Final Impact Evaluation

Small/Medium Commercial Sector
Program Year 2019

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SECTION 1:

EXECUTIVE SUMMARY

1-1 NEED FOR THE STUDY

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

1-2 ENERGY EFFICIENCY TECHNOLOGIES STUDIED

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

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

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

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

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

1-3 APPROACH

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

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

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

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

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

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

1-4 RESULTS

The results of our evaluation establish the gross and net energy savings of the four technologies studied over the life of the installed equipment (lifecycle). The tables below show the evaluated and reported energy savings values for each technology studied. Table 1-1 presents Therm savings for gas saving technologies, and

Table 1-2 shows MWhs and MWs savings for electric technologies. The tables also provide the ratios of evaluated savings to the PAs' reported savings and the corresponding NTGRs.[4] Just one of the four technologies showed much lower energy savings than reported, and therefore resulted in lower gross savings. Furthermore, some technologies studied showed that the program had only a moderate-to-low

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

influence on the installation of the equipment, as participants would have installed the equipment anyway (hence the low NTGR and lower net savings for some measures).

Table 1-1: Reported (PA) and Evaluated Lifecycle Therm Savings, Realization Rates and NTGRS for Evaluated Gas Technologies

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

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

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

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

1-5 RECOMMENDATIONS

1-5-1 Ozone Laundry Equipment

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

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

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

- **Ozone laundry equipment installations are not always properly screened for eligibility requirements.** We found that two of our sample points, out of a total sample size of 35 sites, replaced existing ozone laundry equipment with new equipment. Such installations are not eligible for the program and do not save energy.
  - The program's application and review process should include verification steps that better screen projects against eligibility requirements and exclusions.

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

- **We found that VFD controls installed through the programs are not being properly screened in many cases for eligibility criteria.** Out of a total sample size of 45 pumps, commonly observed reasons for failing eligibility requirements includes the installation of speed controls in the following cases:
  - 5 pumps run fewer than 1,000 hours per year
  - 2 pumps pump well water into a water storage reservoir or trucks
  - 12 pumps have settings that are at or near full load
  - 4 pumps previously ran uncontrolled.

  Many of the VFDs are installed on new pumps that irrigate orchards that have been planted in the last couple of years; these young trees require less water than mature trees and this results in low run hours, many below 500 hours per year.
  - The program's application and review process should include verification steps that better screen projects against eligibility requirements and exclusions.
- **In most cases, pump loads and run hours per year can be determined using interval billing data, such as hourly demand measurements for a given pump.** In fact, our evaluation applied interval billing data as a key model input used to determine VFD savings.
  - We recommend that the programs make use of interval billing data for characterizing pump operations, including use of those data to derive updated estimates of savings for the pump VFD measure, and as screening criteria for pump run hours.
- **Beside the potential to save energy, there are other common reasons that farmers will decide to install VFD controls on crop irrigation pumps.** Some pumps cannot continue to operate without the VFD due to operational requirements, such as the use of VFD controls to automatically adjust

pump speed in response to pressure settings, or due to sand contamination in the well water column that can be controlled using VFD pump speed settings. Another common reason is that the VFD pump gives the farmer the ability to monitor and control the pump remotely, from a desk in their office. Furthermore, the VFD pumps can save on equipment maintenance and extend the life of the pump. This results in a high free ridership rate for VFD controls because a considerable number of farmers indicate that they would have installed VFD controls independent of the program / incentive.

- For these reasons, we recommend that the appropriate baseline be determined as a function of pump type and size. Current program savings estimates assume a throttle valve flow control baseline, in which partially closed valves are used to control pump flow. However, this assumed baseline ignores the fact that VFD flow controls are commonly installed, even without the influences of program intervention. VFD flow controls may already be the most commonly installed approach for certain pump type and size combinations.

1-5-3 Agricultural Irrigation

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

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

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

1-5-4 Tankless Water Heaters

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

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

1-6 CONTACT INFORMATION

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

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