.0			
SCG	SCG - GAS FRYERS - MIDSTREAM	0.0	0.0			
SCG	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0.0	0.0	1.00	100.0%	
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	0.0	0.0	1.00	100.0%	
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	0.0	0.0			
SDGE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	0.0	0.0			
MCE	**Total**	**0.0**	**0.0**			
	Statewide	***4.8***	***1.0***	***0.21***	***4.1%***	***0.17***

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	PGE - AGRICULTURAL PUMPING VFD	2.3	0.3	0.11	0.0%	0.65	0.42	0.65	0.42
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0.0	0.0						
PGE	PGE - CLEAN WATER PUMP UPGRADES	0.0	0.0						
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0.0	0.0						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	0.0	0.0	1.00	100.0%	0.65	0.65		
PGE	PGE - GAS FRYERS - DOWNSTREAM	0.0	0.0						
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	0.0	0.0						
PGE	**Total**	**2.4**	**0.3**	**0.13**	**2.0%**	**0.65**	**0.44**	**0.65**	**0.42**
SCE	SCE - AGRICULTURAL PUMPING VFD	0.6	0.1	0.15	0.0%	0.65	0.57	0.65	0.57
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0.0	0.0						
SCE	SCE - FOOD SERVICE - PASSTHROUGH	0.1	0.1	1.00	100.0%	0.65	0.65		
SCE	**Total**	**0.7**	**0.2**	**0.23**	**10.0%**	**0.65**	**0.60**	**0.65**	**0.57**
SCG	SCG - FOOD SERVICE - PASSTHROUGH	0.0	0.0	1.00	100.0%	0.71	0.71		
SCG	SCG - GAS FRYERS - DOWNSTREAM	0.0	0.0						
SCG	SCG - GAS FRYERS - MIDSTREAM	0.0	0.0						
SCG	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.71**	**0.71**		
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0.0	0.0	1.00	100.0%	0.65	0.65		
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	0.0	0.0	1.00	100.0%	0.65	0.65		
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	0.0	0.0						
SDGE	**Total**	**0.0**	**0.0**	**1.00**	**100.0%**	**0.65**	**0.65**		
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	0.0	0.0						
MCE	**Total**	**0.0**	**0.0**						
	Statewide	***3.1***	***0.5***	***0.16***	***4.1%***	***0.65***	***0.49***	***0.65***	***0.45***

Gross First Year Savings (MTherms)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
PGE	PGE - AGRICULTURAL PUMPING VFD	0	0			
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0			
PGE	PGE - CLEAN WATER PUMP UPGRADES	0	0			
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0			
PGE	PGE - FOOD SERVICE - PASSTHROUGH	120	120	1.00	100.0%	
PGE	PGE - GAS FRYERS - DOWNSTREAM	264	264	1.00	0.0%	1.00
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	0	0			
PGE	**Total**	**384**	**384**	**1.00**	**31.2%**	**1.00**
SCE	SCE - AGRICULTURAL PUMPING VFD	0	0			
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0			
SCE	SCE - FOOD SERVICE - PASSTHROUGH	0	0			
SCE	**Total**	**0**	**0**			
SCG	SCG - FOOD SERVICE - PASSTHROUGH	374	374	1.00	100.0%	
SCG	SCG - GAS FRYERS - DOWNSTREAM	176	176	1.00	0.0%	1.00
SCG	SCG - GAS FRYERS - MIDSTREAM	975	975	1.00	0.0%	1.00
SCG	**Total**	**1,526**	**1,526**	**1.00**	**24.5%**	**1.00**
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0			
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	4	4	1.00	100.0%	
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	9	9	1.00	100.0%	
SDGE	**Total**	**13**	**13**	**1.00**	**100.0%**	
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	0	0			
MCE	**Total**	**0**	**0**			
	Statewide	***1,922***	***1,922***	***1.00***	***26.4%***	***1.00***

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	PGE - AGRICULTURAL PUMPING VFD	0	0						
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0						
PGE	PGE - CLEAN WATER PUMP UPGRADES	0	0						
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	81	81	1.00	100.0%	0.68	0.68		
PGE	PGE - GAS FRYERS - DOWNSTREAM	172	102	0.60	0.0%	0.65	0.39	0.65	0.39
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	0	0						
PGE	**Total**	**253**	**183**	**0.73**	**32.1%**	**0.66**	**0.48**	**0.65**	**0.39**
SCE	SCE - AGRICULTURAL PUMPING VFD	0	0						
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	0	0						
SCE	SCE - FOOD SERVICE - PASSTHROUGH	0	0						
SCE	**Total**	**0**	**0**						
SCG	SCG - FOOD SERVICE - PASSTHROUGH	252	252	1.00	100.0%	0.67	0.67		
SCG	SCG - GAS FRYERS - DOWNSTREAM	115	68	0.59	0.0%	0.65	0.39	0.65	0.39
SCG	SCG - GAS FRYERS - MIDSTREAM	634	694	1.09	0.0%	0.65	0.71	0.65	0.71
SCG	**Total**	**1,001**	**1,014**	**1.01**	**25.1%**	**0.66**	**0.66**	**0.65**	**0.66**
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	0	0						
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	3	3	1.00	100.0%	0.65	0.65		
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	6	6	1.00	100.0%	0.65	0.65		
SDGE	**Total**	**9**	**9**	**1.00**	**100.0%**	**0.65**	**0.65**		
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	0	0						
MCE	**Total**	**0**	**0**						
	Statewide	***1,262***	***1,206***	***0.96***	***27.0%***	***0.66***	***0.63***	***0.65***	***0.61***

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 - AGRICULTURAL PUMPING VFD	0	0.0%	0.0%	9.3	1,487.6	135.7	159.7
PGE	PGE - CLEAN WATER PUMP UPGRADES	0	0.0%	0.0%	15.0	539.6	36.0	36.0
PGE	PGE - GAS FRYERS - DOWNSTREAM	0	0.0%	0.0%	12.0	0.0	0.0	0.0
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	1						
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	1						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.0	10,826.7	909.6	909.6
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	1	0.0%		5.0	161,453.4	32,290.7	32,290.7
SCE	SCE - AGRICULTURAL PUMPING VFD	0	0.0%	0.0%	7.0	1,851.0	180.6	267.3
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	1	0.0%		15.0	2,715.6	181.0	181.0
SCE	SCE - FOOD SERVICE - PASSTHROUGH	1	0.0%		11.5	53,609.9	4,502.6	4,502.6
SCG	SCG - GAS FRYERS - DOWNSTREAM	0	0.0%	0.0%	12.0	0.0	0.0	0.0
SCG	SCG - GAS FRYERS - MIDSTREAM	0	0.0%	0.0%	12.0	0.0	0.0	0.0
SCG	SCG - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.0	474.7	36.6	36.6
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	1	0.0%		10.0	2,580.0	258.0	258.0
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.5	30,751.9	2,367.5	2,367.5
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	1	0.0%		12.0	0.0	0.0	0.0
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	1	0.0%		15.0	328,318.5	21,887.9	21,887.9

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 - AGRICULTURAL PUMPING VFD	0	0.0%	0.0%	9.3	0.0	0.0	0.0
PGE	PGE - CLEAN WATER PUMP UPGRADES	0	0.0%	0.0%	15.0	0.0	0.0	0.0
PGE	PGE - GAS FRYERS - DOWNSTREAM	0	0.0%	0.0%	12.0	4,975.6	414.6	414.6
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	1						
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	1						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.0	3,375.0	281.2	281.2
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	1	0.0%		5.0	0.0	0.0	0.0
SCE	SCE - AGRICULTURAL PUMPING VFD	0	0.0%	0.0%	7.0	0.0	0.0	0.0
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	1	0.0%		15.0	0.0	0.0	0.0
SCE	SCE - FOOD SERVICE - PASSTHROUGH	1	0.0%		11.5	0.0	0.0	0.0
SCG	SCG - GAS FRYERS - DOWNSTREAM	0	0.0%	0.0%	12.0	4,968.0	414.0	414.0
SCG	SCG - GAS FRYERS - MIDSTREAM	0	0.0%	0.0%	12.0	4,968.0	414.0	414.0
SCG	SCG - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.0	4,361.7	363.2	363.2
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	1	0.0%		10.0	0.0	0.0	0.0
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.5	2,936.3	240.2	240.2
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	1	0.0%		12.0	5,041.1	420.1	420.1
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	1	0.0%		15.0	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 - AGRICULTURAL PUMPING VFD	0	0.0%	0.0%	9.3	618.8	56.5	66.4
PGE	PGE - CLEAN WATER PUMP UPGRADES	0	0.0%	0.0%	15.0	320.6	21.4	21.4
PGE	PGE - GAS FRYERS - DOWNSTREAM	0	0.0%	0.0%	12.0	0.0	0.0	0.0
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	1						
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	1						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.0	7,056.7	592.8	592.8
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	1	0.0%		5.0	104,944.7	20,988.9	20,988.9
SCE	SCE - AGRICULTURAL PUMPING VFD	0	0.0%	0.0%	7.0	1,055.9	103.0	152.5
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	1	0.0%		15.0	2,444.0	162.9	162.9
SCE	SCE - FOOD SERVICE - PASSTHROUGH	1	0.0%		11.5	34,846.5	2,926.7	2,926.7
SCG	SCG - GAS FRYERS - DOWNSTREAM	0	0.0%	0.0%	12.0	0.0	0.0	0.0
SCG	SCG - GAS FRYERS - MIDSTREAM	0	0.0%	0.0%	12.0	0.0	0.0	0.0
SCG	SCG - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.0	338.4	26.3	26.3
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	1	0.0%		10.0	1,677.0	167.7	167.7
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.5	19,988.8	1,538.9	1,538.9
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	1	0.0%		12.0	0.0	0.0	0.0
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	1	0.0%		15.0	344,734.4	22,982.3	22,982.3

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 - AGRICULTURAL PUMPING VFD	0	0.0%	0.0%	9.3	0.0	0.0	0.0
PGE	PGE - CLEAN WATER PUMP UPGRADES	0	0.0%	0.0%	15.0	0.0	0.0	0.0
PGE	PGE - GAS FRYERS - DOWNSTREAM	0	0.0%	0.0%	12.0	1,927.8	160.6	160.6
PGE	PGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	1						
PGE	PGE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	1						
PGE	PGE - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.0	2,287.1	190.6	190.6
PGE	PGE - GLYCOL PUMP VFD - PASSTHROUGH	1	0.0%		5.0	0.0	0.0	0.0
SCE	SCE - AGRICULTURAL PUMPING VFD	0	0.0%	0.0%	7.0	0.0	0.0	0.0
SCE	SCE - CLEAN WATER PUMP UPGRADES - PASSTHROUGH	1	0.0%		15.0	0.0	0.0	0.0
SCE	SCE - FOOD SERVICE - PASSTHROUGH	1	0.0%		11.5	0.0	0.0	0.0
SCG	SCG - GAS FRYERS - DOWNSTREAM	0	0.0%	0.0%	12.0	1,924.8	160.4	160.4
SCG	SCG - GAS FRYERS - MIDSTREAM	0	0.0%	0.0%	12.0	3,534.7	294.6	294.6
SCG	SCG - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.0	2,934.9	244.4	244.4
SDGE	SDGE - AGRICULTURAL PUMPING VFD - PASSTHROUGH	1	0.0%		10.0	0.0	0.0	0.0
SDGE	SDGE - FOOD SERVICE - PASSTHROUGH	1	0.0%		12.5	1,908.6	156.2	156.2
SDGE	SDGE - GAS FRYERS - DOWNSTREAM	1	0.0%		12.0	3,276.7	273.1	273.1
MCE	MCE - GLYCOL PUMP VFD - PASSTHROUGH	1	0.0%		15.0	0.0	0.0	0.0

APPENDIX AC:

RESPONSE TO RECOMMENDATIONS

EM&V Impact Study Recommendations

Study Title: PY20 Pump & Food Service 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)
APVFD1	PG&E, SCE	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 57 pumps, commonly observed reasons for failing eligibility requirements includes the installation of speed controls in the following cases: 14 pumps run fewer than 1,000 hours per year; 9 pumps pump well water into water storage reservoirs; 13 pumps have settings that are at or near full-load. 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.	The program's application and review process should be enhanced to better screen projects against eligibility requirements and exclusions.		
APVFD2a	PG&E, SCE	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	We recommend that the programs make use of interval billing data for characterizing pump operations, including use of		

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)
			applied interval billing data as a key model input used to determine VFD savings.	those data to derive updated estimates of deemed savings for the pump VFD measure, and as screening criteria for pump run hours.		
APVFD2b	PG&E, SCE	5		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 installations, 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.		
APVFD3	PG&E, SCE	5	Beside the potential to save energy, there are other common reasons that farmers will decide to install VFD	For these reasons, we recommend that the appropriate baseline be		

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)
			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.	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.		

<table>
<tr><th>ID</th><th></th><th>Section</th><th>Conclusion</th><th>Recommendation</th><th>Disposition (Accepted, Rejected, or Other)</th><th>Disposition Notes (e.g. Description of specific program change or Reason for rejection or Under further review)</th></tr>
<tr><td>APVFD4a</td><td>PG&E, SCE</td><td>5</td><td rowspan="2">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, motor efficiency, VFD efficiency, 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.</td><td>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.</td><td></td><td></td></tr>
<tr><td>APVFD4b</td><td>PG&E, SCE</td><td>5</td><td>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,</td><td></td><td></td></tr>
</table>

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)
				etc. The PAs should make use of those data to fine tune ex ante savings values to better represent 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.		
APVFD4c	PG&E, SCE	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		

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)
				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.		
APVFD5	PG&E, SCE	5	Tracking system improvements are needed to properly characterize the pumps on which the VFD controls are installed. Pumps are mis-	The program's verification process should ensure that pump VFD installations are both valid and accurately		

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)
			labeled, including proper classification by motor size (horsepower) and type of pumping being performed by each pump (well pump versus booster pump).	represent the associated irrigation system.		
CWP1	PG&E	5	For the majority of water pump upgrades evaluated, program tracking data did not provide sufficient information. For approximately 70% of projects sponsored by PG&E in 2020, we did not have sufficient participant contact data to verify pump installations or evaluate savings. As a result, we expanded our evaluation recruitment pool to include all participants in 2020 but ultimately fell short of the target sample count.	The PAs should require participating distributors and partnering contractors to collaboratively collect and submit basic information for each customer ultimately receiving the equipment. 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		

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)
				PAs, the CPUC, and its contractors to verify installations and maintain the integrity of ratepayer incentive dollars.		
CWP2	PG&E	5	The reported savings were overestimated primarily due to differences in pump efficiency indices (PEIs). For all pumps rebated in 2020, we compared the installed pump efficiency indices (PEIs) with corresponding baseline PEIs as a function of pump size, application, and controls system. Overall, we found that the achieved efficiency increase was 69% lower than that reflected in program savings claims. This difference was the primary contributor to the measure's 19% GRR.	The Water Pump Upgrade workpaper should be revised to reflect the most accurate and up-to-date PEI values available. Our evaluation team has been working with PG&E and the CPUC to refine this measure's workpaper, and this recommendation aligns with those ongoing efforts. Should PG&E prefer that the workpaper incorporates blended PEI values for installed and/or baseline pumps, we recommend that the revised workpaper reflects the characteristics of pumps (sizes, applications, and		

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)
				controls types) rebated in 2020.		
CWP3	PG&E	5	We determined that 6 of the 20 evaluated projects have not saved energy. 2 projects occurred at newly constructed facilities that have not yet opened, 2 projects occurred at facilities that have not yet installed the rebated pumps, and 2 projects involved pumps with rated PEIs identical to baseline. These projects resulted in zero savings and reduced the realized program savings by 12%.	PAs should require participating distributors and partnering contractors to submit more comprehensive installation documentation (e.g., invoices, commissioning reports, photographs) to prove measure installation, quantity, size, and efficiency. 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.		

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)
CWP4	PG&E	5	9 of the 20 evaluated projects involved incorrect per-unit savings values or mischaracterizations of the rebated pumps. Correcting these errors resulted in a 1% decrease in realized savings.	PAs should redouble efforts to ensure that reported savings estimates are based on the correct application of per-unit savings values. We primarily attribute these observed errors to mischaracterizations of pump horsepower, pump application, or pump controls. This recommendation coincides with recommendations to collect more comprehensive installation data from contractors for all claimed installations.		
FRY1	PG&E, SCG and SDG&E	5	For many of the gas fryer projects evaluated, program tracking data did not provide sufficient information. For approximately 83% of projects rebated in 2020, we did not have sufficient participant contact data to verify fryer installations or evaluate savings. In	We recommend that PAs require participating distributors and partnering contractors to collaboratively collect and submit basic information for each customer ultimately receiving the equipment or other		

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)
			addition, the ongoing COVID-19 pandemic further limited our ability to access food preparation areas for verification and measurement of the rebated fryers. As a result, we expanded our evaluation recruitment pool to include all 2020 participants but ultimately fell short of the target sample count.	program support. 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.		
FRY2	PG&E, SCG and SDG&E	5	We verified the installation of all rebated fryers in the evaluation sample. However, we determined one fryer to be ineligible for program rebates, as it was not	PAs should continually update eligible products lists to reflect the most up-to-date ENERGY STAR qualified product list. PAs should continually disseminate		

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)
			ENERGY STAR-qualified. Similar to the clean water pump measure, fryers are primarily delivered through retail or equipment supplier channels. But in contrast to the clean water pump measure, we determined an installation rate of 100% after confirming fryer claims at 12 sampled participating facilities. We did not consider the lone ineligible fryer in the installation rate calculation.	eligible product lists to participating distributors to ensure that rebates exclusively support high-efficiency equipment.		
FRY3	PG&E, SCG and SDG&E	5	Measured operation differed from workpaper assumptions and led to slightly reduced savings. We deployed temperature measurement devices on rebated fryers installed at sampled facilities. The operational data showed that fryers operate more frequently than predicted by the reported savings calculations. Increased operation led to a corresponding increase in realized savings. On the other hand,	The measure workpaper should be revised to incorporate operational data from this evaluation study as well as the PY2017 evaluation cycle. The metered dataset now represents a combined sample of 55 projects. This real-world data can inform workpaper assumptions on operating hours per year among idle, preheat, and frying modes.		

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)
			we determined higher energy usage rates than predicted, counterbalancing the operation increase. We confirmed through phone surveys and in-person interviews that our evaluation data collection, which occurred between November 2021 and February 2022, reflected typical operation and was not affected by COVID-19 precautions.			
FRY4	SCG	6	The programs exhibit influence in making high-efficiency fryers cost-competitive. Participating distributors indicated that the program has caused them to stock and sell more high-efficiency models than they would have absent the program. Distributors generally use the program rebates to discount the high-efficiency fryers. These point-of-sale discounts help convince end-users to choose a more efficient model than they otherwise would have. Overall, we	NA		

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)
			observed net-to-gross ratios from distributors to be slightly above that predicted in the measure workpaper.			

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 PY20 evaluations for the Pump and Food Service 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 it is asked. It is well known in the interview literature that the more factual and concrete the information

[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.

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

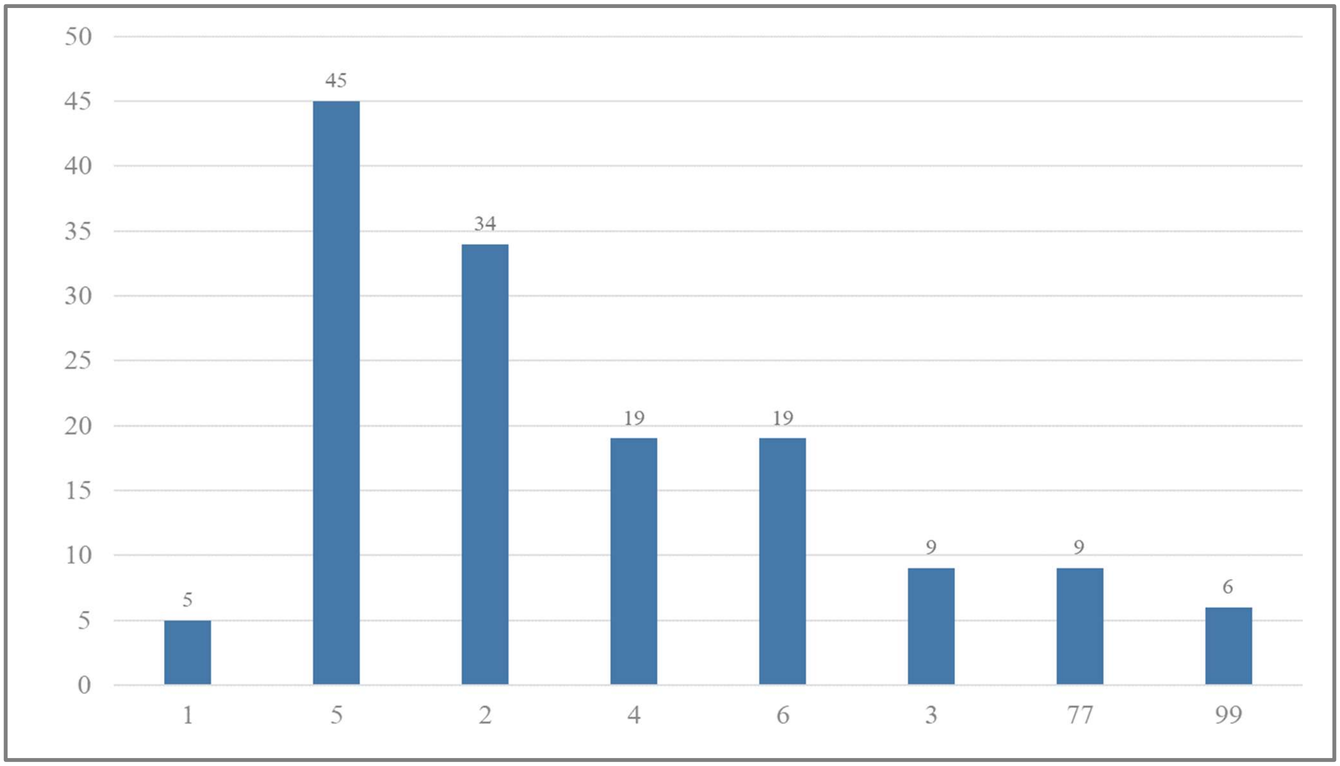
NTGR_2c – PAI-1 alternative 3 = Assign value based on No Program actions (N6). This Approach uses the N6 value and assigns a PAI score as follows.

- If N6 = 2,4 then NTGR = 1
  - 2 Install standard efficiency equipment or whatever required by code
  - 4 Done nothing (keep existing equipment as is)
- If N6=5 then NTGR = 0
  - 5 Done the same thing I would have done as I did through the program
- If N6=1, then NTGR = 1.00 minus the % share they would have installed
  - 1 Install/Delamped fewer units
- If N6=3, then NTGR =0.75
  - 3 Installed equipment more efficient than code but less efficient than what you installed through the program
- IF N6=6, NTGR=missing – this is an Accelerated Replacement and the efficiency of the action is unknown, therefore this response is excluded from the analysis
  - 6 Repair/rewind or overhaul the existing equipment
- If N6=77, the response is reviewed and a judgment made regarding the likely NTGR level, usually a 0, 0.5 or 1
  - 77 Something else (specify what ______________)

The overall NTGR_2c is the average of PAI-2, PAI-3, and PAI-N6.

Figure 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



NTGR_2d – PAI-1 alternative 4 = Preponderance of Evidence approach. If there is significant evidence of free ridership, the value is set to 0, if there is significant evidence of program influence, the value is set to 1, or else the PAI-1 alternative algorithm of choice is used to determine the NTGR. Here is the algorithm.

First calculate PAI_2 and PAI_3 and use question N6 shown earlier:

- If PAI_2 >= 7 then NTG_2 = 1
- Else if PAI_2<= 3 then NTG_2 = -1
- Else NTG_2 = 0

- If PAI_3 >= 7 then NTG_3 = 1
- Else if PAI_3<= 3 then NTG_3 = -1
- Else NTG_3 = 0

- IF N6 = 2, 4 (and possibly more options) then NTG_6 = 1
- Else if N6 = 5 (and possibly more options) then NTG_6 = -1
- Else NTG_6 = 0

THEN:

- If sum of NTG2,3,6 >=2, then NTGR = 1 (so in other words you have at least 2 indicators of being net, and no contradictions)
- Else, if sum of NTG2,3,6 <= -2, then NTGR = 0, (so in other words you have at least 2 indicators of being a free rider, and no contradictions)
- ELSE = NTGR = the standard calculation (the average of PAI2, PAI3 and the PAI-1 alternative algorithm of choice)

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

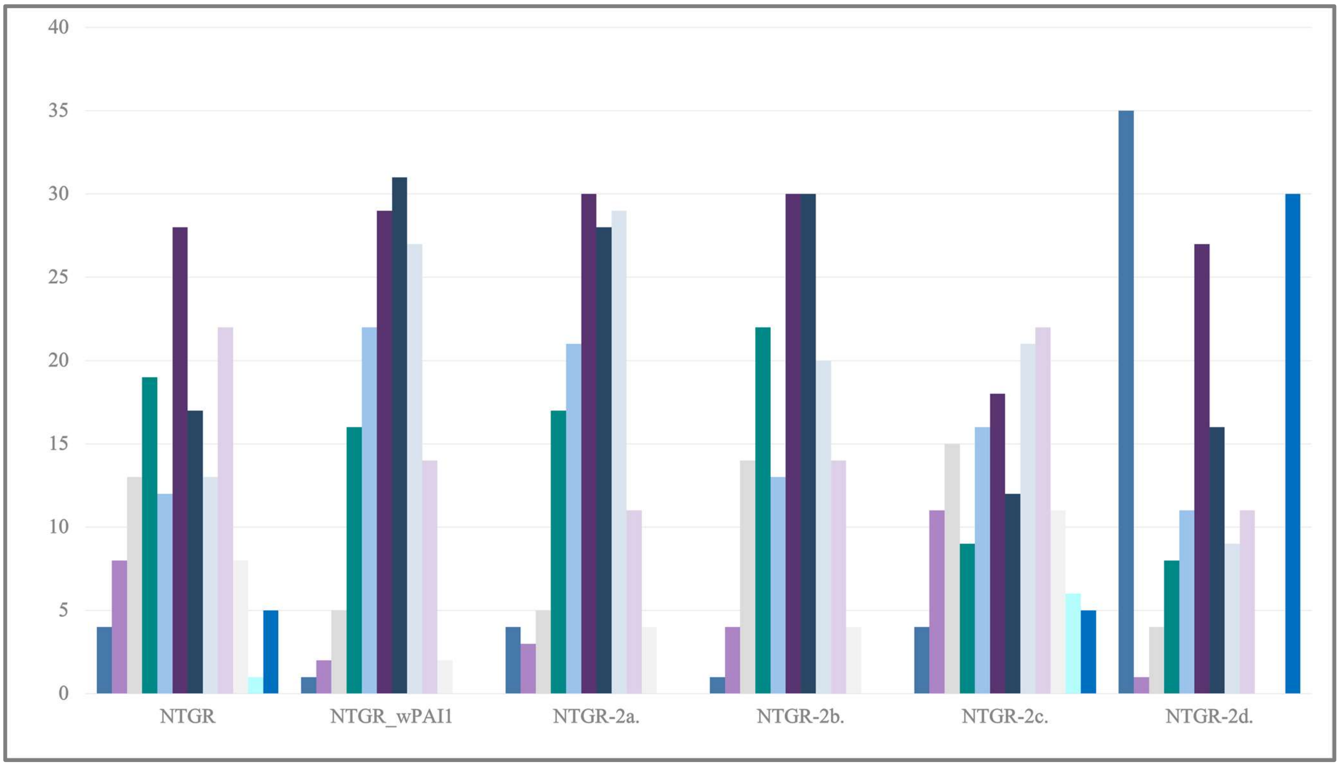
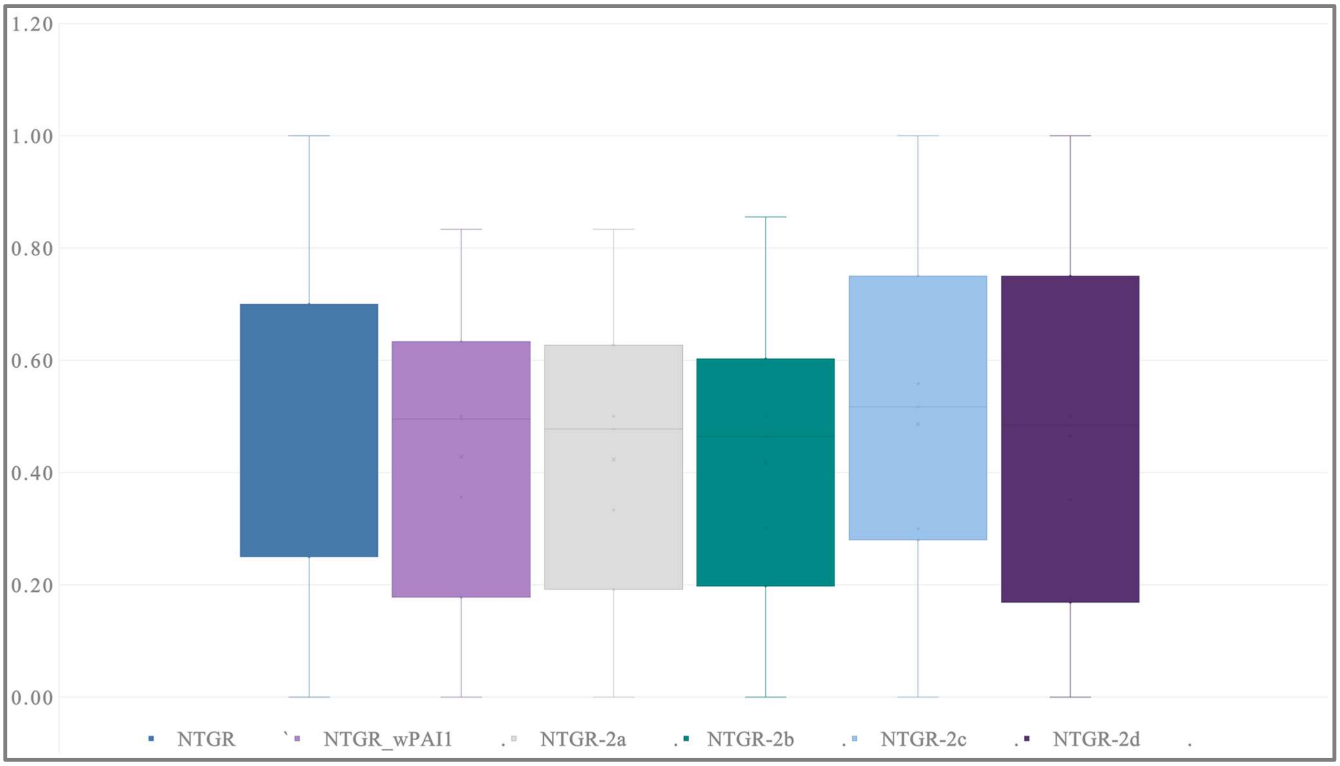


Figure A-3 below provides mean NTGR values and 90% confidence intervals across all six cases. The whiskers indicate the range of values analyzed.

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 NTG SURVEY

The following data was passed to the surveyor by decision maker ID (MDID, where each DMID may be just a single VFD record/application, or might represent several VFD records spread across one or more applications/farm locations:

<%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, 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, 2020.

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

VFD1 should be the record and application randomly selected for evaluation

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

Participant NTG Survey for CPUC

PY20 Pump and Food Service Evaluation

INTRODUCTION AND FINDING CORRECT RESPONDENT

OUTCOME 1	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 2020.	
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 2020.

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 2020...I was told that would be you.

...Your organization participated in <%UTILITY>'s <%PROGRAM> by installing variable frequency drive flow controls in 2020.

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: Yeshi Lemma, California Public Utilities Commission 415-703-1794/ Yeshi.Lemma@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

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/these 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 another flow control option. 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 add up to 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 add up to 10.

<%N41P> for Program influence and

<%N42P> for Non Program factors

NOTE: We are skipping this question for VFDs:

REPLACE — Was the installation of this the VFD(s) an add-on to an existing pump or does the VFD/do the VFDs serve a new irrigation pump/new irrigation pumps?

1	Add-on to an existing pump	DISPLAY
2	Add-on to a new pump	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.

ASK ALL

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

NOTE: We are skipping this question for VFDs:

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

Vendor_Name	Ask if V1(1) 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 DMID, 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 2020 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

This appendix includes the vendor NTG survey instruments used for the following measures in this evaluation:

- Clean Water Pump Upgrades
- Gas Fryers

C-1 Clean Water Pump Upgrades

Vendor NTG Survey Instrument – Clean Water Pump Upgrades

Introduction

AA1 This is **[Interviewer]** calling on behalf of the CPUC (California Public Utilities Commission) from DNV regarding your firm's involvement with the sales and/or installations of high-efficiency water pumps through PG&E's **Commercial Deemed Incentive PROGRAM** between January 1, 2020 and December 31, 2020. 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 **PG&E's Commercial Deemed Incentive PROGRAM** during 2020?

1

A1 PG&E has indicated that your firm is an approved distributor supporting the **Commercial Deemed Incentives PROGRAM** and was involved in selling and/or installing energy-efficient water pumps throughout their service territory during 2020. 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 pump market in general. This includes standard and energy efficient models. Can you please give us a quick overview of the types of pumps that you stock for Commercial customers?

RECORD ANSWER HERE:

A2 According to **PG&E,** your firm promotes and sells program-qualifying water pumps through the PG&E's 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 "pumps".]

The focus of this survey is on your business' sales and promotional practices of pumps after the COVID-19 shutdown. Please answer the following questions based on your business' approach after the COVID-19 shutdown.

A3 Now, I'm going to ask you about the various strategies you might have used to sell program-qualified pumps. 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 PG&E's PROGRAM and NON-PROGRAM factors in influencing your decision to recommend high-efficiency pumps 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** program-qualifying pumps 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 high-efficiency pump benefits among contractors and customers
Record 0 to 10 score
f. Reduced pump 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 pumps 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 pumps?

RECORD ANSWER HERE:

A4aa. Using a 0 to 10 scale, how important was this factor's influence on your pump 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 program-qualifying pumps to PG&E's 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 PG&E's contractors and customers purchase program-qualifying pumps 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 **pump** make/model to PG&E's contractors and customers?

#	Record 0 to 10 score	A7

A7 Approximately, in what percent of sales situations did you recommend this high-efficiency **pump** MEASURE before you learned about the **Commercial Deemed Incentive Program**?

- Record share in %

A8 And approximately in what percent of sales situations do you recommend this **high-efficiency pump** MEASURE now that you have worked with the **Commercial Deemed Incentive Program**?

- Record share in %

A9 And what role, if any, has the PG&E's **Commercial Deemed Incentive Program** played in increasing your recommendations of **high-efficiency pumps** since you began working with the **Commercial Deemed Incentive Program**?

RECORD ANSWER HERE:

A10 Approximately, what percentage of your pump sales over the last 12 months in **PG&E's** service territory are energy efficient models that qualify for incentives from the program?

- Record share in %

A11 On a 0 to 100 percent scale, in what percent of sales situations do you encourage your contractors and customers in **PG&E's** territory to purchase program-qualifying **water pumps**?

- Record share in %

IF A11 < 100,

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

RECORD ANSWER HERE:

A12 Of those installations of **pumps** in **PG&E'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 **pumps** 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 high-efficiency pumps 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 **high-efficiency pumps** are represented by these areas where incentives are not offered?

- Record share in %

IF A15 > 10% & A15 < 100%,

A15a And approximately what percentage of your sales of **pumps** in these areas are the energy efficient models that would qualify for incentives in **PG&E's** service territory?

RECORD ANSWER HERE:

A16 Have you changed your stocking practices as a result of **PG&E's** Program?

1	Yes	A16a
2	No	A17

A16a How so?

RECORD ANSWER HERE:

IF A14=1 (or Yes)

A17 Do you promote energy efficient **pumps** 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

C-2 Gas Fryers

Vendor NTG Survey Instrument – Gas Fryers

IMPORTANT: The focus of this survey is on your business' sales and promotional practices of gas fryers during 2020 and thereafter. We acknowledge that the COVID-19 pandemic has substantially hit the food service industry. This survey is designed to collect perspectives on typical business practices absent extenuating circumstances from the pandemic. With that, we ask that your responses represent typical businesses practices that ignore anomalous sales trends due to COVID-19 effects.

Number	Questions	Responses	Additional Notes
1 -	DNV is conducting this interview on behalf of the CPUC (California Public Utilities Commission) regarding your firm's involvement with the sales and/or installations of high-efficiency gas fryers through SCG's Food Service Point-of-Sale Instant Rebate Program between January 1, 2020 and December 31, 2020. Our records indicate that you are the person most knowledgeable about this. Is this correct?		

If Yes, please move to Q3
If No, please move to Q2

2 -	Who would be the person most knowledgeable about your firm's involvement with SCG's Food Service Point-of-Sale Instant Rebate Program during 2020? Please either forward this sheet to them or include their name and contact information in the answer cell.		

3 -	SCG has indicated that your firm is an approved distributor supporting the Food Service Point-of-Sale Instant Rebate Program and was involved in selling and/or installing energy-efficient gas fryers throughout their service territory during 2020. Is this correct?		

If Yes, please move to Q4
If No, please respond to the email sent to you indicating you are not an approved distributor supporting the Food Service Point-of-Sale Rebate Program, thank you!

4 -	Great, we are trying to understand the gas fryer market in general. This includes standard and energy efficient models. Can you please give us a quick overview of the types of fryers that you stock for Commercial customers?		

5 -	According to SCG, your firm promotes and sells program-qualifying gas fryers through SCG's Food Service Point-of-Sale Instant Rebate Program. Is that correct?		

If Yes, please move to Q6

If No, please move to Q17

6 -	Please indicate which one of the following strategies you might have used to sell program-qualified fryers (you may select more than one):

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:		

Program vs. Non-Program Factors
The next section is going to ask you to rate the importance of the various SCG's PROGRAM and NON-PROGRAM factors in influencing your decision to recommend high-efficiency fryers 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.

7 -	Using this 0-to-10 scale, please rate the following in terms of their importance in your **decision to recommend** program-qualifying fryers to contractors and your other customers

Program rebate		
Program promotional materials		
Program-provided training of sales staff		
Information from the program implementer or utility website		
Increased awareness of high-efficiency fryer benefits among contractors and customers		
Reduced fryer prices from Manufacturers		
Availability of manufacturers' promotional rebates/spiffs		
Information about the cost-effectiveness of more efficient units		
Increased stocking of high-efficiency fryers		
Past participation in SCG rebate or audit program		

8 -	Was there another way the Food Service Point-of-Sale Instant Rebate Program influenced your recommendations regarding your promotion of program-qualified fryers?		
	Please describe the other program influences >>>		

If Yes, please move to Q9
If No, please move to next section

9 -	Using a 0 to 10 scale, how important was this factor's influence on your fryer recommendations?		

Program Influence The next section is going to ask you to rate the importance of the Food Service Point-of-Sale Instant Rebate Program in general in influencing your decision to recommend program-qualifying fryers to SCG's contractors and customers.

10 -	Using this 0 to 10 scale where 0 is NOT AT ALL IMPORTANT and 10 is EXTREMELY IMPORTANT, how important was the Food Service Point-of-Sale Instant Rebate Program, including rebates as well as program services and information, in influencing your decision to recommend that SCG's contractors and customers purchase program-qualifying fryers in 2020?		

The next question 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:

a. Program rebate
b. Program promotional materials
c. Program-provided training of sales staff
d. Information from **utility** website

NON-PROGRAM factors include:

e. Increased awareness of high-efficiency fryer benefits among contractors and customers
f. Reduced fryer prices from Manufacturers
g. Availability of manufacturers' promotional rebates/spiffs
h. Past participation in SCG rebate or audit program

11 -	If you were given 10 points to award in total, how many points would you assign 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? **The sum must equal 10.**

Program Factors		
Non-Program Factors		

12 -	And using a 0-to-10 likelihood scale where 0 is NOT AT ALL LIKELY and 10 is EXTREMELY LIKELY, if the Food Service Point-of-Sale Instant Rebate Program, including rebates as well as program services and information, had not been available, what is the likelihood that you would have recommended **the specific rebated fryer** makes/models to SCG's contractors and customers?		

13 -	Approximately, in what percent of sales situations did you recommend **high-efficiency fryers** before you learned about the Food Service Point-of-Sale Instant Rebate Program?		

14 -	And approximately in what percent of sales situations do you recommend **high-efficiency fryers** now that you have worked with the Food Service Point-of-Sale Instant Rebate Program?		

15 -	And what role, if any, has the SCG's Food Service Point-of-Sale Instant Rebate Program played in increasing your recommendations of **high-efficiency fryers** since you began working with the program?		

16 -	Approximately, what percentage of your fryer sales over the last 12 months in SCG's service territory are energy efficient models that qualify for rebates from the program?		

17 -	On a 0 to 100 percent scale, in what percent of sales situations do you encourage your contractors and customers in SCG's territory to purchase program-qualifying fryers?		

If less than 100%, please move to Q18
If equal to 100%, please move to Q19

18 -	In what situations do you NOT encourage your contractors and customers to purchase energy efficient fryers if they qualify for a rebate? Why is that?		

19 -	Of those installations of fryers in SCG's service territory that qualify for incentives, approximately what percentage **do not** receive the rebate?		

If greater than 0%, please move to Q20
If equal to 0%, please move to Q21

20 -	Why do you think they do not receive the rebate?		

21 -	Do you also sell fryers in areas where contractors and other customers do not have access to rebates for energy efficient models?		

If Yes, please move to Q22
If No, please move to Q25

22 -	What role, if any, have the California utilities' rebate programs played in your decision to promote and sell high-efficiency fryers in areas where contractors/customers **do not have access** to incentives for energy efficient models?		

23 -	About what percent of your sales of high-efficiency fryers are represented by these areas where incentives are not offered?		

If greater than 10% and less than 100%, please move to Q24
If less than or equal to 10% or equal to 100%, please move to Q25

24 -	And approximately what percentage of your sales of fryers in these areas are the energy efficient models that would qualify for incentives in SCG's service territory?		

25 -	Have you changed your stocking practices as a result of the SCG's Program?		

If yes, please move to Q26
If no, please move to Q27

26 -	How so?		

27 -	Do you promote energy efficient fryers equally in areas with and without incentives?		

28 -	For the Food Service Point-of-Sale Instant Rebate 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?		

____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:

- Agricultural Pumping Variable Speed Drives (VFDs)
- Clean Water Pump Upgrades
- Gas Fryers

D-1 AGRICULTURAL PUMPING VARIABLE SPEED DRIVES (VFDS)

PY20 PUMP AND FOOD SERVICE FINAL IMPACT REPORT

Project Information		
IOU		
DMID		
FarmID		
ApplicationCode or ProjectID		
Program ID		
Program Name		
Point of Sale Purchase?		NA
IOU Claim ID(s)	Measure 1:	
	Measure 2:	
IOU Measure Description	Measure 1:	
	Measure 2:	
Number of Units Installed	Measure 1:	
	Measure 2:	
Project Application Date		
Project Installation Date		
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		
Date of First On-Site Visit		
All Participating Sites for Same Decision Maker		
Sum of Tracking System Records		
Sum of FarmIDs		
Appended List of Cities		
Appended List of Addresses		
Utility Meter Information		
Account Number from Tracking Data	Measure 1:	
Dedicated Electric Meter for Pump Measure 1 Y/N		
Associated Electric Meter Number for Measure 1		
Account Number from Tracking Data	Measure 2:	
Dedicated Electric Meter for Pump Measure 2 Y/N		
Associated Electric Meter Number for Measure 2		

On-Site Recruitment Checklist

Application # ______________________________

Meeting	
Location of Meeting or Phone Number	
Directions to Meeting Spot or Teams Meeting Join Information	
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)	
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 the drought	
Describe how farm operations and irrigation in particular has been affected by COVID	
Are farm operations and irrigation in particular during the year leading up to today representative of expected ongoing operations?	
If different then describe why irrigation is not representative, how irrigation is different in terms of pump operations and use of the pumps for measure #1 and 2, and availability of district versus well water or other factors	
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]

[Answer for Measure #1]		**[Answer for Measure #2]**	
[Circle One Entry]	How would you describe the condition of the pump being controlled by the VFD? Would you say it is in…	**[Circle One Entry]**	How would you describe the condition of the pump being controlled by the VFD? Would you say it is in…
9	Poor condition	**9**	Poor condition
10	Fair condition	**10**	Fair condition
11	Good condition	**11**	Good condition
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

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

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

[Answer for Measure #1]		**[Answer for Measure #2]**	
[Circle One Entry]	How many years are left in the pump itself until you will replace it?	**[Circle One Entry]**	How many years are left in the pump itself until you will replace it?
12	Remaining pump life _______ years	**12**	Remaining pump life _______ years
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

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

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]

[Answer for Measure #1]		**[Answer for Measure #2]**	
[Circle One Entry]	What type of pump flow controls were in place BEFORE the VFD was installed?	**[Circle One Entry]**	What type of pump flow controls were in place BEFORE the VFD was installed?
13	None; pump was uncontrolled	**13**	None; pump was uncontrolled
14	Throttle valve controls	**14**	Throttle valve controls
15	VFD controls	**15**	VFD controls
16	Other / Provide Related Commentary Below:	**16**	Other / Provide Related Commentary Below:
88	Refused	**88**	Refused
99	Don’t know	**99**	Don’t know

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

[Ask for any new VFD added to an existing pump; ANSWER #3 ABOVE]

[Answer for Measure #1]		**[Answer for Measure #2]**	
(Circle One Entry)	Approximately how old were the replaced pump flow controls? Would you say...	**(Circle One Entry)**	Approximately how old were the replaced pump flow controls? Would you say...
17	Less than 5 years old	**17**	Less than 5 years old
18	Between 5 and 10 years old	**18**	Between 5 and 10 years old
19	Between 10 and 15 years old	**19**	Between 10 and 15 years old
20	More than 15 years old	**20**	More than 15 years old
21	Stated age _______ years	**21**	Stated age _______ years
88	Refused	**88**	Refused
99	Don't know	**99**	Don't know

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

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]

[Circle One Entry]	[Answer for Measure #1] What was the main reason you decided to control your pump flow using a VFD?	[Circle One Entry]	[Answer for Measure #2] What was the main reason you decided to control your pump flow using a VFD?
26	Existing controls were not functioning adequately	**26**	Existing controls were not functioning adequately
27	Using alternative controls was not a feasible solution (such as throttling or running an uncontrolled pump)	**27**	Using alternative controls such as throttling or running an uncontrolled pump was not a feasible solution
28	The pump and VFD were sold as an integrated unit	**28**	The pump and VFD were sold as an integrated unit
29	Wanted improved pump performance or functionality	**29**	Wanted improved pump performance or functionality
30	Wanted remote monitoring and control capability	**29**	Wanted improved pump performance or functionality
31	Wanted automatic speed controls	**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?
42	Vertical turbine pump	**42**	Vertical turbine pump
43	Submiersible pump	**43**	Submiersible pump
44	Centrifugal pump	**44**	Centrifugal pump
45	Other / Provide Related Commentary Below:	**45**	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...
46	Less than 25 hp	**46**	Less than 25 hp
47	Between 25 and 50 hp	**47**	Between 25 and 50 hp
48	Between 50 and 100 hp	**48**	Between 50 and 100 hp
49	Between 100 and 200 hp	**49**	Between 100 and 200 hp
50	Between 200 and 300 hp	**50**	Between 200 and 300 hp
51	More than 300 hp	**51**	More than 300 hp
52	Rated capacity _______ hp	**52**	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 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]

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

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

(Circle One Entry)	Which of the following alternatives would you have been MOST likely to do if the program had not been available?	**(Circle One Entry)**	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] ===>

[Ask IF additional farms associated with decision maker]
[Answer for all measures]

In addition to the VFD installation(s) we described earlier, according to our records your business installed additional VFDs in 2020 through <%Utility>'s energy efficiency programs.

[Circle One Entry]	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
2	No
77	Something else _____ (Specify below)
88	Refused
99	Don't know

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

2021 Pumping System Operation by Measure

Measure # ___________________________

Application # ___________________________

Month of 2021	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

Measure # ___________________________

Application # ___________________________

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 # ___________________________

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]

2021 Pumping System Operation by Measure (part 2) (page 1 of 2)

Measure # ___________________________

Application # ___________________________

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]

2021 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 From 4 PM until 9 PM
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 # ___________________________

[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 # ___________________________

[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-2 Clean Water Pump Upgrades

Category heading
Input
Auto-Populated
CRITICAL

Measure Data

Tracking Order#	Measure Description	Pump (hp)
1	-	-
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	-	-
9	-	-
10	-	-
11	-	-
12	-	-

General Info

DNV ID	
Visit Date & Time	
Field Engineer	
PGE Site ID	
Facility/Customer Name	
Street Address	
City	
Building Type	
Contact Name	
Phone Number	
Alternative Phone and Email	
Project Installation Date	

Category		Dialogue	Response	Additional notes	
Introduction		Hello, my name is ____________________ and I'm calling from DNV on behalf of PG&E.			
		My company is contracted by the California Public Utilities Commission to analyze the energy savings associated with clean water pump upgrade projects funded by PG&E's rebate programs. The [Project Name] project for [Owner/Facility Name] is one of the projects that has been selected for this evaluation and we would greatly appreciate your participation in this important study. We are offering a $25 Amazon gift card as a thank-you for participating. Can you spare 15 minutes to answer a few questions about the clean water pump upgrade that occurred at [Address] in 2020?			
		[If yes] Our records indicate that your organization installed [describe quantity and size of high efficiency clean water pumps] through the program on [Install Date]. Does this sound familiar? [If yes] record name and title of respondent and proceed to the "**project characteristics**" section. [If no] Is there someone I can talk to who might be more familiar with this particular project? [Record contact information and retry].		[Obtain name, title, email address, phone number]	
		[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 and/or email]	
Project Characteristics		*First, I'd like to get a few basic details about the project.*			
		Our records show that the project occured at [Enter address]. Is this correct? [If no] Ask for the installed address.		[record yes or no. If no, record address]	CRITICAL
		We see from our records that the pump upgrade project occured in [Month/Year]. Is this correct? [If no] when did the pump upgrade project occur? [month/year]		[record yes or no. If no, record date]	CRITICAL
		Would you classify the building as a [Building Type]?		[Select from the dropdown]	CRITICAL
		How many pumps were installed/upgraded?		[record quantity]	CRITICAL
Facility Operation		*Ok. Next, I'll ask a few questions about your facility's operation schedule*			
		What is your facility's typical hours of operation?		[record days/weeks/months]	
		Is there any seasonality associated with the building operations that could impact on the energy bills? [if yes] please explain.		[record seasonalities if any]	
		Does the facility operate on holidays? Indicate holidays and/or shutdown with no operation.		[record number of holidays/shutdowns]	

Installed System Details

Next, I'd like to get some information on the type of irrigation system you installed.

As part of our energy study, we are hoping to gather information about the installed pumps. Our original plan for the evaluation was to conduct a site visit to the facility to confirm measure installation and to collect pump operational data for estimating electric 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.
(Methods: 1) video conference, or 2) photos of pumps/nameplates, 3) over the phone have the contact read out pump make/model number and nameplate 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

Explain the study objectives to site contact and ask them how they'd like to share the pump nameplate information.
If there are more than three pumps installed on site, visually inspect/gather nameplate pictures for at least 3 pumps (select the 3 biggest pumps), and gather the make and model information of the remaining pumps.

CRITICAL

	Tracking Data		*Request nameplate pictures for first 3 pumps and request make/model information for all installed pumps*				*Update based on verified nameplate*			Site Interview		[record any additional notes here]
Pump #	**Measure Description**	**Size (hp)**	**Pump Make/Model**	**Quantity**	**Pump Type**	**Pump Controls Strategy**	**Size (hp)**	**Pump Nominal Speed**	**Pump PEI**	**Pump End Use**	**Pump Run Hours/Week**	**Note**
1	#N/A	#N/A										
2	#N/A	#N/A										
3	#N/A	#N/A										
4	#N/A	#N/A										
5	#N/A	#N/A										
9	#N/A	#N/A										
7	#N/A	#N/A										
8	#N/A	#N/A										
9	#N/A	#N/A										
10	#N/A	#N/A										
11	#N/A	#N/A										
12	#N/A	#N/A										
	Total	**#N/A**		**0**			**0**					

Category		Dialogue	Response	Additional notes	
Pre-project Details		*Ok great. The next questions are about the pump system that was in place before.*			
		How many preexisting pumps were replaced/upgraded?		[record quantity]	CRITICAL
		Were the preexisting old pump(s) same size as the new ones?		[select from the dropdown]	
		How were the preexisting pumps controlled?		[select from the dropdown]	CRITICAL
		Can you confirm that all preexisting pump(s) were powered by electricity?		[select from the dropdown]	
		About how old were the preexisting pumps?		[record age in years]	
		What condition were the preexisiting pumps in?		[Select from the dropdown]	
		How much longer do you think the preexisting pumps would have lasted if you had not replaced it?		[record RUL estimate in years]	
AMI Meter Details		*Ok great. The next questions are about the PG&E electric meters on the installed pumps.*			
		What other major electric end-uses are connected to the same meter as the pump(s)?		[record equipment connected to meter]	
		Can you estimate the total load (kW or hp) of the major equipment connected to the same electric meter as the pump(s)? Enter in terms of kW or hp		[record additional equipment load]	
		Do you have pump trend data (run hours/cumulative kWh/volume of water pumped) that you can share with us? [If yes] ask for electronic copies.		[record yes or no]	
Effects of COVID		How has COVID impacted the hours of operation at your facility?		[record response]	
		How has COVID impacted the operation of the installed pumps?		[record response]	
Decision Make Contact Information		*The next questions are about the decision maker at your facility.*			
		Are you familiar with and could you speak to the decision to install this equipment?		[record yes or no]	CRITICAL
		[If no] Who could I speak to that would be familiar with this decision? (collect information) [If yes] Do you have 10 additional minutes to answer some additional questions about the decision making process? [If yes] continue to NTG survey, [if no] ask for their availability for the net survey phone call.		[record decision maker contact info]	CRITICAL

Conclusion		Thank you for your time in helping to improve PG&E's programs.		
		We appreciate your time and would like to compensate you for your participation with either an Amazon gift card (if acceptable) or a donation made in your name. Can you please select from one of the following options: Amazon gift card, donation to CA United Ways?		[select delivery option]
		Great! Again, thank you for taking time to answer my questions. [if Gift Card] Could you please provide us the best email address to deliver the gift card? You should expect to see that in your inbox in the coming weeks. If there are no further questions I will let you go about your day. Thanks again!		[record name and email]

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 Yeshi Lemma, and she can be reached at yeshi.lemma@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-3 Gas Fryer

Gas Fryer Data Collection Form

Glossary

Page 1 - Glossary

Page 2 - Facility & Project Characteristics

1. Facility busines type
2. Food service type
3. Confirm installed quantity
4. Facility gas meter reading

Page 3 - Facility Operation

1. Gather information on general fryer use (hours/day & days/week)
2. Simultaneous fryer operation question
3. Seasonality
4. Holidays observed by facility

Page 4 - Fryer Inventory

1. Gather general information on all project installed fryers

Page 5 - Installed Fryer Details (sample) - "Metering Sample"

1. Gather fryer specific data for sampled fryers
2. Number of preheats per day
3. Time from idle to cookng temperature
4. Weekly schedule

Page 6 - Logger Details

1. Record information on logger used. (model, ID No., location, date & time deployed)

Page 7 - Equipment Life Questionnaire

1. Questions on the pre-existing fryer's age, condition, fuel type, etc.

Page 8 - Additional Notes

Facility & Project Characteristics

	What is the main business ACTIVITY at this facility?
☐	Offices (non-medical)
☐	Restaurant/Food Service
☐	Food Store (grocery/liquor/convenience)
☐	Agricultural (farms, greenhouses)
☐	Retail Stores
☐	Warehouse
☐	Health Care
☐	Education
☐	Lodging (hotel/rooms)
☐	Public Assembly (church, fitness, theatre, library, museum, convention)
☐	Services (hair, nail, massage, spa, gas, repair)
☐	Industrial (food processing plant, manufacturing)
☐	Laundry (Coin Operated, Commercial Laundry Facility, Dry Cleaner)
☐	Condo Assoc./Apartment Mgr (Garden Style, Mobile Home Park, High-rise, Townhouse)
☐	Public Service (fire/police/postal/military)
☐	Other / Record Business Activity [ENTER BELOW]

	Which of the following types of restaurants or food service best describes this facility?
☐	Fast Food or Self Service
☐	Specialty/Novelty Food Service
☐	Table Service
☐	Bar/Tavern/Nightclub/Brew Pub or Microbrewery/Other entertainment
☐	Caterer
☐	Cafeteria
☐	Other / Record Food Service [ENTER BELOW]

How many gas fryers were installed/upgraded?		[record quantity]

Gas Meter Reading	Record Meter Reading
Spot read gas meter (1st visit, logger deployment)	
Spot read gas meter (2nd visit, pickup loggers)	

Facility Operation

How many hours per day do the gas fryers operate?		[record hours per day]
How many days per week are the gas fryers used?		[record days per week]
[If there are more than one upgraded gas fryer] **Are all the gas fryers in operation at the same time typically? [if no] How many gas fryers are typically operating at the same time?**		[record yes or no. if no, record number]
Are there any seasonal differences in gas fryer operation, or routine shutdowns/closures?		[record yes or no. if yes, add notes]
During what holidays is the facility closed?		

- ☐ New Year's Eve
- ☐ New Year's Day
- ☐ Martin Luther King Day
- ☐ Presidents' Day
- ☐ St. Patrick's Day
- ☐ Easter Sunday
- ☐ Memorial Day
- ☐ Flag Day
- ☐ July 4th
- ☐ Labor Day
- ☐ Columbus Day
- ☐ Veteran's Day
- ☐ Thanksgiving
- ☐ Thanksgiving Friday
- ☐ Christmas Eve
- ☐ Christmas Day
- ☐ Other [ENTER BELOW]

Inventory of Installed Fryers

Record all fryers that were installed as part of the program.

Fryer #	Fryer Make/Model	Qty [Installed and Operable]	Vats per Fryer	Vat Width (in)	Input Rating (Btu/hour)	Year of Mfr.	Notes
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

16							
17							
18							
19							
20							
Total		0					

Installed Fryer Details (sample)			
Gather the following information from the fryer nameplate, discussions with site contact, or lookup based on fryer model number.			
General Information	**Fryer #1**	**Fryer #2**	**Fryer #3**
Manufacturer			
Model			
Input Rating			
Input (Units) [btu/hr or kBtu/hr or Mbtu/hr]			
Number of Vats per Fryer Unit			
Vat width (inch)			
Year of Manufacture			
On Average how many times per day is the gas fryer vat pre-heated following a period where it is off?			
Approximately how long does it normally take to pre-heat the gas fryer vat?			
Minimum Temperature during Idle			
Cooking Temperature setting			
How long does it take to reach cooking temp from idle temp			
Fryer Schedule	**Fryer #1**	**Fryer #2**	**Fryer #3**
How many hours per day are the gas fryers operate?			
How many days per week are the gas fryers used? [Record each day of week the fryer unit would typically operate]			
Mon			
Tue			
Wed			
Thur			
Fri			
Sat			
Sun			

Data Logger Details	Fryer #1	Fryer #2	Fryer #3
Logger Model			
Logger ID			
Logger Installation Date			
Logger Installation Time (military)			
Target Logger removal date (7 to 10 days)			
Logger data extraction date completed			
Spot reading flue gas temp			
Logger Location Details			

RUL & EUL	Fryer #1	Fryer #2	Fryer #3
Remaining Useful Life (RUL) & Effective Useful Life (EUL)			
Did the new gas fryer replace an existing fryer?	Replaced existing fryer Added the new gas fryer New construction Refused Don't know	Replaced existing fryer Added the new gas fryer New construction Refused Don't know	Replaced existing fryer Added the new gas fryer New construction Refused Don't know
Was the replaced fryer a gas or electric fryer?	Existing gas fryer Existing electric fryer Refused Don't know	Existing gas fryer Existing electric fryer Refused Don't know	Existing gas fryer Existing electric fryer Refused Don't know
Approximately how old was the fryer that was removed and replaced? Would you say…	0-5 years 5-10 years 10-15 years 15+ years Refused Don't know	0-5 years 5-10 years 10-15 years 15+ years Refused Don't know	0-5 years 5-10 years 10-15 years 15+ years Refused Don't know
How would you describe the removed fryer's condition? Would you say it was in…	Poor condition Fair condition Good condition Refused Don't know	Poor condition Fair condition Good condition Refused Don't know	Poor condition Fair condition Good condition Refused Don't know
What was the main reason you replaced the existing fryer	Equipment was not functioning adequately Purchased as part of a general facility renovation Wanted improved performance or functionality Other / Provide Related Commentary Below: Refused Don't know	Equipment was not functioning adequately Purchased as part of a general facility renovation Wanted improved performance or functionality Other / Provide Related Commentary Below: Refused Don't know	Equipment was not functioning adequately Purchased as part of a general facility renovation Wanted improved performance or functionality Other / Provide Related Commentary Below: Refused Don't know

Other Notes

APPENDIX E:

MEASURE NAME MAPPING

PA	Measure Group	Measure Name	Evaluated Measure
PGE	PROCESS PUMPING VFD	VARIABLE FREQUENCY DRIVE ON AGRICULTURAL WELL PUMPS (<=300HP)	Agricultural Pumping VFD
PGE	PROCESS PUMPING VFD	VARIABLE FREQUENCY DRIVE ON AG WELL PUMPS >75HP TO <=300HP (TIER 1)	Agricultural Pumping VFD
PGE	PROCESS PUMPING VFD	TIER 2 MID-TIER SPECIFICATION VFD ON AG BOOSTER PUMPS <=75HP	Agricultural Pumping VFD
PGE	PROCESS PUMPING VFD	VARIABLE FREQUENCY DRIVE ON AGRICULTURAL BOOSTER PUMPS (<=150HP)	Agricultural Pumping VFD
PGE	PROCESS PUMPING VFD	VARIABLE FREQUENCY DRIVE ON AG BOOSTER PUMPS >75HP TO <=150HP (TIER 1)	Agricultural Pumping VFD
PGE	PROCESS PUMPING VFD	TIER 3 ENHANCED SPECIFICATION VFD ON AG WELL PUMPS >75HP TO <=600HP	Agricultural Pumping VFD
PGE	PROCESS PUMPING VFD	TIER 3 ENHANCED SPECIFICATION VFD ON AG BOOSTER PUMPS >75HP TO <=150HP	Agricultural Pumping VFD
PGE	PROCESS PUMPING VFD	TIER 3 ENHANCED SPECIFICATION VFD ON AG BOOSTER PUMPS <=75HP	Agricultural Pumping VFD
SCE	PROCESS PUMPING VFD	EFFICIENT VFD AG PUMPS WELL NC	Agricultural Pumping VFD
SCE	PROCESS PUMPING VFD	EFFICIENT VFD AG PUMPS BOOSTER NC	Agricultural Pumping VFD
SCE	PROCESS PUMPING VFD	EFFICIENT VFD AG PUMPS WELL AOE	Agricultural Pumping VFD
SCE	PROCESS PUMPING VFD	EFFICIENT VFD AG PUMPS BOOSTER AOE	Agricultural Pumping VFD
PGE	PROCESS PUMPING HIGH EFFICIENCY	AG, CL TO CL, LT 0.96 PEI, GTE 3HP, LTE 50HP	Clean Water Pump Upgrades
PGE	PROCESS PUMPING HIGH EFFICIENCY	CLEAN WATER PUMP, HIGH PEI, AG, CONSTANT, 50 < HP <= 200	Clean Water Pump Upgrades
PGE	PROCESS PUMPING VFD	AG, VL TO VL, LT 0.46 PEI, GTE 3HP, LTE 50HP	Clean Water Pump Upgrades
PGE	PROCESS PUMPING VFD	CLEAN WATER PUMP, HIGH PEI, IND, VARIABLE, 50 < HP <= 200	Clean Water Pump Upgrades
PGE	FOOD SERVICE	COMMERCIAL FRYER (GAS)	Gas Fryers
SCG	FOOD SERVICE	COMMERCIAL FRYER, GAS, TIER 1	Gas Fryers
SDGE	FOOD SERVICE	FOOD SERVICE - COMMERCIAL GAS FRYER (SWFS011B)	Gas Fryers

APPENDIX F:

RESPONSE TO COMMENTS

<table>
<tr><th>Comment #</th><th>PA</th><th>Location</th><th>Page</th><th>Topic</th><th>Question/Comment</th><th>Evaluator Response</th></tr>
<tr><td>SCE-1</td><td>SCE</td><td>Overall</td><td></td><td>Overall</td><td>SCE notes that the implementation of the PY 2020 program varied considerably by PA and may not present actionable results or conclusions across the board.</td><td>Evaluators agree with SCE. Care must be taken in interpreting the meaning of results throughout the report, as program delivery approach differs acrpss PAs for a particular measure. Additionally, interpretation of results should also include an assessment of sample size, and an array of other potentially influential factors that might steer results or their relevance to a particular program or PA.</td></tr>
<tr><td>SCE-2</td><td>SCE</td><td>Overall</td><td></td><td>Overall - Contact Info</td><td>SCE agrees that adequate customer contact information and project eligibility are crucial for program performance and EM&V efforts and will continue to improve the collection of this data to facilitate program performance and robust EM&V. SCE agrees that workpapers need to reflect the most recent EM&V results and will strive to meet these requirements.</td><td>We appreciate those efforts to make improvements.</td></tr>
<tr><td>SCE-3</td><td>SCE</td><td>Section 7 - Gross</td><td></td><td>Gross</td><td>SCE recommends that the program savings should be allocated by PA or services territory. The implementation of the programs in 2020 varied considerably by PA and may not present actionable results or conclusions. Additionally, the data pool per PA may need to be expanded to ensure that sufficient data is collected to support the analysis and draw conclusions.

<table>
<tr><th rowspan="2">Measure Results</th><th colspan="4">First-Year Gross MWh Savings</th><th colspan="4">First-Year Gross MW Savings</th></tr>
<tr><th>Ex Ante Savings</th><th>Ex Post Savings</th><th>GRR</th><th>RP</th><th>Ex Ante Savings</th><th>Ex Post Savings</th><th>GRR</th><th>RP</th></tr>
<tr><td>Agricultural Pump VFDs</td><td>9,589</td><td>5,454</td><td>0.57</td><td>23%</td><td>4.58</td><td>0.80</td><td>0.17</td><td>22%</td></tr>
<tr><td>Clean Water Pumps</td><td>2,294</td><td>435</td><td>0.19</td><td>43%</td><td>0</td><td>0</td><td>NA</td><td>NA</td></tr>
</table></td><td>The savings presented in Section 7 are aggregate cross-PA results for each measure. Where relevant/applicable, PA-specific results are presented in Section 5 and Appendix AA. However, for the two electric measures included in-scope, SCE had just a single clean water pump installation in PY2020, so ex ante savings estimates for that one claim are passed through (essentially a realization rate of 1.0 is applied). For the agricultural pump VFD measure there was an adequate number of sample points by PA to develop separate results for SCE and PG&E, as reflected in Section 5 and Appendix AA.

Evaluators planned for larger sample sizes than achieved for the clean water pump measure, and would hope that future evaluations will be more successful in achieving the targeted number of completes.</td></tr>
<tr><td>SCE-4</td><td>SCE</td><td>Section 7 - Gross</td><td></td><td>Gross</td><td>SCE requests that these results be broken down by PA when possible.

<table>
<tr><th rowspan="2">Measure Results</th><th colspan="4">Lifecycle Gross MWh Savings</th><th colspan="4">Lifecycle Gross MW Savings</th></tr>
<tr><th>Ex Ante Savings</th><th>Ex Post Savings</th><th>GRR</th><th>RP</th><th>Ex Ante Savings</th><th>Ex Post Savings</th><th>GRR</th><th>RP</th></tr>
<tr><td>Agricultural Pump VFDs</td><td>84,493</td><td>58,740</td><td>0.7</td><td>24%</td><td>40.37</td><td>8.93</td><td>0.22</td><td>26%</td></tr>
<tr><td>Clean Water Pump Upgrades</td><td>34,410</td><td>6,525</td><td>0.19</td><td>43%</td><td>0</td><td>0</td><td>N/A</td><td>N/A</td></tr>
</table></td><td>Refer to response above.</td></tr>
<tr><td>SCE-5</td><td>SCE</td><td>Section 5 - Gross</td><td></td><td>Gross</td><td>SCE notes that these helpful criteria above may depend on the timeline of the evaluation. For example, use of these pumps could change from year to year resulting in changing run times.

SCE also notes that some of these factors also depend on the crop mix.

<table>
<tr><th rowspan="2">Strata</th><th rowspan="2">First-Year Gross Impact Realization Rate</th><th>Pump Run Hours >1500</th><th>Pump Run Hours < 500</th><th>Pump Speed Typically 90-100%</th><th>Pump Speed is Relatively Low</th><th>Farmer Prefers Using District Water</th><th>Farmer Also Irrigates with a Different Pump</th><th>Pump Peak Coinc. Factor < 50%</th><th>Pump Type is Incorrect</th><th>Applied Mean Modeled Result from Sample</th><th>Applied Result from Other Point at Same Farm</th><th>Other</th></tr>
<tr><th>Up</th><th>Dn</th><th>Dn</th><th>Up</th><th>Dn</th><th>Dn</th><th>Dn</th><th>-</th><th>-</th><th>-</th><th>-</th></tr>
<tr><td>PGE Well (n=20)</td><td>0.32</td><td>8</td><td>1</td><td>7</td><td>0</td><td>1</td><td>6</td><td>12</td><td>2</td><td>4</td><td>0</td><td>7</td></tr>
<tr><td>PGE Booster (n=12)</td><td>0.98</td><td>3</td><td>0</td><td>0</td><td>2</td><td>0</td><td>8</td><td>3</td><td>5</td><td>2</td><td>2</td><td>0</td></tr>
<tr><td>SCE Well (n=12)</td><td>0.49</td><td>7</td><td>0</td><td>5</td><td>2</td><td>1</td><td>3</td><td>8</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>SCE Booster (n=13)</td><td>1.36</td><td>3</td><td>1</td><td>1</td><td>2</td><td>0</td><td>5</td><td>3</td><td>4</td><td>5</td><td>0</td><td>3</td></tr>
<tr><td>Total</td><td></td><td>21</td><td>2</td><td>13</td><td>6</td><td>2</td><td>22</td><td>26</td><td>11</td><td>11</td><td>2</td><td>11</td></tr>
</table></td><td>Evaluators agree with SCE. The gross impact results for the agricultural pump VFD measure were driven to a large extent based upon observed post-installation pump operation, as expressed in interval AMI data for all pumps modeled. These loads are driven by factors that inlcude orchard age, the annual crop planted and, importantly, the drought. Regarding the drought, we found that some pumps operated more hours than usual, while other ran fewer hours. Also, for VFDs the pump speeed may vary due to current conditions, and that might change over time due to farmer preferences and other factors that are difficult to quantify.

This above set of facts also highlights the reason evaluators chose to evaluate the as-found condition, and did not attempt to analyze results that are normalized for typical conditions. Furthermore, CPUC policy tends to favor analysis of as-found conditions, consistent with our evaluation approach. Forecasting conditions is not generally encouraged without adequate justification.</td></tr>
</table>

<table>
<tr><th>Comment #</th><th>PA</th><th>Location</th><th>Page</th><th>Topic</th><th>Question/Comment</th><th>Evaluator Response</th></tr>
<tr><td>SCE-6</td><td>SCE</td><td>Section 5 - Gross</td><td></td><td>Gross</td><td>If possible, can this be broken down by PA?
<table>
<tr><th></th><th colspan="2">Negative</th><th colspan="2">Positive</th></tr>
<tr><th>Discrepancy Category</th><th>Frequency</th><th>RR Impact</th><th>RR Impact</th><th>Frequency</th></tr>
<tr><td>Differences in PEI ratings</td><td>399</td><td>-74%</td><td>5%</td><td>141</td></tr>
<tr><td>Pumps not installed</td><td>4</td><td>-12%</td><td>0%</td><td>0</td></tr>
<tr><td>Difference in installed pump size</td><td>5</td><td>-4%</td><td>0%</td><td>2</td></tr>
<tr><td>Difference in annual operating hours</td><td>0</td><td>0%</td><td>3%</td><td>6</td></tr>
<tr><td>Difference in pump load factor</td><td>9</td><td>0%</td><td>0%</td><td>5</td></tr>
<tr><td>Claimed savings do not match workpaper</td><td>0</td><td>0%</td><td>0%</td><td>1</td></tr>
<tr><td>Residual</td><td>5</td><td>0%</td><td>0%</td><td>5</td></tr>
<tr><td>Total</td><td>422</td><td>-90%</td><td>8%</td><td>160</td></tr>
</table></td><td>The sample-based results shown reflect PG&E alone.

The one SCE project was not sampled, and there were no SDG&E participants in PY2020.</td></tr>
<tr><td>SCE-7</td><td>SCE</td><td>Section 5 - Gross</td><td></td><td>Gross</td><td>SCE understands that some PAs are working with the CPUC to change the method to estimate energy savings including basing them on currently available pump databases from the Hydraulic Institute as opposed to other sources such as the Northwest RTF. If possible, SCE would like to understand how PEI values were determined at the installation site and clarify how they verified the PEI values with customers.</td><td>PG&E supplied the evaluation team with a database of 540 pumps rebated by their Commercial Deemed Incentives program in 2020. The database included detailed pump specifications, including make/model, application type, and horsepower. This information allowed evaluators to extract the installed and baseline PEI vaues from the Hydraulic Institute database.

Evaluators independently verified the PEI values through virtual verifications with 20 customers that elected to participate in the evaluation. The virtual verification process included visual validation (e.g., videochat, photograph exchange) of the installed pump(s) and their nameplates. The make/model information collected from virtual verifications was cross-checked with the PG&E-supplied information. This process generally corroborated the distributors' sales information supplied to PG&E as required for rebate payout.</td></tr>
<tr><td>SCE-8</td><td>SCE</td><td>Section 6 - Net</td><td></td><td>Net</td><td>SCE notes that NTG and therefore NRR are lower than ex ante.
Could the evaluation team provide more detail on the ISP definition recommendation that likely lowered NTG? SCE understands this to mean that some installations were ISP and not influenced by the program and it would be helpful to have an example in the final report. In addition, SCE understands that some VFDs could be installed for multiple reasons such as mitigating water table fluctuations.</td><td>Evaluators assume that this SCE comment refers to the agricultural pump VFD measure, with a resulting NTGR of 0.39. And yes, this relatively low NTGR suggests that some customers would still have chosen to install VFDs in the absence of the program. One reason for this might be that VFDs are standard practice under certain circumstances; in fact there are many non-energy benefits associated with VFD installations that can also drive selection. Mitigating water table fluctuations is a good example, and we can add that example to the report. Otherwise we think the ISP discussion on page 1-7 does an adequate job providing examples of non-energy decision making factors that may drive VFD selection.</td></tr>
<tr><td>SCG-1</td><td>SoCalGas</td><td>Section 8 Conclusions and Recommendations</td><td></td><td>Segmentation of Findings by Delivery Channel</td><td>SoCalGas recommends that the fryer evaluation data be divided by program delivery channel, i.e., downstream vs. Midstream to better distinguish the difference between data collected and validated.</td><td>While evaluators agree with this comment in principal, unfortunately the gross impact sample size of 12 points cannot support further segmentation by delivery channel.

Regarding the conclusions and recommendations, we believe that delivery channel is already identified in some instances as a driver of a particluar finding, where feasible.

Two of the conclusions, FRY1 and FRY4, were informed in-part by the more substantial net impact sample size achieved, and in both cases it is the mid-stream delivery channel that can benefit from improvements suggested in each recommendation.</td></tr>
<tr><td>SCG-2</td><td>SoCalGas</td><td>Section 6.2.1. NTG Approach for Midstream Programs</td><td></td><td>NTG Approach for Midstream Programs</td><td>While SoCalGas agrees with the approach, SoCalGas suggests that the same evaluation process be implemented for all midstream programs, such as the Midstream Water Heating program.</td><td>Thank you for your comments.

Evaluators note that the same NTGR approach was also used in PY2019 to evaluate the mid-stream tankless water heater measure.

All programs and evaluation designs are unique, so difficult to make any blanket statements about this topic. Best timing for such comments is at the evaluation planning stage.</td></tr>
</table>

Comment #	PA	Location	Page	Topic	Question/Comment	Evaluator Response
SCG-3	SoCalGas	Section 8 - Conclusions and recommendations: Recommendation FRY1 [PG&E, SCG, and SDG&E]: We recommend that 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.		Conclusions and recommendation	SoCalGas currently collects customer centric data as it relates to each program market channel. For midstream programs, end-use customer data is collected and submitted to SoCalGas.	Evaluators thank you for collecting and storing the relevant customer contact information described.
SCG-4	SoCalGas	Section 3 - Sampling		Sample Sizes	Sampling plan vs. achieved, the report refers to site M&V sample size for Commercial Gas Fryers as 12 application and vendor NTG telephone survey sample size as only 3 successful cases. SoCalGas believes that sample size is too low to draw meaningful conclusions.	With regard to the M&V sample size obtained, evaluators agree with SCG. Due to a small sample size all gross impact results were passed through. Regarding the vendor sample size of 3, Quantum also agrees this is not a sufficient sample size, which is why Quantum applied the results of the 3 vendor surveys (approx 50% savings), and passed through the NTG to the unevaluated sample (remaining 50% of savings).
SCG-5	SoCalGas	Section 6		NTGR	SoCalGas NTGR There is a discrepancy between the NTGR indicated on page 6-19 section 6.5.3 (0.34) and page 144 (0.39). These two should match and preferably 0.39 if that is accurate.	The appendices on page 144 & 150 include the 5% market adder, while the NTG results in section 6 are evaluated results excluding the 5% market adder, which is where this discrepancy comes from.
SCG-6	SoCalGas	Section 3 - Sampling		Sample Sizes	SoCalGas Down-stream sample rate issue N=32 (table 6-7) is a low sample rate to draw a meaningful conclusion.	We disagree that a sample size of 32 is a low sample rate to draw a meaningful conclusion. For larger populations, such as gas fryers (over 1,000 claims), it is not necessary to have a high sampling rate, it is important to have a sufficient sample size. And a sample size of 32 is sufficient to draw a meaningful conclusion. For smaller populations where you cannot sample a large sample size like 32, then it becomes important to have a high sampling rate. For example, if the population was only 100, and we had the same 3% sampling rate (or a sample size of 3) then this would not be sufficient. Given the parameter that is being measured and the distribution of the resulting responses, we feel the sample size is more than sufficient to draw a meaningful conclusion. The resulting relative precision of 6% suggests a low level of measurement error. We also developed NTG estimates separately for SoCalGas and PG&E and found both strata to have the same 0.34 value, providing further support in the result.
SDGE-1	SDG&E	Section 6 & Appendices	Page 144 & 150	NTG	PG&E and SCG were evaluated, where SDG&E was excluded due to relatively low savings claims for gas fryers. During the webinar, when SDG&E asked for clarity on the application of the evaluated NTGR, evaluators mentioned that SDG&E was a pass-through and no changes should have been applied. However, ex-post NTG was less that ex-ante claim for downstream and the results from PG&E/SCG were applied to SDG&E. This is shown on pages 144 & 150 of the report, having an "Eval Ex-post NTG" of 0.39. Recommend on page 3-19, to update the first "implication" to clearly state SDG&E's claims are a pass-through and no further adjustments were made from the result of PG&E/SCG, as well as adjust the corresponding tables to have the 0.60 ex-ante value since its a pass-through.	Quantum has corrected the error on pages 144 & 150, and SDG&E's NTGR and NRR were passed through. Quantum also added one sentence in section 6 to clarify that SDG&E's NTG was passed through.
SDGE-2	SDG&E	Section 6 & Appendices	Page 144 & 150	NTG	Page 6-19 shows NTGR = 0.34 but differs in Net Savings Table on page 144 & 150 of the report showing a value of 0.39. Recommend updating the values to appropriately note the correct NTGR value for PGE/SCG, as well as note the pass-through for SDG&E.	The appendices on page 144 & 150 include the 5% market adder, while the NTGR results in section 6 are evaluated results excluding the 5% market adder, which is where this discrepancy comes from.

Comment #	PA	Location	Page	Topic	Question/Comment	Evaluator Response
PGE-1	PG&E			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.
PGE-2	PG&E		pp. 1-9, 3-19 to 3-20	Gas Fryers	Within the Executive Summary under sub-section 1-5-3, it is stated that "For approximately 83% of projects rebated in 2020, we did not have sufficient participant contact data to verify fryer installations or evaluate savings." However, within Data Sources under sub-section 3-2-1 (PDF pg. 45-46), it states that "PG&E and SCG ultimately provided credible end-user contact information for 55% of the population of PY20 gas fryer installations." There appears to be a discrepancy in the reported rate of obtained participant contact data. Can the evaluation team update the draft report language to ensure clarity around the data obtained for the sample targets?	This language has been clarified in the revised version of the report. The 83% estimate includes unreachable records as well as records that pointed to only the contractor or distributor.
PGE-3	PG&E		pp. 5-5 to 5-42	Discrepancy Tables	PG&E commends the evaluation team for providing the excellent tables (e.g., Tables 5-2, 5-6, 5-24, 5-31) 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., 5 PG&E ineligible Well Pumps that led to being zero-saver projects; projects with differences in PEI ratings; 1 ineligible Gas Fryer installed)? The information can allow PAs to understand 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.
PGE-4	PG&E		pp. 5-34 to 5-35	Clean Water Pump Upgrades	PG&E is working with the CPUC to change the method to estimate energy savings based on the currently available pump database from the Hydraulic Institute rather than using the method approved in previous revisions of the measure package and based on the Northwest RTF. For the current evaluation results, PG&E would like to understand how the PEI values were determined from the actual installation. Can the evaluation team clarify how it determined and verified the PEI values with customers?	Evaluators independently verified the PEI values through virtual verifications with 20 customers that elected to participate in the evaluation. The virtual verification process included visual validation (e.g., videochat, photograph exchange) of the installed pump(s) and their nameplates. The make/model information collected from virtual verifications was cross-checked with the PG&E-supplied information. This process generally corroborated the distributors' sales information supplied to PG&E as required for rebate payment.
PGE-5	PG&E		pp. 8-7	Gas Fryers	Table 5-31 illustrated that 'Difference in idle energy rate' accounted for the largest impact on realization rates. There are multiple manufacturers that supply eligible fryers, which could result in a wider variety of idle energy rates. Given the low sample size of units tested, is it possible that the idle energy rates measured may not be representative of the population? Could the evaluation team share their thoughts on this possibility?	The lower-than-desired sample size introduces more uncertainty in the evaluation results, including for the idle energy rate parameter. The low sample size and associated variability in results has caused the evaluation team to elect a 100% GRR for the gas fryer measure in PY2020. The evaluators have more clearly acknowledged this parameter-level uncertainty in the report.