Process and Load Impact Evaluation of the Single-Family Affordable Solar Housing Program (SASH)

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Final Report

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1 Executive Summary

1.1 Introduction

In 2006, in response to Assembly Bill (AB) 2723, the Single-Family Affordable Solar Housing (SASH) program began offering incentives to low-income households (80% of area median income) located within a housing tract defined by the Department of Housing and Urban Development (HUD), designated as affordable housing, or located on tribal lands. The SASH program was intended to decrease electricity usage and reduce energy bills by offering incentives to offset the expense of solar ownership for low-income and single-family homeowners while also referring customers to the investor-owned utilities' (IOUs) Energy Savings Assistance program. Additionally, the program intended to develop the solar workforce while providing hands-on installation experience.

In 2015, California Public Utilities Commission (CPUC) Decision 15-01-027 reauthorized a second iteration of the SASH program (SASH 2.0). The Decision increased the incentive budget to serve more households and decreased the incentive level from the first iteration of SASH (SASH 1.0) in order to maximize the overall benefit to ratepayers.[1] The Decision also required additional energy efficiency education for participants, including Energy Savings Assistance (ESA) program referrals, energy efficiency walkthroughs, and a job training component.

The Program Administrator (PA), GRID Alternatives, administered both programs (SASH 1.0 and SASH 2.0) under the name "Energy for All Program." At the time of this research, March 2022, GRID had completed 9,501 SASH projects for a total of 30,003 kW (CEC-AC[2]), thus making solar accessible to low-income households as intended. An impact analysis of projects resulted in an average realization rate of 105 percent, indicating that the program's expected generation estimates are accurate.

In Decision 15-01-027 that reauthorized the SASH program, the CPUC also required a "close of program" evaluation. This report serves as independent measurement to verify the program's impacts and document the performance of the PA, now that the SASH program is closed.

Program Accomplishments

Through the installation of 9,501 projects from 2009 to March 2022, the program realized the following accomplishments:

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[1] SASH 1.0 had an incentive level as high as $7 per Watt and was determined based on the homeowners' federal income tax liability and their CARE eligibility. SASH 2.0 simplified the incentive level and offered a $3 per Watt incentive.

[2] A rating system used to determine the eligibility of a solar system by the California Energy Commission.

- 30,003 kW (CEC-AC[3]) total installed capacity with an average of 3.2 kW per home
- Estimated reduced greenhouse gas (GHG) emissions of 16,601 metric tons of CO_2 equivalent (similar to the average carbon footprint for one year for 738 California households), along with criteria pollutant reductions of 519 kg of methane (CH4) reduction and 64 kg of nitrogen oxides (NOx) reduction[4]
- Participation from customers in all eligible investor-owned utility (IOU) service territories, with 46 percent of projects in PG&E's, 42 percent in SCE's, and 11 percent in SDG&E's service territories
- $133.9 million in incentives paid out for installation projects with an average of $14,089 going to each project[5]
    - $92 million in incentives paid out for SASH 1.0 projects, with an average of $17,489 per project
    - $41.9 million in incentives paid out for SASH 2.0 projects, with an average of $9,876 per project
- $160 million total spent (administration, marketing and outreach [M&O], and incentives) out of a $160.7 million total budget with an average of $16,907 spent per project on administration, M&O costs, and incentives[6]
    - $108.7 million spent on administration, M&O, and incentives for SASH 1.0, with an average of $20,501 per project
    - $51.3 million spent for SASH 2.0, with an average of $12,050 per project
- Solar system performance slightly better than projected (105 percent of projected performance)
- Reports of lower bills (81% of surveyed customers)
- An average of 67 percent decrease in energy consumption (5 MWh per year) for an average total annual bill savings of $904 per year (91% reduction in annual bill costs)
- High customer satisfaction and appreciation for the services provided by the program

Increased solar industry participation from volunteers and trainees after participation in trainings and/or volunteer opportunities created by the program (8 percent worked in the industry before the program and 23 percent reported working in the industry afterwards)

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[3] A rating system used to determine the eligibility of a solar system by the California Energy Commission.

[4] https://rael.berkeley.edu/wp-content/uploads/2018/04/Jones-Wheeler-Kammen-700-California-Cities-Carbon-Footprint-2018.pdf

[5] Analysis of incentives was done on the 9,501 projects that were considered fully complete as of March 2022. There were additional projects that were installed but not yet interconnected, or where incentives had not yet been paid out. Those projects were excluded from this analysis of per-project incentive costs.

[6] Analysis of administration and M&O costs was done on the 9,559 projects that were started as of March 2022. These costs are reported on a semi-annual basis and include administration and M&O time spent before a project is fully completed.

Overall, the programs were responsible for increasing the number of homes with solar rooftops and for providing an opportunity for low-income customers to benefit from solar power. The programs were not cost effective from a total resource or ratepayer perspective. However, this was expected given the cost of providing near-full incentives for photovoltaic (PV) systems to program participants. The programs were cost effective from a societal perspective, where the monetary value of carbon reductions outweighed the program costs.

1.2 Findings and Lessons Learned

While this program has ended, we identified lessons that may be helpful for similar solar programs in the future. This section is organized in the following sections:

1. Lessons learned related to goals of the program
2. Lessons learned related to barriers to solar installation
3. Lessons learned for tracking and collecting valuable data in future programs

1.2.1 Lessons Learned Related to Program Goals

The goals listed in Decision 07-11-045 to authorize the program specified a shared targeted number of kW installed for Multifamily Affordable Solar Homes (MASH) and SASH of 50 megawatts (MW) but did not provide direction on the number of homes served or guidance on the type of customers that should be prioritized through SASH. However, five goals of the SASH program were clear:

1. Decrease electricity use by solar installation and reduce energy bills without increasing monthly expenses.
2. Provide full and partial incentives for solar systems for low-income participants.
3. Offer the power of solar and energy efficiency to homeowners.
4. Decrease the expense of solar ownership with a higher incentive than the General Market California Solar Initiative (CSI) program.
5. Develop energy solutions that are environmentally and economically sustainable.

In this section, we comment on successes by each stated goal and recommend how future related programs can set measurable goals.

Program Goals 1 & 3: Decrease electricity use by solar installation and reduce energy bills without increasing monthly expenses. Offer the power of solar and energy efficiency to homeowners.

Based on analysis of customer energy bills, SASH participants *avoided* the increases in bill costs observed in the matched comparison group, while *saving* money on their energy bill after installing solar. On average, a SASH 1.0 participant experienced a 60 percent decrease in energy consumption (4.4 MW per year) resulting in total bill savings of $1,032 per year, while SASH 2.0 participants were estimated, on average, to have a 67 percent decrease in energy usage (5.0 MW per year), resulting in bill savings of $904 per year. The SASH program successfully reduced energy bills without increasing monthly expenses for most participants.

- Future programs should set measurable goals for bill savings and/or reductions in energy usage to better track successes.

GRID referred customers to the Energy Savings Assistance (ESA) program as part of the SASH participation process to reduce energy usage alongside the installation of solar panels, but we found that only 11 percent of participants had enrolled in the ESA program. GRID also provided energy efficiency education to customers to help them understand how to reduce their usage, and 55 percent of survey respondents that reported lower electricity usage believed their usage decreased due to a better understanding of energy usage in the home or a greater sense of environmental consciousness due to the program.

- Future programs should send an annual follow up letter and email to customers reminding them of related programs (ESA and California Alternate Rates for Energy [CARE], which requires reenrollment every two years).
- Future programs should be sure to offer referrals for parallel programs to eligible customers who are not interested in participating.

Program Goals 2 & 4: Provide full and partial incentives for solar systems for low-income participants. Decrease the expense of solar ownership with a higher incentive than the General Market CSI Program.

As of March 1, 2022, GRID had completed 9,501 SASH projects for a total of 30,003 kW (CEC-AC) for low-income households. GRID offered solar systems to be no-cost to low-income customers by combining the SASH incentive and leveraging other sources of funding external to the program. The SASH program succeeded in its goal to provide full and partial incentives, and to decrease the expense of solar ownership for this population.

- Future programs should research baseline adoption metrics among the eligible population, then set specific, time-constrained goals to measure success.
- Future programs should leverage GRID's model of administering SASH, utilizing local sources of grant funding to help cover full costs of installation so the program is no-cost to low-income households. Continuing to leverage grant funding will ensure that the program funds can be used to serve more households.

Program Goal 5: Develop energy solutions that are environmentally and economically sustainable.

In market rate solar installations, there is a trend of increased energy usage after installation.[7] An analysis of SASH savings over time, however, found that there was not an expected drop off in savings, and the overall trendline suggests there is a 7.3 percent decrease in savings over 12 years (0.61% per year). This decrease is smaller than expected, indicating that SASH was successful in developing solutions that are sustainable.

To evaluate cost effectiveness of the program, we used the Total Resource Cost (TRC) test, Societal Cost Test (SCT), and Ratepayer Impact Measure (RIM) test (Table 1). For the TRC and RIM tests, the cost-benefit ratios are less than one, meaning the costs exceed the benefits from the total resource and ratepayer perspectives. These findings are to be expected given the high costs of providing near-full to full incentives for PV systems to program participants.

For the SCT, which includes the additional benefit of the monetary value of a reduction in carbon, ratios for all IOUs are greater than or equal to one for SASH 2.0, indicating cost effectiveness. On average, ratios increased from SASH 1.0 to SASH 2.0, attributable in part to declining system equipment and installation costs and lower administrative costs.

Table 1: SASH Program Cost-Benefit Ratios

Program	IOU	TRC	SCT	RIM
SASH 1.0	PG&E	0.55	0.88	0.11
	SCE	0.74	1.13	0.08
	SDG&E	0.48	0.78	0.08
	Average	**0.59**	**0.93**	**0.09**
SASH 2.0	PG&E	0.60	1.00	0.10
	SCE	0.68	1.12	0.09
	SDG&E	0.69	1.10	0.09
	Average	**0.66**	**1.07**	**0.10**
Overall	PG&E	0.58	0.94	0.10
	SCE	0.71	1.12	0.08
	SDG&E	0.58	0.94	0.09
	Average	**0.62**	**1.00**	**0.09**

[7] In the CSI impact evaluation, PG&E residential customers increased their consumption by an average of 7.1 percent during the first year after installing solar. Though these systems were incentivized, it is a clear example of the pattern we expected to see, where solar installations often lead to increases in consumption.

1.2.2 Lessons Learned Related to Barriers to Solar Installation

Evergreen identified a set of barriers that have hindered installation progress but found that GRID did a good job of addressing these and became more effective over the years. The biggest barriers were:

1. Trust in a "free program"
2. Customers with homes that were not "solar-ready"
3. Tree location

Trust in a "Free" Program:

- Future programs should follow GRID's model and leverage partnerships with trusted organizations and municipalities, as well as customer referrals, to build up credibility within communities they are aiming to serve.

Customers Not "Solar-Ready":

- Future programs should consider implementing a fund for additional services that may be required to allow customers that are not solar-ready to participate.

Tree Location:

- Future programs should be aware that tree trimming (the need for or the desire not to do so) may create barriers to program participation.

1.2.3 Lessons Learned Regarding Data Tracking

To support future programs and to ensure evaluability of goals, we recommend that future programs track and measure metrics related to specific goals of the program. Lessons learned from SASH include:

- Metrics should be collected on marketing outreach on an annual basis and be divided by total installations, including leads received from the IOUs, purchased from other sources, direct mailers, and referrals.
- Verification that IOU account numbers entered into participant databases are accurate should occur.

2 Introduction

The California Public Utilities Commission (CPUC) established the Single-Family Affordable Solar Housing (SASH) program (as well as a similar program directed at the multifamily sector) in response to Assembly Bill (AB) 2723 that directed at least 10 percent of California Solar Initiative (CSI) funds for assisting low-income households in the electric investor-owned utility IOU service territories. The SASH program began offering incentives to eligible customers in 2009, and while the CSI general market program closed at the end of 2016, the CPUC has continued to provide incentives to low-income customers installing solar PV systems though SASH 2.0 and DAC-SASH (as well as the net energy metering program for all solar and incentives for solar water heaters).

This report contains an evaluation of the SASH program. A separate report covers findings from the DAC-SASH Program Evaluation and Vendor Assessment.

2.1 Program Background

In 2006, in response to Assembly Bill (AB) 2723, the SASH program began offering incentives to install solar to low-income and single-family homeowners residing in the service territories of the electric IOUs: Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E). The goal of SASH was to decrease electricity usage and reduce energy bills.

In 2015, CPUC Decision 15-01-027 reauthorized a second iteration of the SASH program (SASH 2.0). The Decision increased the incentive budget to serve more households and decreased the incentive level from the first iteration of SASH (SASH 1.0) in order to maximize the overall benefit to ratepayers. The incentive level was determined by the capacity installed, and for SASH 1.0, was designated as high as $7 per watt installed ($7/W) for California Alternate Rates for Energy (CARE) eligible households and $5.75/W for non-CARE eligible households. The program offered lower rates dependent on the homeowner’s tax liability. For SASH 2.0, the incentive level was lowered to a flat rate of $3/W.[8] The Decision also required additional energy efficiency education for participants, including Energy Savings Assistance (ESA) program referrals, energy efficiency walkthroughs, and a job training component.

To qualify for the program, customers must be homeowners of a single-family home that receives electric service from one of the three electric IOU service providers and is located within a qualified census tract as defined by the Department of Housing and Urban Development (HUD), be considered affordable housing, or reside on tribal lands.[9] They must also be income qualified,

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[8] Accessed via: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M145/K938/145938475.PDF

[9] Affordable housing was defined by California Public Utility Code 2852 and includes HUD Qualified Census Tracts, defined at the tract level from https://www.huduser.gov/portal/sadda/sadda_qct.html. Eligibility requirements were retrieved from https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/california-solar-initiative/csi-single-family-affordable-solar-homes-program

which is defined as having a household income of 80 percent or less of the area median income, as defined at the county level.

The Program Administrator (PA), GRID Alternatives (GRID), administered both iterations of the program (SASH 1.0 and SASH 2.0) across the state through regional affiliate offices. While the SASH program has closed as of 2022, GRID is also the PA for a related program modeled after the SASH program, called Disadvantaged Communities Single-Family Affordable Solar Housing Program, or DAC-SASH. Many lessons learned from the SASH programs can be adopted as recommendations for DAC-SASH.

Customer Journey

GRID administered the SASH program in two main ways: homeowner-owed and third-party owned (TPO). Table 2 below summarizes the differences in the models.

Table 2: Deployment Models

Model	Owner of System	Responsible Party for:				
		Finding & Qualifying Customers	Designing System	Installing System	Servicing Equipment	Monitoring Generation
Homeowner-Owned	Homeowner	GRID Alternatives	GRID Alternatives	GRID Alternatives	GRID Alternatives (10 years)	Homeowner
Third-Party Owned (TPO)	Third-Party Solar Company	GRID Alternatives	GRID Alternatives	GRID Alternatives	GRID Alternatives (10 years) AND Solar Company (25 years)	Solar Company

With homeowner-owned systems, GRID purchases solar equipment in bulk, finds and qualifies customers for SASH, designs and installs the systems, and provides a 10-year warranty for both the service and equipment. With the TPO model, GRID is responsible for all the same tasks but also pre-pays a 25-year power purchase agreement (PPA) from a third-party solar company. In the TPO model, the solar company provides monitoring services and a production guarantee for the entire 25-year lifespan of the PPA. The system itself is owned by the third-party solar company, and at the end of 25 years, the customer has the option to either:

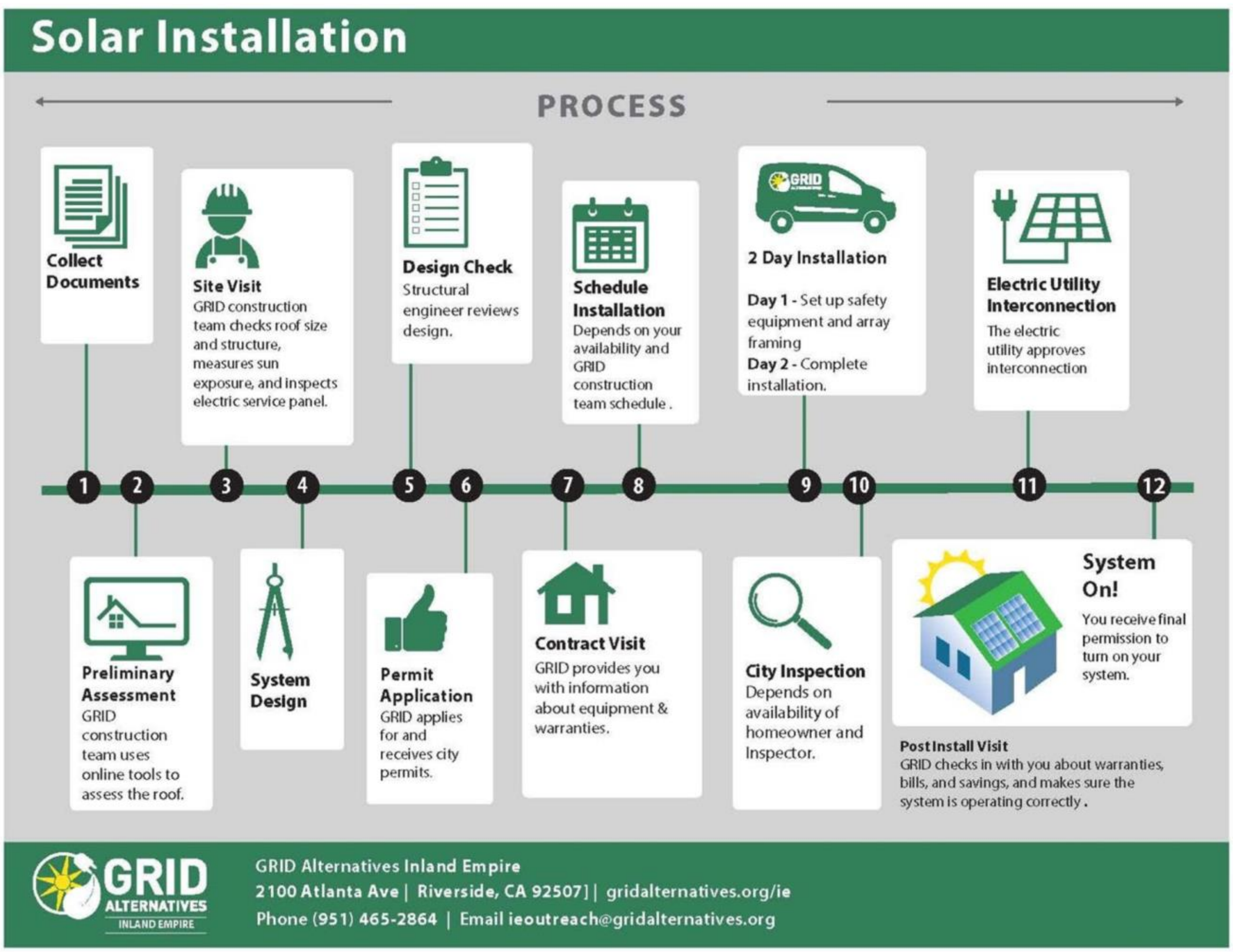
- Purchase the system from the company at the market rate;[10]
- Pay a monthly PPA to continue to receive electric service at a reduced cost; or
- Have the third-party solar company uninstall the solar panel at no cost to them.

Costs and benefits of the TPO system are described in detail in Section 4.2.2

[10] In interviews and an advice letter (AL 18), GRID Alternatives states that the system should be worth $0 after 25 years, but that they cannot guarantee this will be the case, as market conditions and equipment conditions drive the market value of the old equipment.

Figure 1, provided by GRID, illustrates the process a homeowner can expect during their participation in the program. After identifying interested participants, GRID will collect documents to verify eligibility. These typically include proof of homeownership, proof of income, and energy bills. Once the customers are qualified, GRID will perform a preliminary assessment using online tools and conduct a site visit to ensure that the property is fit for solar installation. Many properties are screened out at this stage due to poor quality roofing, older panels, or shading from trees. Once a property is deemed solar-ready, GRID will proceed with the design and permitting steps necessary to schedule the installation. After the installation, the city inspector will inspect the solar system, and the electric utility will facilitate interconnection. The entire process, from outreach to interconnection, can take anywhere from two to six months, with many delays occurring due to scheduling inspections and interconnection with the municipality and the utility.

Figure 1: Participation Process



This process is standard for many of GRIDs regional offices, but details and order may differ by region. We examine the implications of this in Section 4.2.

2.2 Study Objectives

In Decision 15-01-027 that reauthorized the SASH program, the CPUC also required a "close of program" evaluation. Per the study request for proposals (RFP), the study must independently measure and verify the program's impacts and document the performance of the PA and summaries of administrative costs. Evergreen categorized the initial set of program evaluation metrics developed by the CPUC into a set of research questions to organize our evaluation approach. See Appendix B for more detail.

Program administration and marketing: How effective is program administration? What have the programs spent to-date on administration, management, direct implementation, and marketing? Have there been issues related to tracking administrative costs? How effective has program marketing been? Has the Program Administrator (PA) made use of customer data provided by the IOUs, and has that impacted program enrollment?

Customer participation: What are the characteristics of participants versus eligible non-participants? What are the main barriers to participation? Are customers satisfied with the program? How effective are the programs in driving enrollment in other related programs? What is the size of the total eligible customer pool? How many out of program/market adoptions are happening among the eligible population?

PV system performance: Have systems degraded over time since installation? What factors contribute to such degradation? How cost-effective was the SASH program?

Customer bill impacts: What is the average monthly bill reduction outcome for program participants? Are there any measurable changes in energy usage post-participation?

Environmental benefits: What environmental benefits is the program creating as a result of installed projects? Are participating customers aware of the program's environmental benefits?

Workforce development: What job training programs are being leveraged? How many local jobs are being created? What are the longer-term job outcomes for trainees?

3 Methodology

This section describes the overall study approach and details the methodology behind the various analysis tasks.

We linked the metrics for the evaluation to the research activities described to ensure that all metrics were included in the research. Evergreen developed a data collection plan that documented the linkages of the study research components to the metrics, ensuring a systematic approach to assessing the program. This set of metrics and linked data collection plan established data collection protocols and can be found in Appendix B.

We used numerous data and information sources for this study including secondary and primary research:

- Secondary Research:
  - Background document review
  - Program documentation and report review
  - PA program tracking data analysis
  - IOU billing system data analysis
  - Geographic and census data analysis
- Primary Research:
  - Customer surveys with program participants (n = 368) and non-participants (773 completed surveys, with 154 eligible for SASH)
  - Web survey with trainees of the workforce development training (n = 99)
  - Phone interviews with the PA, IOUs, M&O organizations, TPO partner, CPUC Tribal Liaison (n = 17)
  - In-person field research of solar installation sites, marketing and outreach activities, and trainings (Greater Los Angeles area, Inland Empire, and North Valley)
  - On-site solar verification visits (n = 8)

Appendix A provides additional detail on sampling and analysis methodology.

4 Findings

This section presents the study findings. After a summary of data limitations and program progress to date, we provide findings with conclusions following. Additional findings not directly related to metrics are included in Section 6 of this report after the conclusions.

The findings follow the metrics for the evaluation and are categorized by topic:

- Program Administration and Marketing
- Customer Participation
- PV System Impacts
- Customer Bill Impacts
- Cost Effectiveness
- Environmental Benefits
- Workforce Development and Job Training

Appendix B provides more detail on all metrics and maps them to sections in this report.

4.1.1 Data Limitations

The study team identified a number of limitations for completing the evaluation. These limitations are acknowledged in the relevant sections and inform recommendations for future evaluations. Table 3 summarizes the limitations.

Table 3: Data Limitations

Data	Limitation	Implication	Recommendations for Future Programs
Enphase-Enlighten Monitoring Data	Most (22 of 30) systems in our sample had reporting errors.	The prevalence of reporting errors limited Evergreen's ability to comment on the long-term performance of SASH 1.0 projects due to the inconsistency of monitoring system tracking of older systems.	Future programs should ensure program participants know how to access their generation data and determine if the PA should be responsible for tracking or fixing monitoring issues.
IOU Billing Data	Lack of pre-2012 data for some IOUs. Some participants lacked enough pre- or post- solar install	Early SASH 1.0 billing analysis findings could be biased because of the different climate zones contained in each IOU.	PAs of future programs should verify IOU account numbers in their program database to help with data matching for evaluations.

Data	Limitation	Implication	Recommendations for Future Programs
	data to be included in the analysis (30%).	Results may be biased in an unknown way due to the availability (or lack) of data.	
Trainee Contact Information	No trainee address; missing trainee type field before 2019	Not able to compare if trainees are from targeted communities themselves or if they are travelling for the work.	PAs of future programs should collect and report on this information.
IOU CIS Data	No standardized information on own/rent, home type, or income eligibility	Sampling was done via census analysis to target high concentrations of eligible households.	No recommendation – Future evaluations should use similar methods for sampling eligible households (i.e., Census).
PA Cost Data	No marketing, outreach, and admin costs split out by region	Not able to compare acquisition costs for program participants across regions	PAs of future programs should collect and report on this information.
PA Tracking Data	Time spent on searching for gap financing not tracked	Not able to quantify staff time spent on gap financing	PAs of future programs should collect and report on this information.

4.1.2 Program Progress

At the time of this research, March 2022, GRID had completed **9,501 SASH projects, for a total of 30,003 kW** installed. Completed projects are defined as those that were installed and interconnected, and for which incentives were paid out. There were an additional 466 projects installed at the time of data collection but not yet fully completed with incentives paid out, so we did not include them in the analysis. SASH projects were distributed across all three IOUs. PG&E had 46 percent of all installations, SCE had 42 percent, and SDG&E had 11 percent (Table 4).

Table 4: SASH Projects Completed by IOU

IOU	Projects Installed	% of Total
Pacific Gas & Electric Company (PG&E)	4,414	46%
Southern California Edison (SCE)	4,031	42%
San Diego Gas & Electric (SDG&E)	1,056	11%
Total	9,501	100%

4.2 Program Administration

This section reports on a summary of costs and an assessment of underutilization of funds. We also review the program administration models used by GRID, such as documenting the differences between regional offices and reviewing the third-party ownership (TPO) model. The metrics addressed in this section are:

- How effective was program administration?
- What have the programs spent-to-date on administration, management, direct implementation, and marketing?
- Have there been issues related to tracking administrative costs?
- How effective has program marketing been?
- Has the PA made use of customer data provided by the IOUs, and has that impacted program enrollment?

4.2.1 Summary of Costs

Program costs approved by the CPUC include administration, marketing and outreach, and incentives for the cost of installation and materials (i.e., solar panels). Between 2006 and 2014, the incentive level provided by SASH ($7/W for CARE-households and $5.75/W for non-CARE households) was sufficient to cover the full costs of solar installation (including labor and materials). As of 2015, the CPUC adopted a non-declining incentive rate of $3/W, which created a difference between the total project costs and the incentive received through the program. GRID referred to the efforts needed to fill this gap as "gap financing."

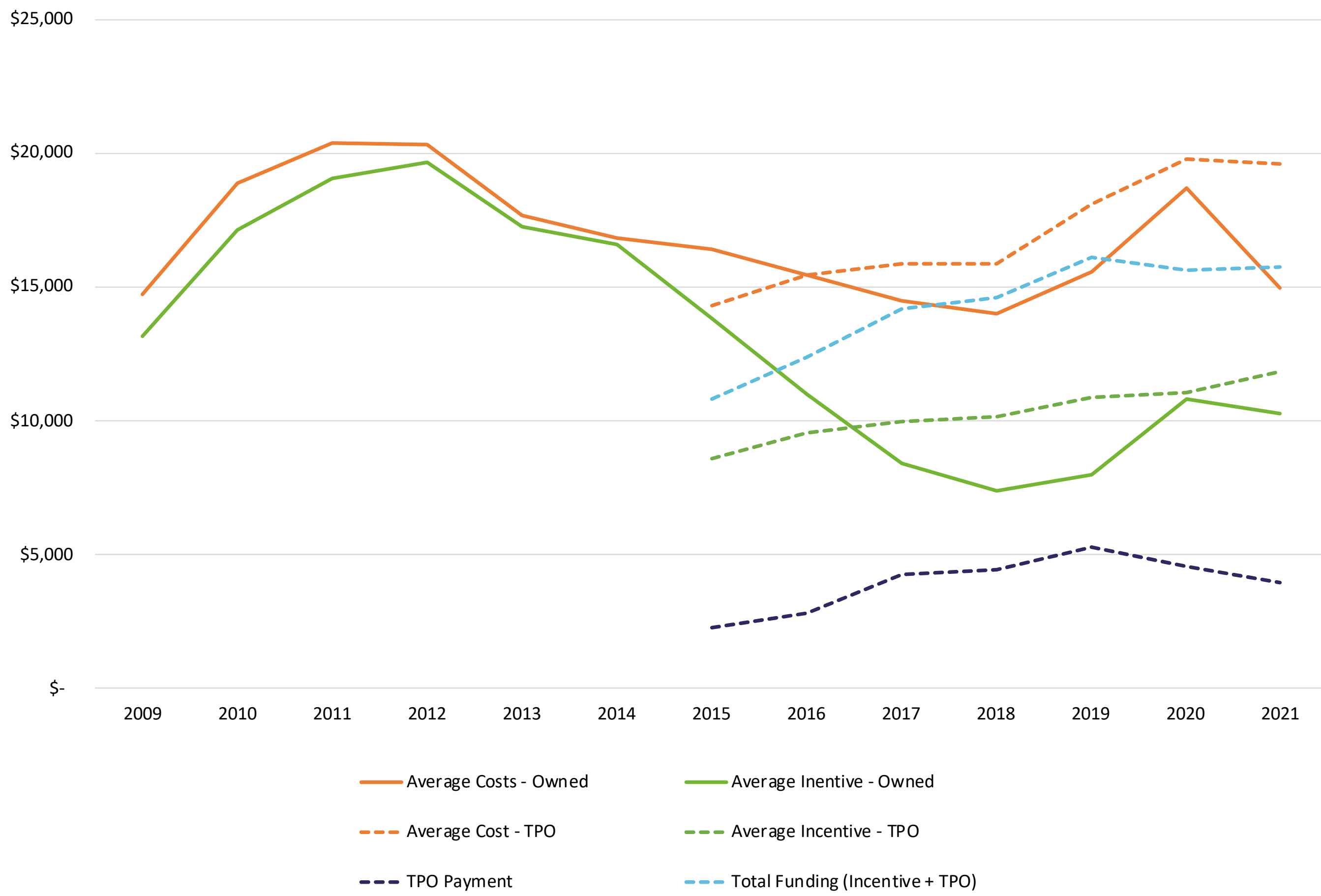
Gap Financing

GRID staff fundraised for other sources of funding to provide professional services needed and to cover the gap between the solar system cost and incentives received. In addition to the money spent on professional services and covering the gap in financing, GRID also reported that a significant amount of SASH staff time went towards identifying sources of gap financing. Time spent on searching for gap financing was not tracked and thus was not quantifiable. GRID staff in different regions employed different tactics due to the unique funding opportunities in their local communities and leveraged local relationships.

Availability of financing differed by region. Some partnered with their local municipalities to provide funding for specific projects, and others leveraged partnerships with other programs to fill the gap. It is worth noting that GRID was originally chosen as the PA for SASH in part because of its ability to leverage community-based organizations (CBOs) for this kind of funding as a non-profit. Though GRID staff could not estimate the cost of fully funding projects, many reported that virtually 100 percent of recent projects required additional funding to ensure the customer has no costs.

To help bridge the gap in financing after the incentive amount changed, the CPUC allowed GRID to utilize a TPO model to leverage the federal tax credit. As part of the TPO model, GRID receives payment from the solar company to install the system, and the TPO company owns the system but passes the bill discounts on to the homeowner. We report on the TPO model in greater detail in Section 4.2.2. Figure 2 shows the average costs and incentives received for owned systems (solid lines) and TPO systems (dashed lines). The TPO funding is the dashed dark purple line indicating the average amount received per TPO project. Finally, the figure depicts the gap between project costs and the incentive plus the TPO funding, as "Total funding" in the light blue dashed line. The gap between the TPO average costs (dashed orange line) and average total funding (dashed light blue line) show that the gap in financing is relieved by TPO payments, but still not enough to cover full costs of each project.

Figure 2: Average Costs and Incentive Amounts for SASH Projects by Year, Owned Systems and TPO Systems



4.2.2 Budget Assessment

Evergreen used GRID-provided data and budget allocations from the SASH Semi-Annual Progress Report to consider allocated budget versus actual spending for SASH 1.0 and SASH 2.0. GRID provided data for all program functions besides evaluation (which makes up 1% of the projected program budget). For the purposes of this analysis, Evergreen assumed that evaluation budget projections were equal to actual evaluation spending. GRID provided administrative and ME&O cost data aggregated across IOUs, so Evergreen calculated actuals by IOU based on budget allocations by IOU listed in Table 5 below.

Table 5: Budget Allocation by IOU

IOU	Budget %
PG&E	43.7%
SCE	46.0%
SDG&E	10.3%
	100%

Table 6 shows allocated budget by program function. The CPUC decision called for most program spending to go toward incentives (85%), and the remaining to be split by administration (10%), M&O (4%), and evaluation (1%). On average, GRID spent $1,661 on administrative costs per project, and $13,563 per project on incentives, roughly meeting the intent of the program distribution to spent 85 percent on incentives and 10 percent on administration.[11]

Table 6: Mandated Budget Allocation Caps by Program Function

Program Function	Budget %
Administration	10%
ME&O	4%
Evaluation	1%
Incentives	85%
	100%

Table 7 shows allocated budget by IOU and program function and compares the values to actual spending. When comparing SASH 1.0 and SASH 2.0 separately for all IOUs combined, we see that SASH 1.0 was $1.4 million over budget while SASH 2.0 was $2.2M under budget. This was largely driven by incentive spending on projects in PG&E's service territory being $898,000 over the allocated amount for SASH 1.0 and $1 million under the allocated amount for SASH 2.0.[12] We

[11] Analysis of administration and M&O costs were done on the 9,559 projects that were started as of March 2022. These costs are reported on a semi-annual basis and include administration and M&O time spent before a project is fully completed.

[12] Spending totals may be slightly misrepresented due to inconsistencies in the data cutoffs used to compartmentalize SASH 1.0 versus 2.0 (e.g., Administrative and M&O costs were pulled starting with Q4 2008, but incentives were pulled starting with a grouping of 'dates earlier than June 25th, 2009).

found that, on average, SASH 1.0 spent $0.55/W installed on administration and $0.23/W on ME&O. SASH 2.0 spend less with $0.37/W on administration and $0.14W on ME&O, indicating that the program became more effective over time.

Table 7: Allocated Budget and Actual Spending for SASH 1.0 & 2.0 (Millions of Dollars)

IOU	Admin		ME&O		Evaluation		Incentives		Total	
	Allocated	Actuals	Allocated	Actuals	Allocated	Actuals	Allocated	Actuals	Allocated	Actuals
SASH 1.0										
PG&E	$4.73	$4.48	$1.89	$1.87	$0.47	$0.47	$40.24	$41.42	$47.34	$48.24
SCE	$4.98	$4.72	$1.99	$1.97	$0.50	$0.50	$42.36	$42.76	$49.84	$49.94
SDG&E	$1.12	$1.06	$0.45	$0.44	$0.11	$0.11	$9.49	$9.99	$11.16	$11.59
All	**$10.83**	**$10.26**	**$4.33**	**$4.28**	**$1.08**	**$1.08**	**$92.09**	**$94.16**	**$108.34**	**$109.78**
SASH 2.0										
PG&E	$2.36	$2.57	$0.94	$0.97	$0.24	$0.24	$20.06	$18.82	$23.60	$22.60
SCE	$2.48	$2.71	$0.99	$1.02	$0.25	$0.25	$21.11	$20.16	$24.84	$24.13
SDG&E	$0.56	$0.61	$0.22	$0.23	$0.56	$0.56	$4.73	$4.22	$5.56	$5.11
All	**$5.40**	**$5.88**	**$2.16**	**$2.22**	**$0.54**	**$0.54**	**$45.90**	**$43.20**	**$54.00**	**$51.84**
Total (SASH 1.0 & 2.0)										
All	**$16.23**	**$16.14**	**$6.49**	**$6.49**	**$1.62**	**$1.62**	**$137.99**	**$137.36**	**$162.34**	**$161.62**

In Table 8, we calculate the difference in allocated funding and actual spending by IOU and program function. Values are presented in millions of dollars, with parentheses indicating overspending compared to the allocated budget. We can clearly see that differences in incentive spending compared to allocated amounts is driving both the overall budget deficit in SASH 1.0 and surplus in SASH 2.0. Overall, there were no major differences between budgeted versus actual spending and no concerning trends.

Table 8: Differences in Allocated Budget and Actual Spending (Millions of Dollars)

IOU	Admin		ME&O		Incentives		Total	
	Difference	% Dif.	Difference	% Dif.	Difference	% Dif.	Difference	% Dif.
SASH 1.0								
PG&E	$0.25	5%	$0.02	1%	($1.18)	-3%	($0.90)	-2%
SCE	$0.26	5%	$0.02	1%	($0.40)	-1%	($0.10)	0%
SDG&E	$0.06	5%	$0.01	2%	($0.50)	-5%	($0.43)	-4%
All	**$0.57**	**5%**	**$0.05**	**1%**	**($2.07)**	**-2%**	**($1.44)**	**-1%**
SASH 2.0								
PG&E	($0.21)	-9%	($0.03)	-3%	$1.24	6%	$1.00	4%
SCE	($0.23)	-9%	($0.03)	-3%	$0.95	5%	$0.71	3%
SDG&E	($0.05)	-9%	($0.01)	-5%	$0.51	11%	$0.45	8%
All	**($0.48)**	**-9%**	**($0.06)**	**-3%**	**$2.70**	**6%**	**$2.16**	**4%**
Total (SASH 1.0 & 2.0)								
All	**$0.09**	**1%**	**$0.00**	**0%**	**$0.63**	**0%**	**$0.72**	**0%**

4.2.1 GRID Regional Affiliates

GRID implemented the SASH program through regional offices throughout the state. GRID chose the locations of these offices due to their proximity to eligible HUD-qualified census tracts and their distribution across the state. The regional offices worked with GRID headquarters to follow up on leads, but often formed their own relationships with community-based organizations (CBOs) or municipalities local to the region. This regional approach allowed GRID to leverage CBOs and municipalities familiar with the eligible population to overcome the barrier of introducing a new organization to the community.

In addition to helping with community trust and marketing, CBOs and local municipalities provided funding specific to regional offices. For example, the North Valley office in Sacramento leveraged city grants from the City of Stockton to help pay for re-roofing projects for SASH customers that may otherwise not be able to participate in SASH.[13] This allowed the program to move more efficiently with projects that may otherwise be delayed or not approved.

The regional office approach also allowed for experimentation between the offices. For example, in the Greater Los Angeles office (GLA), rather than qualifying customers first then conducting the construction site visit second, as is typical in other offices, outreach coordinators first conducted the construction site visit before collecting all eligibility documents. GLA claims that many customers were disqualified from the program after the site visit stage due to poor housing quality in their region; therefore, they save time by disqualifying them early in the process. Other offices noted that they were aware of this approach but preferred to collect income and homeownership eligibility documentation before sending a construction crew out for the site visit.

4.2.2 Third Party Ownership Model

GRID leveraged a TPO model to help close the gap between the incentive and the cost of the solar systems installed. The TPO model was approved by the CPUC in 2015, and GRID moved most projects over to this model throughout the years. Interviews with GRID found that they used the TPO model wherever possible in order to reduce costs, except for in cases of tribal projects or systems under 2 kW.

In this section, we explain the TPO model in terms of costs and benefits to the homeowner, the program, GRID, and the TPO company. During the evaluation, we identified areas of uncertainty where more data collection and documentation would be required to fully characterize these costs and benefits. We expand on these in Section 6.1.

[13] We expand on this further in Section 4.5.2

In the TPO model, GRID pre-paid a 25-year Power Purchase Agreement (PPA) to the TPO company, then purchased, designed, and installed the system on customers' homes.

The TPO company then paid for the installation cost and provided monitoring and service for 25 years. At the end of 25 years, the TPO company planned to uninstall the system at no cost to the homeowner, offer to sell the system to the homeowner at the depreciated value, or offer to sell a new PPA to the homeowner.

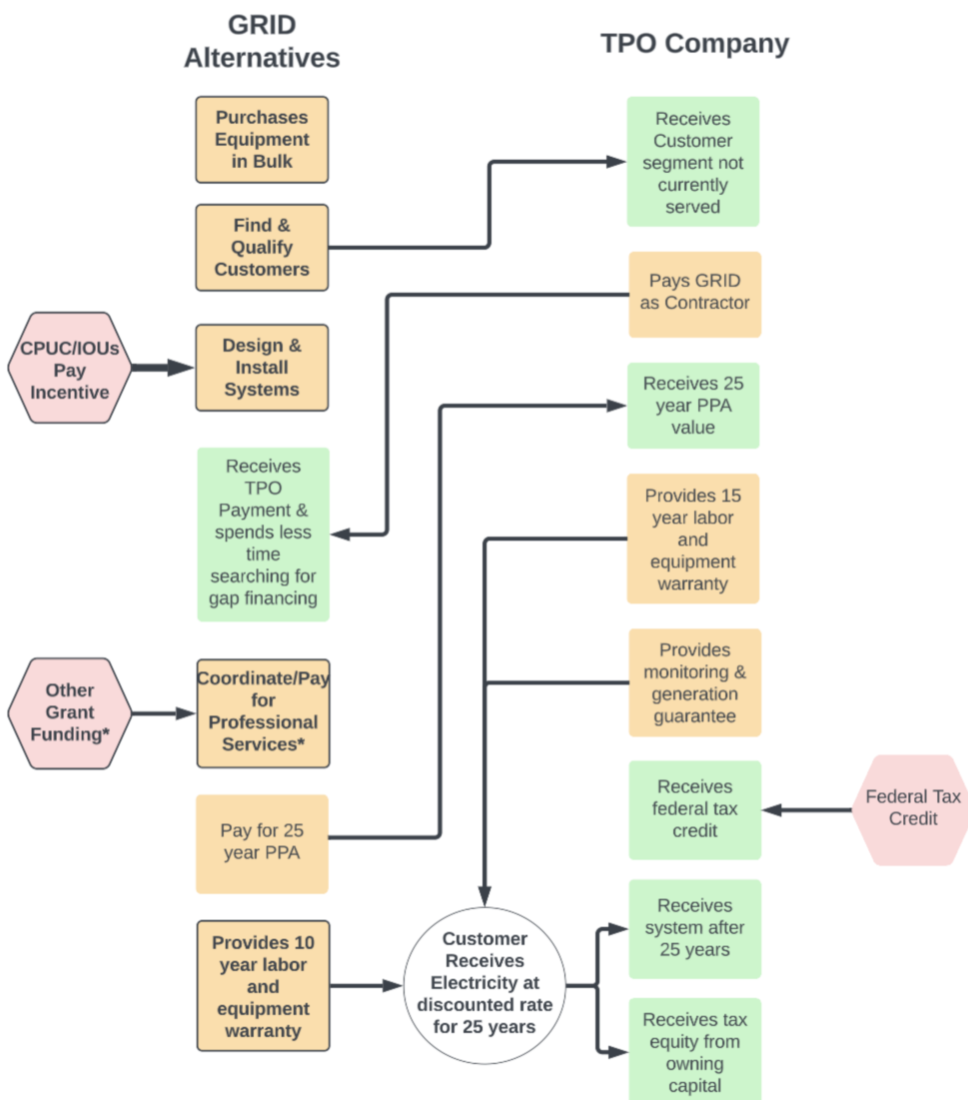
A Power Purchase Agreement (PPA) is a financial arrangement in which a third-party developer owns, operates, and maintains the photovoltaic (PV) system, and a host customer agrees to site the system on its property and purchases the system's electric output from the solar services provider for a predetermined period. In this TPO model, GRID pre-pays the 25-year PPA on behalf of the customer at a pre-arranged assumed rate of generation and energy usage. The customer receives a bill from their utility that is the net of the pre-arranged generation and their specific energy usage. The customer does not receive a bill from the TPO company.

Explaining the TPO Model

Through interviews with GRID staff members and customers, we developed a model to display the various costs and benefits between GRID, the customer, and the TPO company. Notably, the main TPO company involved in these relationships, Sunrun, did not respond to our multiple requests for an interview.

Costs for both GRID and the TPO company are depicted in orange in Figure 3. Benefits or payments to each party are in green. Red items show the benefits that accrue to the CPUC based on the program structures including the use of a non-profit that can leverage grant funding and the use of a TPO that can leverage the federal tax credit. In contrast, for an ownership model, only bolded, outlined cells are active. For example, the federal tax credit is left unclaimed and no activities on the right-hand side of the model occur.

Figure 3: Benefits and Costs of the TPO Model



The costs of participating in the TPO model that are unique when compared to an ownership structure (not inclusive of costs of owned projects) were identified as:

1. The pre-paid 25-year PPA GRID paid to the TPO
2. Staff and administrative time spent coordinating the TPO relationships
3. Staff time coordinating the TPO model with homeowners

Table 9 summarizes the average cost of TPO projects compared to owned projects using costs provided to the evaluation team. This excludes the PPA agreement, staff time coordinating with TPOs, and staff time coordinating with homeowners. These costs include equipment cost, installation cost, and professional services. To normalize across all projects, we report on costs on a per-project and per-kW basis. Additionally, to illustrate how costs have changed over time, the table is segmented by year installed. For SASH projects, we find that **costs per kW** were slightly lower for TPO systems than homeowner-owned systems, but attribute that to the difference in average sizes. On average, TPO systems were larger than owned systems (TPO systems had a minimum system size of 2 kW, compared to owned systems' 1 kW minimum), so there were cost savings in economies of scale.

Table 9: Costs for TPO Systems vs. Owned Systems

Year Installed	Total number of Projects[14]		Average Cost per Project		Average kW per Project		Average Cost per kW	
	Owned	TPO	Owned	TPO	Owned	TPO	Owned	TPO
2009	36		$14,750		2.01		$7,344	
2010	216		$18,896		2.61		$7,245	
2011	767		$20,388		2.95		$6,919	
2012	1364		$20,357		3.19		$6,389	
2013	1050		$17,714		3.00		$5,899	
2014	870		$16,856		3.04		$5,542	
2015[15]	876	123	$16,403	$14,320	3.06	2.87	$5,354	$4,985
2016	305	515	$15,466	$15,485	2.96	3.19	$5,224	$4,849
2017	228	575	$14,515	$15,860	2.79	3.32	$5,201	$4,776
2018	168	907	$14,041	$15,888	2.43	3.39	$5,786	$4,691
2019	163	795	$15,571	$18,113	2.67	3.62	$5,836	$5,004
2020	39	327	$18,738	$19,770	3.61	3.69	$5,189	$5,360
2021	1	135	$14,980	$19,586	3.43	3.94	$4,371	$4,969

The benefits of participating in the TPO model that are unique when compared to an ownership structure (not inclusive of benefits of owned projects) were identified as:

1. The payment from the TPO to GRID as the installation contractor
2. Less staff and administrative time searching for additional funding to cover the gap between the incentive and installation and equipment costs
3. Homeowner receives monitoring and production guarantees

In this report, we have included a range of figures to illustrate the average gap in financing GRID must overcome to keep systems at no-cost for homeowners, however, the contracting cost and PPA pricing agreements between GRID and the third-party solar companies have been requested to be treated as confidential, so we provided a separate memo to the CPUC Energy Division with further detail on these discrepancies. Table 10 illustrates the gap in financing for TPO projects

[14] 41 projects were excluded from this analysis due to insufficient data.

[15] The TPO model was approved in 2015.

compared to owned projects. The gap that GRID must fill with TPO projects is significantly less than the gap it needs to fill for owned projects. This does not account for grant acquisition costs or the PPA and coordination costs mentioned in the previous section.

Table 10: Gap in Financing for TPO Systems vs. Owned Systems

Year Installed	Total number of Projects[16]		Average kW per Project		Average Gap per Project		Average Gap per kW	
	Owned	TPO	Owned	TPO	Owned	TPO	Owned	TPO
2009	36		2.01		$1,598		$796	
2010	216		2.61		$1,740		$667	
2011	767		2.95		$1,341		$455	
2012	1364		3.19		$671		$211	
2013	1050		3.00		$424		$141	
2014	870		3.04		$246		$81	
2015	876	123	3.06	2.87	$2,551	$3,000 - $3,500	$832	$1,000 - $1,500
2016	305	515	2.96	3.19	$4,440	$3,000 - $3,500	$1,500	$800 – $1,200
2017	228	575	2.79	3.32	$6,096	$1,500 - $2,000	$2,184	$400 - $900
2018	168	907	2.43	3.39	$6,646	$1,000 - $1,500	$2,739	$200 - $700
2019	163	795	2.67	3.62	$7,567	$1,000 - $1,500	$2,836	$500 - $1,000
2020	39	327	3.61	3.69	$7,904	$4,000 - $4,500	$2,189	$1,000 - $1,500
2021	1	135	3.43	3.94	$4,699	$3,500 - $4,000	$1,371	$900 - $1,000

We were unable to calculate the full benefits and costs of the TPO model due to the data constraints mentioned previously (i.e., administrative time spent on TPO management and fundraising not collected). However, as we report on in Section 4.8, there did not appear to be evidence that customers who participated using the TPO were seeing less bill savings than homeowner-owned models. Despite the complication of the model, GRID increased its share of TPO projects over the years, indicating that it sees a net value to the relationship.

4.3 Identification of Eligible Customers

This section reports on the characterization of eligible customers. The evaluation focused on understanding the eligible customer market, solar adoptions within that group, and how participation levels varied across the state:

[16] Forty-one projects were excluded from this analysis due to insufficient data.

Evaluation Objective	Summary of Findings
4.3.1 Participation/non-participation by geographic location and other characteristics **4.3.2 Size of the eligible customer market** – We attempted to identify the eligible customer pool for the SASH program to inform assessments of customer participation, program eligibility, and the effectiveness of program outreach and marketing.	Evergreen estimates the total eligible customer pool at 237,000 households. Participation has been well spread out throughout the state; see Table 11. SASH served 4 percent of the 237,000 households; see Table 15.
4.3.3 Market adoptions of rooftop solar among eligible households – We attempted to identify how much natural solar adoption is happening outside of the program among eligible households.	We estimate the upper bound of market adoption among eligible households at 10 percent (11% for PG&E, 6% for SCE, 10% for SDG&E). The number is likely lower due to homes in the eligible population often not being solar-ready.

Additional details on these findings can be found in the remainder of this section.

4.3.1 Participant Distribution Across California

Table 11 characterizes the population served by SASH to date. Participants have been well distributed across the state.

Table 11: Program Participation

Category	Participants	Percent
DAC	3,175	33%
Non-DAC[17]	6,326	67%
Total	**9,501**	**100%**
PG&E	4,415	46%
SCE	4,031	42%
SDG&E	1,055	11%
Total	**9,501**	**100%**
Bay Area/North Coast	1,726	18%

[17] Participants are considered non-DAC if they were not in a DAC at the time of the project. Due to changes in the CalEnviroScreen disadvantaged communities list from V.3 to V.4, some past participants may no longer be in a DAC, but were at the time of eligibility.

Category	Participants	Percent
Central Coast	1,096	12%
Central Valley	2,075	22%
Greater LA	1,257	13%
Inland Empire	1,522	16%
North Valley	770	8%
San Diego	1,055	11%
Total	**9,501**	**100%**

Sections 4.3.2 and 4.5.2 go into detail on barriers to participation beyond eligibility and estimates the number of eligible households in California.

4.3.2 Size of the Eligible Customer Market

For the program, customers must reside in a home defined as affordable housing, as defined by CPUC code 2852, be served by one of the three IOUs, own their home, live in a single-family home, and have an annual household income lower than 80 percent of the area median income.

This Census analysis considers geographic eligibility criteria for the program (i.e., US Department of Housing and Urban Development Qualified Tracts) and other measurable criteria such as income, home type, and homeownership, but does not include the number of homes that are defined under other definitions of affordable housing under CPUC code 2852. This analysis also does not consider whether the eligible households reside in homes are that are "solar-ready." The true number of eligible, solar-ready homes is likely smaller.

To estimate the number of eligible households in California, we used Census data and built a linear regression model on Public Use Microdata Area (PUMA) data. PUMAs provide specific household data such as house type, income, number of occupants, and homeownership. We can determine if a household is eligible for SASH using PUMA data. We then used the regression model and applied it to Census tracts to filter for eligible tracts, which were US HUD Qualified Tracts (HUD QTs). More detail on how we estimated the eligible homes is in Appendix A.

In addition to Census data, we leveraged IOU-provided CIS data, and GRID provided non-participant customer data.

Eligible Customer Maps

Across the state, we estimate there are about 237,000 eligible households, which is about 15 percent of all HUD QT households and almost 2 percent of all households within the state. Of those eligible households, most reside in Pacific Gas and Electric's service territory (48%, or 114,000 households) or Southern California Edison's service territory (44%, or 105,000 households). Very few eligible households reside in San Diego Gas & Electric's service territory, with only 8 percent of the state's eligible households in the region, or about 18,000 households (Table 12).

Table 12: Estimated Number of Eligible Households by IOU

IOU	Estimated Eligible Households	% Of Eligible Population
PG&E	114,000	**48%**
SCE	105,000	**44%**
SDG&E	18,000	**8%**
TOTAL	**237,000**	**100%**

When defining eligibility, GRID first checks a customer's address to see if they reside in a HUD QT or confirms if they are considered affordable housing. Table 13 shows the percent of the population that live in HUD QTs and the percent of those households that are eligible. Once they are confirmed to live in a HUD QT, SCE customers are more likely to be eligible by income, homeownership, and home type, with almost 16 percent of households in those tracts eligible (compared to 14% or 13% in PG&E and SDG&E).

Table 13: Eligibility Estimates by IOU

IOU	IOU Households	HUD QT Households		Estimated Eligible Households		
		N	% Of all IOU HH	N	% Of HUD QT	% Of All IOU HH
PG&E	4,711,933	794,781	16.9%	114,000	14.4%	2.4%
SCE	4,227,833	668,324	15.8%	105,000	15.7%	2.5%
SDG&E	1,050,568	135,132	12.9%	18,000	13.3%	1.7%
Total	**9,990,334**	**1,598,237**	**16.0%**	**237,000**	**14.8%**	**2.4%**

Figure 4 displays the eligibility rate by Census tract, with more detail in the Bay Area and Greater LA Area in Figure 5. Most tracts are grey, as eligibility for this analysis was constrained by HUD QT. The percent eligible is shown by a gradient, and tracts with higher proportions of eligible households are filled in yellow, while homes with lower proportions are filled in purple. On average, 10 percent of households in a HUD QT are eligible for the program.

Figure 4: Eligibility for Program by Tract

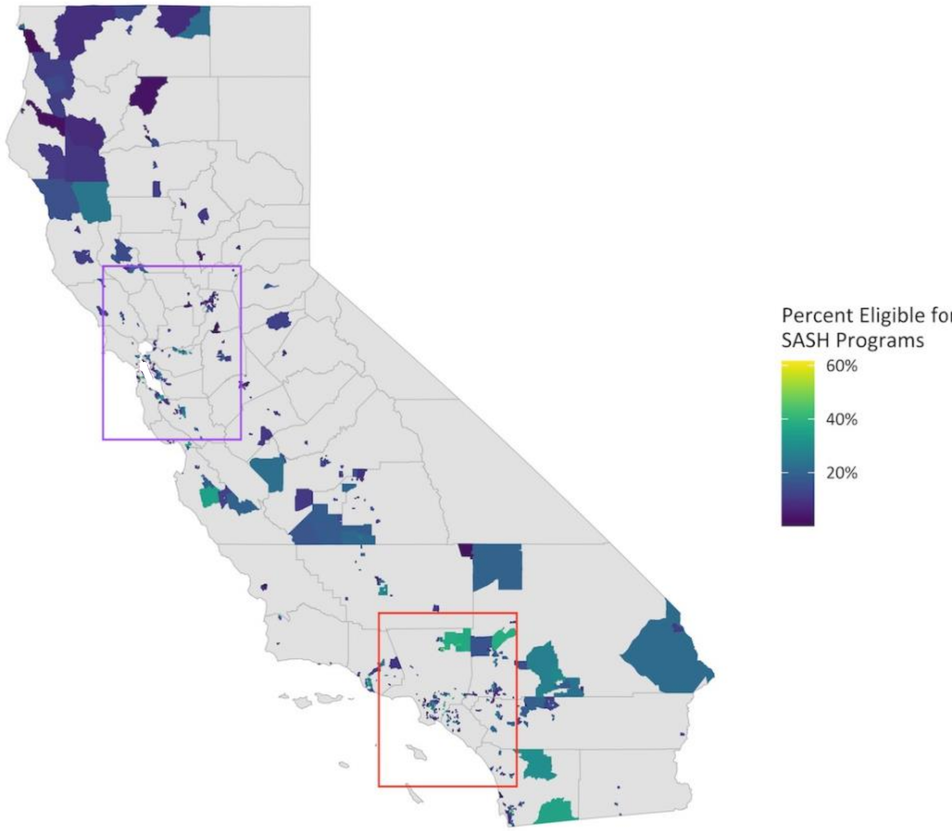
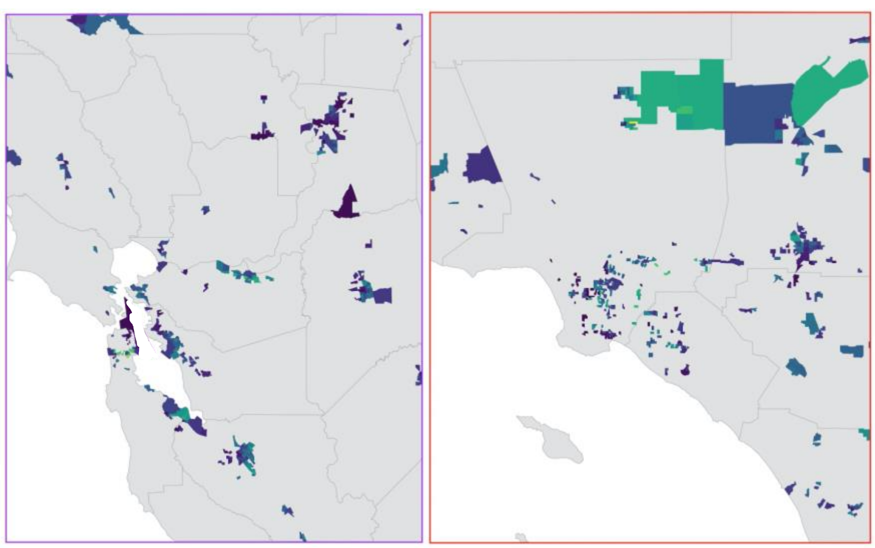


Figure 5: Eligibility for Program by Tract - Bay Area and Greater LA



Interviews with GRID staff found that each office served specific counties near them, but there were exceptions in cases where leads for new customers were managed directly by the regional office and there was flexibility to accommodate capacity constraints. To examine the difficulty in finding eligible customers by GRID regional office, we analyzed the estimated number of eligible households within certain radii of each office location. We pulled the addresses of all completed projects and their associated offices to determine the minimum, average, and maximum distance each office travels. Note that distance had implications for drive time for both outreach staff and installers, who travelled both to the office for equipment, and to homes for installations.

Historically, GRID pursued projects within a certain range of each office, but that range differed based on location. For example, Table 14 shows that projects in the Inland Empire were much farther out than projects in Greater Los Angeles. Central Valley projects had the least number of projects within average distance, with 45 percent. These differences were likely to do with drive times. Driving 20 miles in Greater Los Angeles would take much longer than driving 20 miles in the Inland Empire, for example.

Table 14: Historic Data on Distance Travelled for SASH Projects by Office

GRID Office Assigned	Minimum Distance (Miles)	Average Distance (Miles)	Maximum Distance (Miles)	Number of Projects Served	% of Projects within Average Distance
Bay Area	0	19	106	1364	63%
Bay Area/North Coast	0	53	132	362	66%
Central Valley	1	44	146	2166	45%
Greater Los Angeles	4	22	76	1309	65%
Inland Empire	2	68	467	1672	78%
North Valley	1	32	115	771	51%
San Diego	0	12	56	1063	74%

To assess the coverage based on the office locations, we used these historic distance data to estimate the number of eligible households within a reasonable range from each office. All eligible homes were within the maximum distance that GRID has historically traveled to in the past for an installation, but only 68 percent of all homes are within the average driving distance, suggesting that nearly a third of the eligible households would have required additional travel time compared to the average. These findings are reported on in more detail and visualized in Section 6.2.

Program Penetration

As explained in the previous section, we estimate the number of SASH-eligible households to be around 237,000. With the number of completed installations at 9,501 at the time of this research, program penetration is estimated to be 4 percent across the state. In Table 15, we analyze the program penetration by GRID regional office and find that the Central Valley and North Coast offices had the highest program penetration, while Greater Los Angeles and Inland Empire had the lowest. We estimated program penetration based on the average distance travelled for projects for each regional office. Note that about a third of all eligible households would not be served with this distance assumed, as shown in the last row of the table.

Table 15: Program Penetration by GRID Regional Office, Average Distance

GRID Regional Office	Distance Assumed (mi)	Total Households Served by IOU	Total HUD QT Households Served by IOU	Estimated Eligible	Total Program Participants[18]	Program Penetration
Bay Area	19	1,221,321	266,640	34,000	1,363	4.0%
Bay Area/North Coast	53	59,724	16,986	3,000	362	13.5%
Central Valley	44	393,438	54,953	7,000	2,075	30.3%
Greater Los Angeles	22	1,550,627	222,982	36,000	1,257	3.5%
Inland Empire	68	2,443,730	334,956	54,000	1,522	2.8%
North Valley	32	540,423	92,737	10,000	770	7.5%
San Diego	12	597,084	140,482	19,000	1,057	5.6%
Outside of Office Range		3,183,987	468,502	75,000		
Total		**9,990,334**	**1,598,237**	**237,000**	**9,501**	**4.0%**

Our analysis concludes that travel time to cover the wide spread of eligible homes, especially in rural tracts or tribal lands that are further from regional offices, was a challenge to finding eligible customers, but not necessarily a barrier. Interviews with GRID found that for tribal projects in the Inland Empire, staff members arranged to set up at a community center for a few days. This time would align with multiple scheduled installations in the area. GRID staff then conducted marketing and outreach activities, arranged site visits to assess solar potential, and took applications for the program. This batched process allowed for more one-on-one engagement of the population but also reduced per-unit costs of installation for these further regions.

4.3.3 Market Adoptions of Rooftop Solar

Evergreen heard from both customers and from GRID that targeted customers had been reached by other external solar companies with offers to install rooftop solar. These offers were partly responsible for distrust in the program truly being no-cost to customers and indicated that there may be eligible participants who take a different pathway to solar. Evergreen triangulated an estimate of market adoptions outside of the program using both CIS data and non-participant responses to our survey. Overall, about a fifth of surveyed non-participants who had heard of the program had installed solar without the use of the SASH program (19%, total n = 74).

[18] 1096 program participants were assigned to the Central Coast office, which no longer exists and was not evaluated.

Based on analysis of IOU CIS data of non-participants, the upper bound of market adoption in the eligible population is about 10 percent (11% for PG&E, 6% for SCE, 10% for SDG&E).[19] Surveyed eligible non-participants that had not heard of the program reported a much higher rate of market adoption with about a third (34%, total n = 68) responding that they had installed solar panels without the use of the program. This is likely due to the recruitment method for the survey. The evaluation recruitment postcard mailed to non-participants mentions the CPUC and that we were conducting a survey about solar panels. Customers with solar panels may have been more likely to take the survey, while customers without were more likely to think the survey was not relevant to them.

We examined how this group of low-income homeowners were able to install solar and found that many reported paying for the system on their own, with the help of a tax credit, or another organization (Table 16).

Table 16: Assistance Received (n = 22)

Type of Assistance	N	%
Paid on own	5	23%
Received a tax credit	8	36%
Received help from another program or organization	6	27%
Something else	3	14%

4.4 Marketing to Customers

In this section, we share GRID's marketing strategy, including its use of data from external sources. We then share customer opinions on solar in general, on GRID's marketing strategies, and on the clarity of marketing material from both GRID and the IOUs.

GRID used several marketing and outreach strategies to reach eligible customers. These strategies differed by regional office and IOU service territory to best serve the population reached. Based on the review of background documents, we understand that GRID used a variety of marketing and outreach strategies – it leveraged partnerships with existing organizations; provided consumer education sessions; encouraged adopters to share their participation experience with their friends and neighbors; and used media, marketing collateral (including co-branding with cities, counties, and IOUs), and events to raise awareness. GRID modified its strategies to adapt to COVID-19-related constraints that impacted construction logistics and marketing and outreach approaches.

[19] Additional details on how we estimated the upper bound of 10 percent and the motivations non-participants gave as to why they received solar may be found in Section 6.2.

4.4.1 Program Lead Generation

GRID headquarters purchased lists of potentially eligible customers from sources such as Faraday,[20] an online prediction-based marketing tool, then cleaned the data and forwarded it to the regional offices. Regional offices leveraged existing relationships with local CBOs and hosted their own marketing and outreach events. They also followed up on referrals from participants to generate new leads. This section evaluates the data limitations and successes.

Once customer leads were generated, regional offices took different approaches to qualifying and moving customers through the program. All regional staff interviewed pre-screened customers by phone or in-person (if at an event). In some regions, like the Central Valley and the Bay Area, they first qualified customers by requiring proof of income and home ownership, but others, such as in the Greater Los Angeles area, they began with a site visit to ensure the home is solar ready. Outreach coordinators in Los Angeles mentioned that out of around 550 site visits last year (DAC-SASH and SASH projects), only about 250 homes qualified after the construction site visit. In other regions, outreach coordinators agreed that home quality was a significant barrier to participation, but that they started with the income and ownership verification to save time driving out to sites that were not ultimately eligible. This difference may be attributable to different housing stock and drive time requirements for each regional office. For example, in the Greater Los Angeles area, housing stock issues were a frequent barrier, so the office found it more efficient to conduct the construction site visits before gathering all documentation from the homeowner. On the other hand, in the Inland Empire, projects were more spread out, so gathering all documentation and ensuring homeowners are eligible before conducting the site visit was more appropriate. Allowing GRID to experiment across regional offices is a benefit of the flexibility of the program rules.

Data Sources

GRID received leads from CBOs and municipal partners, online marketing lists, and customer referrals. Table 17 describes different sources and their successes and limitations.

Table 17: Success and Limitations of Different Lead Sources

Data Source	Description	Successes	Limitations
Partner Leads	Local community-based organizations, municipalities, and other low-income programs referred customers to SASH.	Similar eligibility requirements, leads tailored to the needs of the regional office	Eligibility for SASH was harder to meet than other low-income programs.
Faraday	Faraday is an online prediction-based marketing tool that purchases data from various sources, then uses a proprietary predictive model to provide lists of potentially eligible leads	Eligibility information on ownership and income were fairly accurate.	Lists were not geographically strategic and could not identify affordable housing or HUD Qualified Tracts. GRID

[20] Accessed at: https://faraday.ai/

Data Source	Description	Successes	Limitations
			staff had to manually clean these lists.
Referrals	GRID provided a referral bonus for SASH customers to refer friends. Sunrun also provided a bonus that could be stacked.	Communities were likely to share with each other and word-of-mouth was trustworthy.	Not able to break into new markets by word-of-mouth only

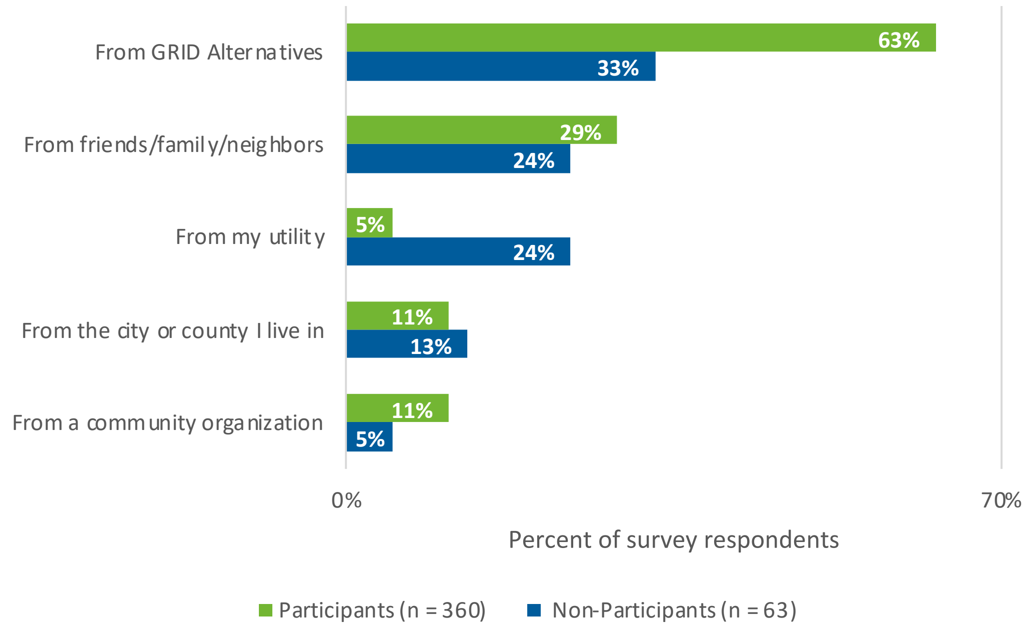
Many GRID staff reported that referrals were the best way to generate new leads for the program. Working with CBOs lent credibility to GRID and allowed staff to reach eligible populations that may not trust IOUs or the CPUC.

GRID's referral program provided a cash referral bonus for participants that referred an eligible neighbor to the program. Participants were also able to stack a referral bonus from Sunrun if they had a TPO system. The monetary incentive, paired with the established credibility of hearing about the program from someone they know, helped increase word-of-mouth about the program and led to increased participation.

4.4.2 Customer Perspectives on Marketing

GRID reported that most participants heard of the program through referrals, and program participants confirmed that that was the second most likely place they heard about the program after hearing from GRID themselves. In Figure 6, survey results from both program participants and non-participants aware of the program found that both groups reported hearing of the program from GRID (63% and 33%, respectively), or from friends, family, or neighbors as a referral (29% and 24%, respectively). Non-participating customers more often heard of the program from their utility (24% vs. 5% of participants). Neither participants nor non-participants emphasize learning about the program from a community organization.

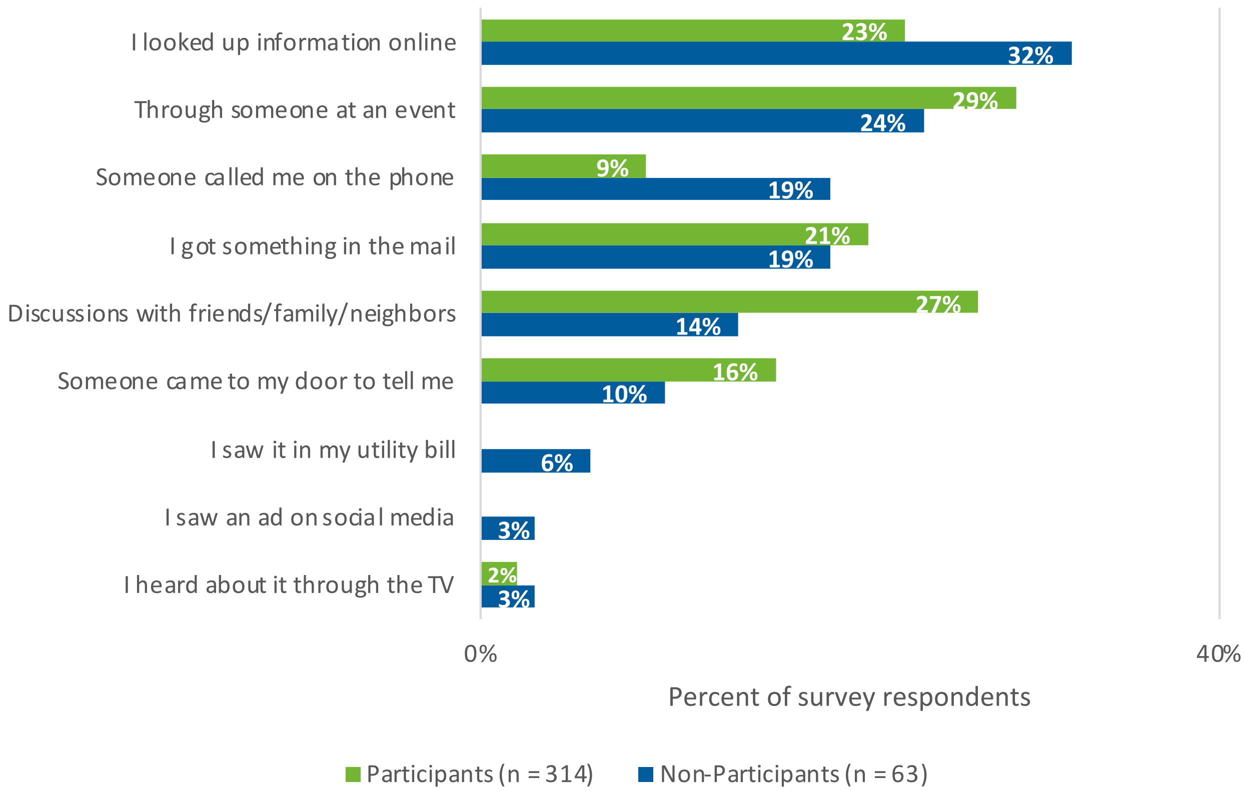
Figure 6: Program Information Source Reported by Survey Respondents (multiple responses allowed)



Both participant and non-participant respondents that heard about the program through their utility were mainly Southern California Edison customers (67% and 60%). This aligns with what we heard in GRID interviews that their co-marketing with Southern California Edison has been successful in generating leads.

Figure 7 reiterates the way in which people learned about the program through word of mouth, with 27 percent of participants receiving information from friends/family/neighbors. Non-participants were less likely to have had discussed the program with friends/family/neighbors, indicating that respondents may be more likely to participate if they already know and trust the opinion of someone else who has participated.

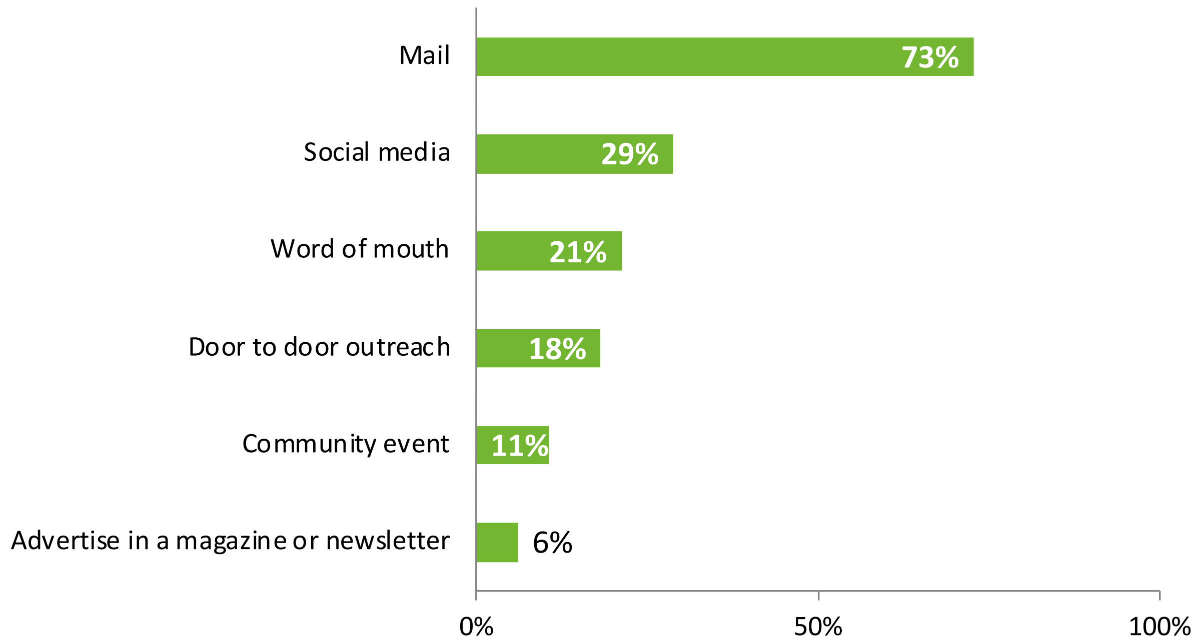
Figure 7: Program Information Mode Reported (multiple responses allowed)



Both participants and non-participants were asked to suggest outreach strategies that may work within their communities to get information out about SASH. Participants and non-participants suggested expanding outreach about the program to social media (56%, n = 343 for participants and 52%, n = 63 for non-participants), which was not a common source of information from current participants. Some respondents also cited specific magazines and events to commit better community outreach (24% of participants and 10% of non-participants): a booth at a local farmers market, community council meetings, church events, health fairs, local schools or law enforcement, resource fairs, and community centers. Of those who recommended advertising in a magazine or newsletter (6%), the *Hi-Desert Star* and the *North Coast Journal* were specifically noted.

We also asked non-participants unfamiliar with the program about their preferred sources of information about energy programs. Mail and social media were both popular responses (73% and 29%, Figure 8).

Figure 8: Preferred Marketing Methods by Unaware Non-Participants (n = 66)



Of respondents that selected community events (11%), a few offered examples including "senior center," "town fair," and "weekly farmers market". A handful of respondents (6%) recommended advertisements in a magazine or newsletter, specifically "local paper" or "Revista de la Ciudad". Of respondents that selected "other" (5%), a couple provided examples: "email" and "online". Most non-participants expected to hear about energy programs from their utility. The majority (80%) of non-participant respondents stated that they receive information about energy programs from their utility.

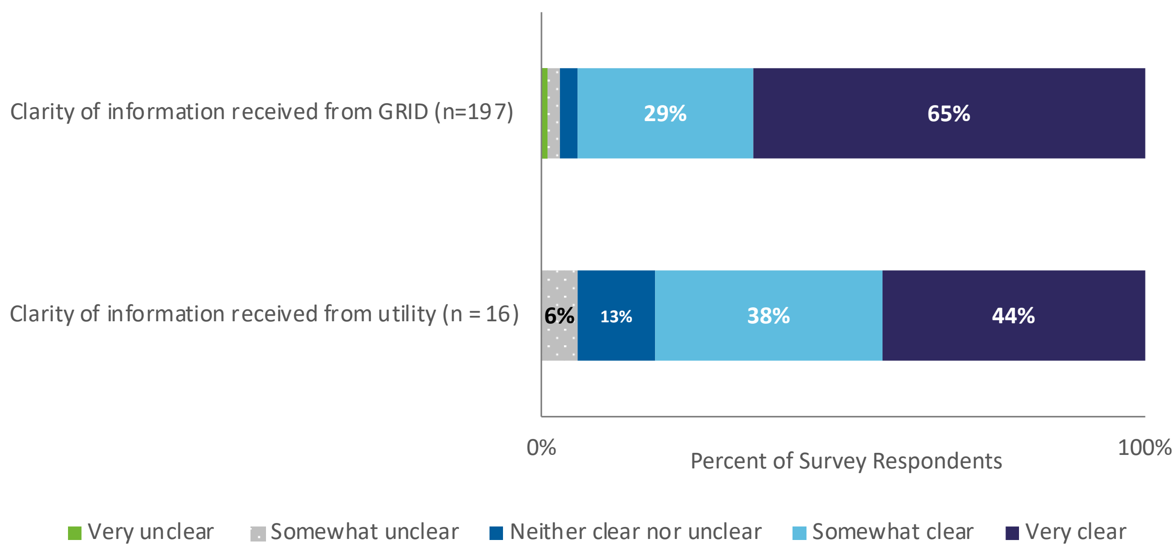
4.4.3 Clarity of Marketing Materials

Over the course of the program, GRID had tested different marketing materials and messaging to recruit eligible participants. Field visits to regional offices allowed us to confirm that marketing materials are translated into the regions' most common languages: English, Spanish, Mandarin, and Cantonese. GRID's ME&O plan also lists Korean, Vietnamese, and Tagalog.

As part of their customer journey, GRID first presented all customers with a homeowner orientation. These orientations varied by region and were presented by GRID outreach coordinators. Some homeowner orientations were one-on-one, and others were in a small group setting. During a field visit, we attended an orientation and found that the outreach coordinator was diligent about answering questions. The questions the homeowner had mirrored what we found in the survey: not understanding the ownership model, how solar panels work, and how their bill would change.

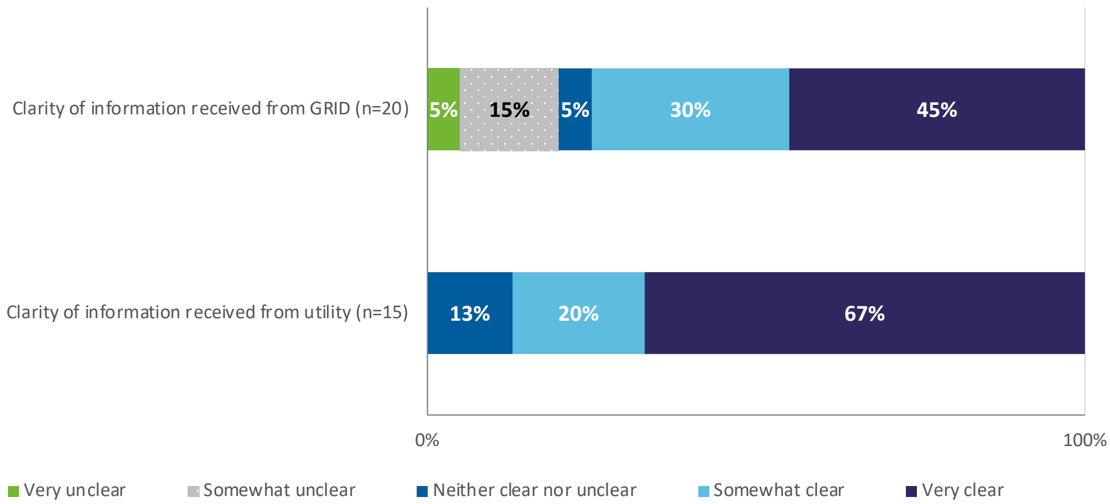
A significant percentage of respondents reported that the marketing materials received from both GRID and their utility were 'very' or 'somewhat clear', with only a very small minority saying otherwise (Figure 9). However, respondents were more likely to report that the information was somewhat unclear when they received it from their utility.

Figure 9: Clarity of Information Reported by Participants



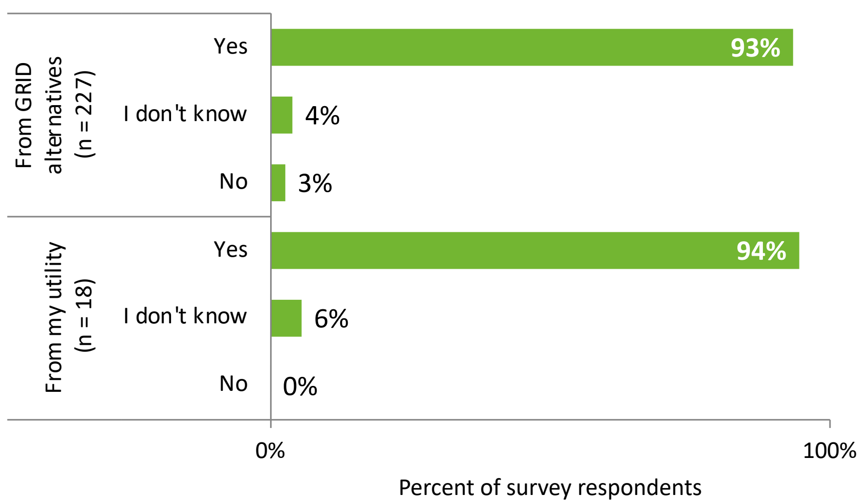
Non-participants who were aware of the program were more likely to say the information received from GRID was very or somewhat unclear when compared to information received from their utility (Figure 10). Interviews with GRID indicated that educating customers on the program and gaining their trust was a barrier. Surveyed non-participants may have had some confusion regarding the program if they were not able to move forward with the program.

Figure 10: Clarity of Information Received Reported by Non-Participants



Ultimately, most surveyed participants reported that they had access to enough information needed to participate in the program (93%), regardless of how they first heard about the program. As shown in Figure 11, respondents that learned about the program through GRID were more likely to report that they had enough information compared to those that heard about the program through their utility (93% and 94%).

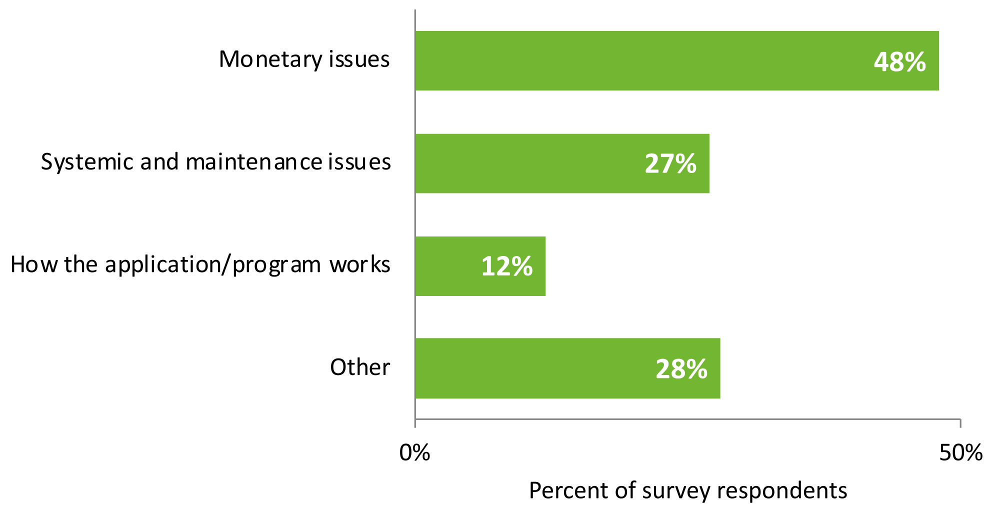
Figure 11: Access to Enough Information Needed for Program Participation



Surveyed participants who did not feel they had enough information to participate provided free-text responses to explain why (n = 100). We categorized those responses by topic. Figure 12 shows that many did not understand issues related to the system itself (including maintenance) (27%), monetary issues (48%), and how the program or application process works (12%). Other responses included:

- Not understanding how ownership works (n = 14)
- How the program works in relation to their utility (n = 5)
- How to receive a battery system (n = 5)

Figure 12: Topics that GRID Alternatives Discussed that Have Not Been Understood Properly (n = 100, multiple responses allowed)



A few (n = 4) non-participants that were aware of the program also shared what was unclear about information they received. The responses included confusion around the following topics:

- Process: did not understand length of process (1); did not understand “downsides” of program (1)
- Financial implications: financial commitment (1), income guidelines (1)
- Communication: was not provided adequate information (1)

4.5 Customer Participation

The evaluation focused on the following metrics associated with customer participation. Findings are expanded upon in the sections below.

Evaluation Objective	Summary of Findings
4.5.1 Customer satisfaction with the programs – A study component was used to solicit input from customers on their experience enrolling in the programs, experience, and satisfaction with the PA, and identify ways to improve their satisfaction going forward.	Customer satisfaction was high amongst participants. Non-participant satisfaction levels reflect frustration with realizing they were ineligible for reasons such as solar-readiness or changing program guidelines.
4.5.2 Effectiveness of the programs in addressing barriers to participation – The CPUC identified several barriers to clean energy adoption among residential customers, and these programs were designed to address those barriers.	Barriers identified include: • Trust in the program offering • Solar-readiness • Unpermitted work • Low energy usage

Part of the study's charge was to identify awareness among target customers of the various programs designed to serve them and whether the programs helped increase enrollment in the other programs. The evaluation also asked customers and reviewed program data to see if customers were being enrolled in other related programs.

Evaluation Objective	Summary of Findings
4.5.3 Enrollment in related programs such as CARE/FERA and ESAP for income-eligible customers.	Interviews with GRID staff found that there was not a formal process to actively refer program participants to CARE or other programs, and this was reflected in our findings of lower participation numbers in programs like CARE (39%). While there was a formal referral for ESA, enrollment was low (11%).

4.5.1 Customer Satisfaction

This section details the participant experience and includes findings from the customer surveys on satisfaction with the program. Overall, customers reported high satisfaction.

Interviewees staff from GRID and IOUs reported that they perceived customer satisfaction to be high; this was confirmed via customer surveys. From the perspective of program implementation staff, complaints from program participants were related to timing, and most complaints came from non-participants who were frustrated to find that they were ineligible.

Nearly half of all program participants (42%) provided feedback about the program via free-text response. Of the respondents that provided feedback, over half (55%) expressed general gratitude, such as “very satisfied”, or “we are very grateful for the solar panels....” Table 18 displays the other topics mentioned in the free-text responses, including program communication, general feedback, and requests for additional support, with some respondents mentioning more than one thing.[21]

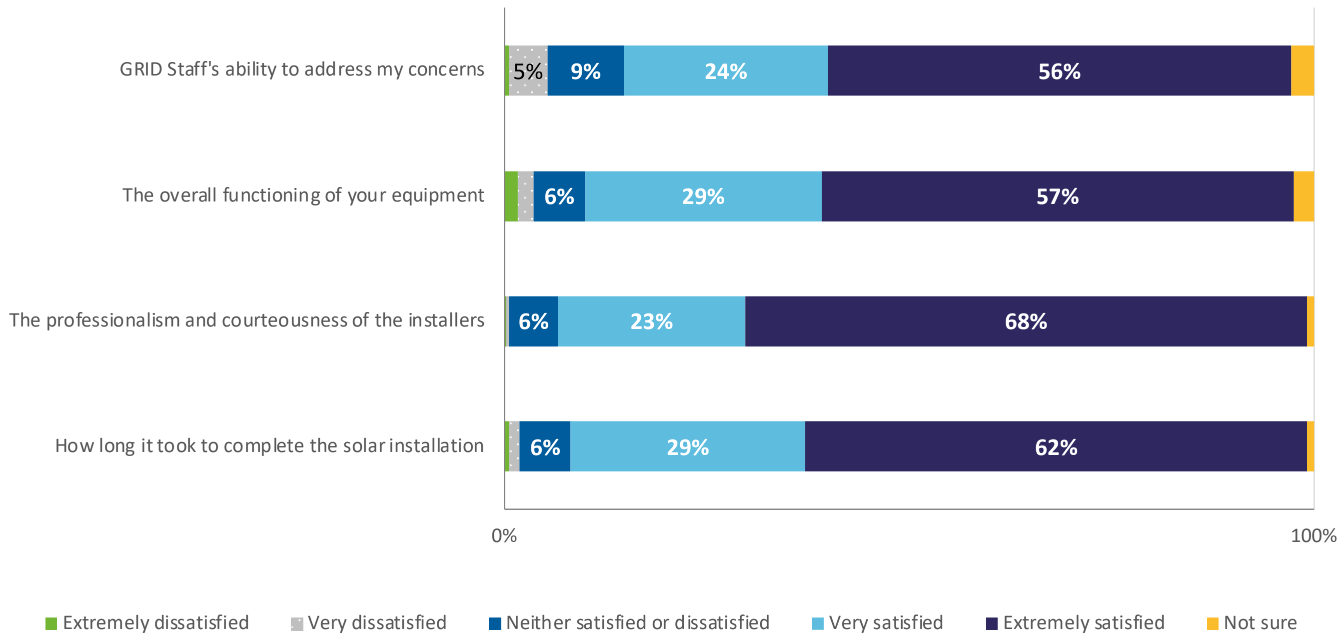
Table 18: Participant Program Feedback from Subset of Respondents (n = 156, multiple responses allowed)

Feedback Theme	Types of Responses	% of Respondents
General gratitude	Includes expressions of gratitude such as “thank you to everyone involved” and “I’m just so grateful…”	55%
Program communication	Includes requests to increase bill transparency, bill amount concerns, recommendation for more accessible outreach/marketing/educational resources, and notes on customer service	38%
General feedback	Includes specific notes on savings from program, demand for program or eligibility criteria expansion, criticism on overall process and providers, complaints on installation, notes on ethical impact of program or opinion on program	23%
Request for additional support	Includes requests for upgraded or additional technology, batter, or machinery installation, additional support: demand for more maintenance, need for general repair or installation, need for greater assistance or referral to other assistance	31%

To assess satisfaction across program elements, surveyed customers were offered a scale from extremely dissatisfied to extremely satisfied to measure four components of their experience with the program: GRID’s ability to address concerns, overall functioning of equipment, professionalism and courteousness of installers, and length of solar installation time. All four components reflected a “satisfied” (extremely satisfied or very satisfied majority) customer experience (Figure 13).

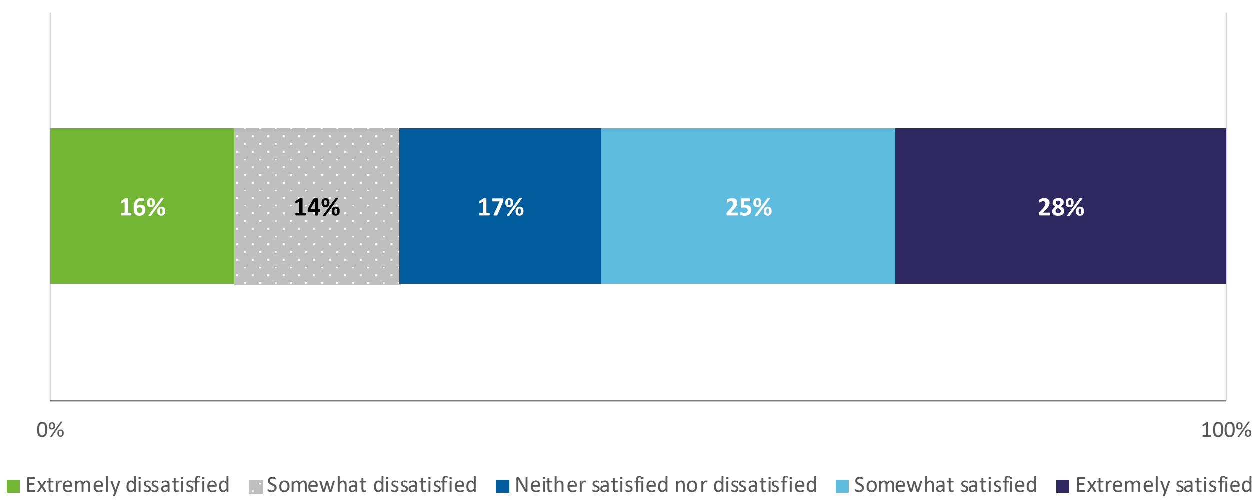
[21] A response could be included in one or more categories. For example, some respondents expressed general gratitude but also requested additional support.

Figure 13: Satisfaction with Installation (n = 368)



We also asked non-participants that had interactions with GRID to share their level of satisfaction with GRID. Figure 14 shows that while respondents were more satisfied than not, there were more dissatisfied responses than among participants.

Figure 14: Non-participant Satisfaction with GRID Alternatives (n = 64)



Many respondents expanded on their response in a free text section. Most dissatisfied respondents cited eligibility or solar readiness for their complaints against GRID, although some did report a lack of communication or poor customer service. We expand upon these barriers in

Section 4.5.2. Among satisfied respondents, however, most reported that GRID's explanations were clear and that staff members were friendly. Table 19 categorizes these findings and provides quotes to illustrate the groups' responses.

Table 19: Satisfaction Among Non-Participants (n = 54)

Interest	Topics	Quotes
Dissatisfied (30%)	Poor communication (12) Home not solar-ready (8) Not enough information (5) Not eligible (3)	"I was to have the system installed and at the last minute they said they couldn't install on my roof. I waited one year for this answer" "They did not give an opportunity to fix the lack of sun they just shut it down" "I had to discover the real facts about the system offered through my own research" "They did not provide a clear enough answer as to when the zip code eligibility rule changed,"
Neither Satisfied nor Dissatisfied (17%)	Home not solar-ready (8) Not eligible (3) Poor communication (3) Not enough information (2)	"I wish they told me that you needed a new home and electrical boxes to add solar…" "I'm still waiting so I have hope that I will be contacted and move forward with this project." "For over three years, I've been reaching out for panels, but there's not (any) project in my area."
Satisfied (53%)	Poor communication (15) Good customer service (17) Not enough information (6) Home not solar-ready (7) Not eligible (4)	"They never called me… I was the one who called them to find out about my status on the application" "Very pleased with their work, communication was great" "Was told out of funding and they would be in touch but never heard again" "The application process was a little difficult… then felt so disappointed when I received the letter telling me I wasn't getting solar" "when my roof needed upgrading in order to move forward, I felt I no longer mattered"

Application Process

Interviews with GRID found that most customers understood the application process. The process was to have an outreach coordinator walk through the documents with the customer or to send them documents and be available for questions via phone or email. Most respondents found the application submission very easy or somewhat easy, regardless of how they completed the applications (Figure 15).

Figure 15: Difficulty Completing Application (n = 142)

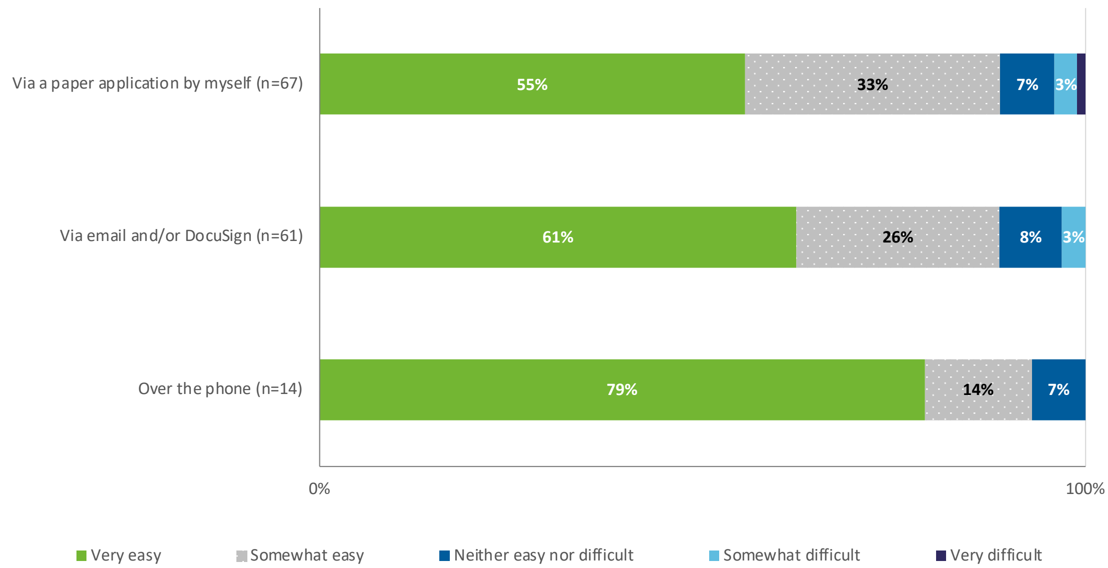
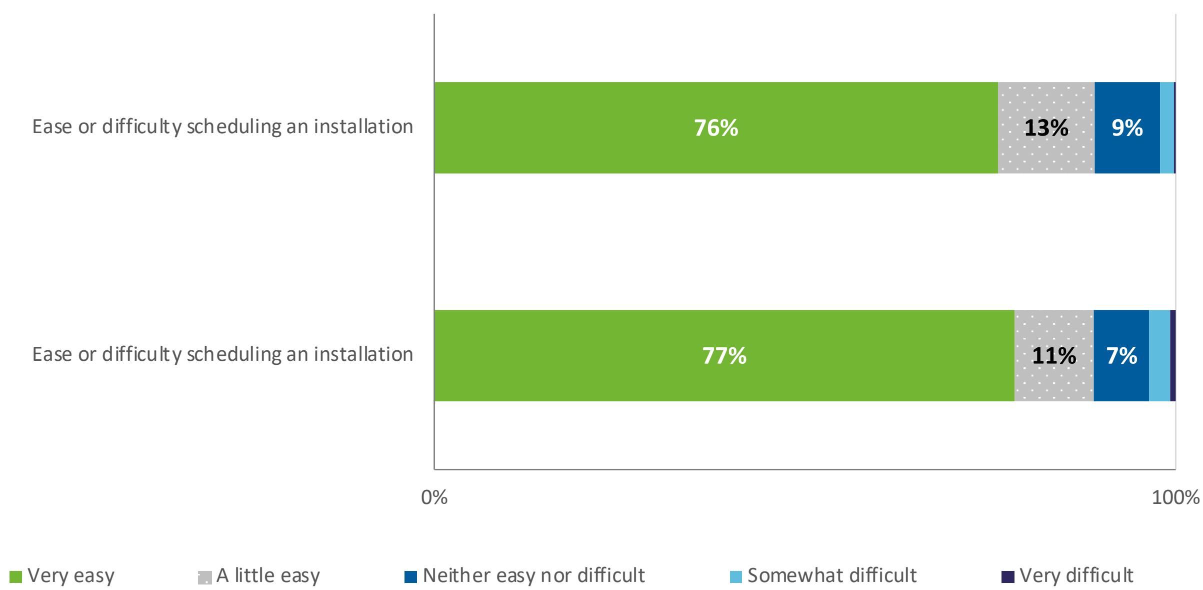


Figure 16 displays levels of ease or difficulty participants experienced when scheduling an installation and the installation overall. Most participants responded that their experiences with installation and its scheduling were "very easy" (76%, 77% respectively).

Figure 16: Ease of Difficulty with Program Elements (n = 368)



4.5.2 Barriers to Participation

GRID staff interviews found barriers that eligible participants may face. Common factors where eligible customers did not move forward with the program, as reported by GRID staff, were:

- Distrust in the program
- Ensuring the home is solar ready
- Energy usage too low to qualify
- Unpermitted work on property

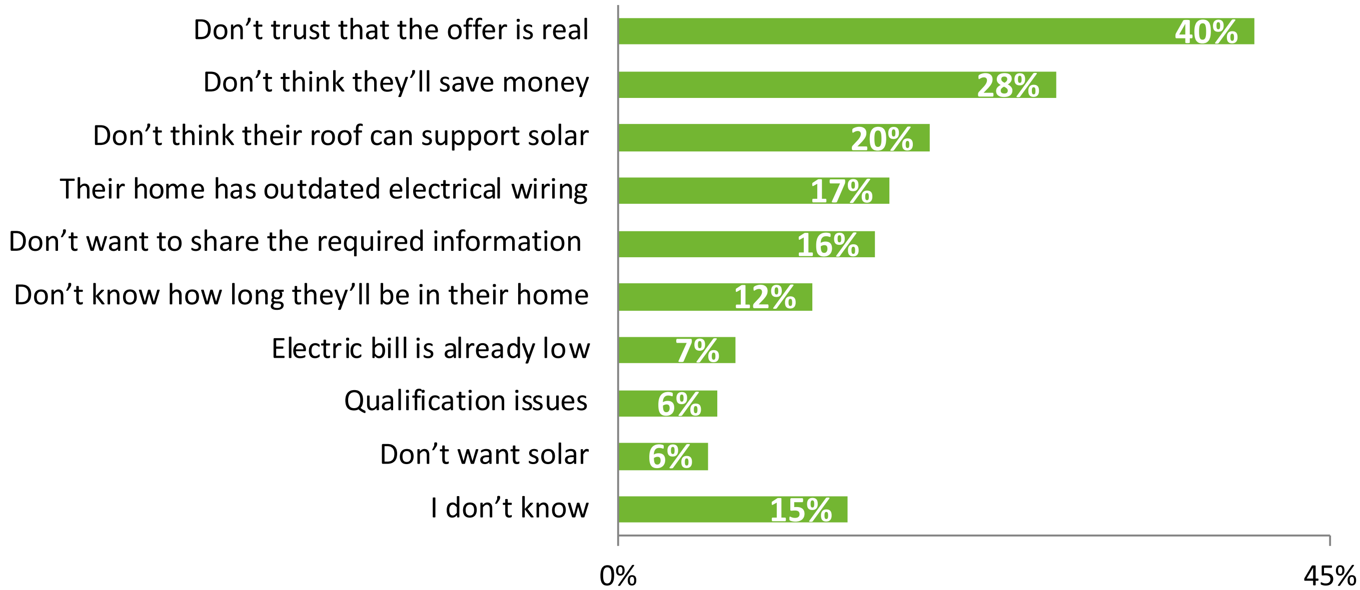
GRID tracked barriers to participation in its program data by indicating whether a customer is inactive or active. Inactive customers included an inactive reason and may include one or more reasons. An analysis of these inactive customers confirmed that many customers did not move forward due to solar-readiness issues such as problems with the roof (44%), code enforcement issues (13%), solar shading, orientation, or pitch issues (12%), or other services needed (6%). Less than a fourth of inactive customers (23%) were inactive due to lack of interest or lost contact, and only 17 percent of customers were deemed ineligible after initial screening of homeownership and income. Table 20 displays all reasons documented by GRID. Note that a customer could be marked inactive for more than one reason, so the percentages shown are of all inactive customers but do not add up to 100 percent.

Table 20: Recorded Reasons for Inactivity (n = 1,728)

Inactive Reason	Detailed Reason	Percent of all Inactive Customers
Home not solar-ready	Roof Issues (unsafe, repairs needed, or too small)	44%
	Code barriers	13%
	Solar shading, orientation, pitch issues	12%
	Other professional services needed	6%
Not interested	Not interested in program	18%
	GRID lost contact with customer	5%
Eligibility	Not eligible	9%
	Energy usage too low	4%
	Other ineligible	4%

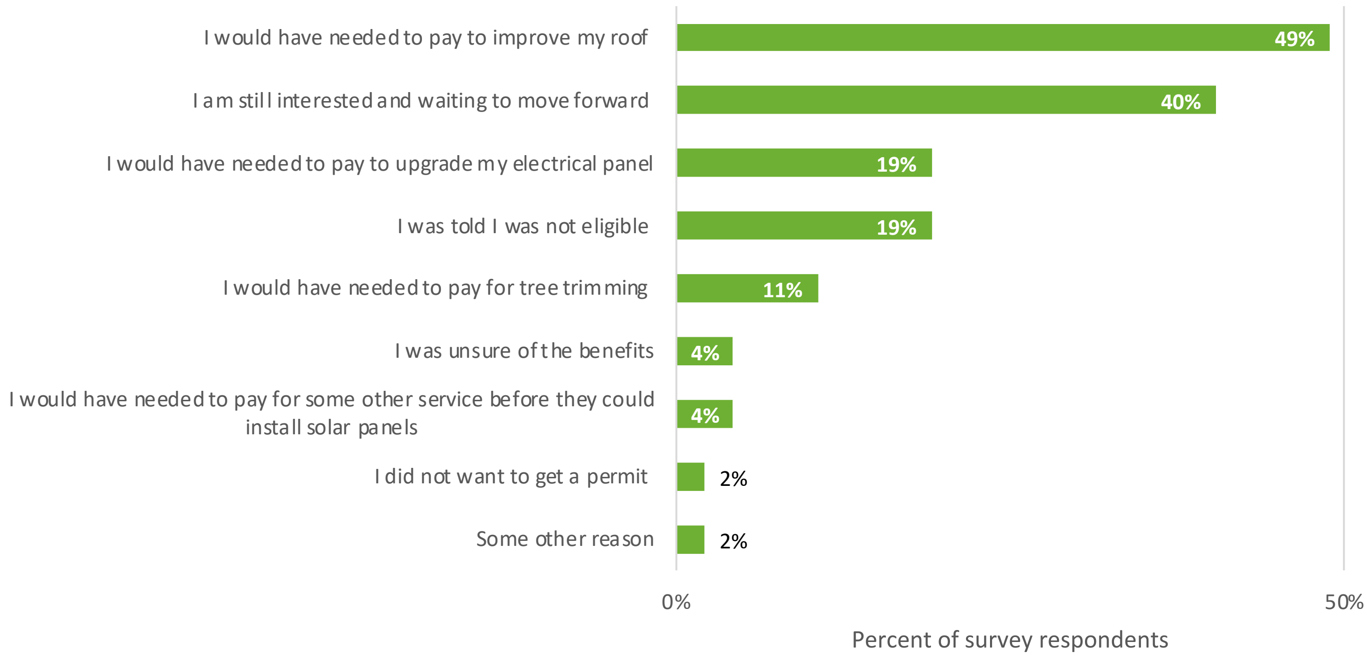
Figure 17 shows that participant-reported barriers align with those reported by GRID, and these are further confirmed in our non-participant survey results shown in Figure 18. Amongst participants, distrust regarding the authenticity of the offer (55%) was most common. Doubts about their ability to save money through the program (32%) and their unwillingness to share required information (22%) were also common responses.

Figure 17: Reported Obstacles to Participation (n = 130, multiple responses allowed)



Notably, interest in solar in general was not a large barrier reported in the survey (see Section 6.4). To further understand why customers who had heard about the program had not yet participated, we asked non-participants to expand on their reasons for not yet participating. Figure 18 shows that about 40 percent of non-participants reported that they are still interested in participating, and the rest of the respondents would have needed to repair their roof before participating (49%), upgrade their electrical panel (19%), or undertake some other service (4%). Only a few respondents reported that they were unsure of the benefits (4%).

Figure 18: Reported Reasons for Not Participating (n = 47, multiple responses allowed)[22]



In the remainder of this section, we expand on the barriers to program participation as identified by GRID, participants, and non-participants.

Trust in Program Offering

Many participants (36%) shared that they felt that the offer seemed too good to be true while deciding to participate in the program (Figure 19). Seventeen percent shared a free-response answer, including:

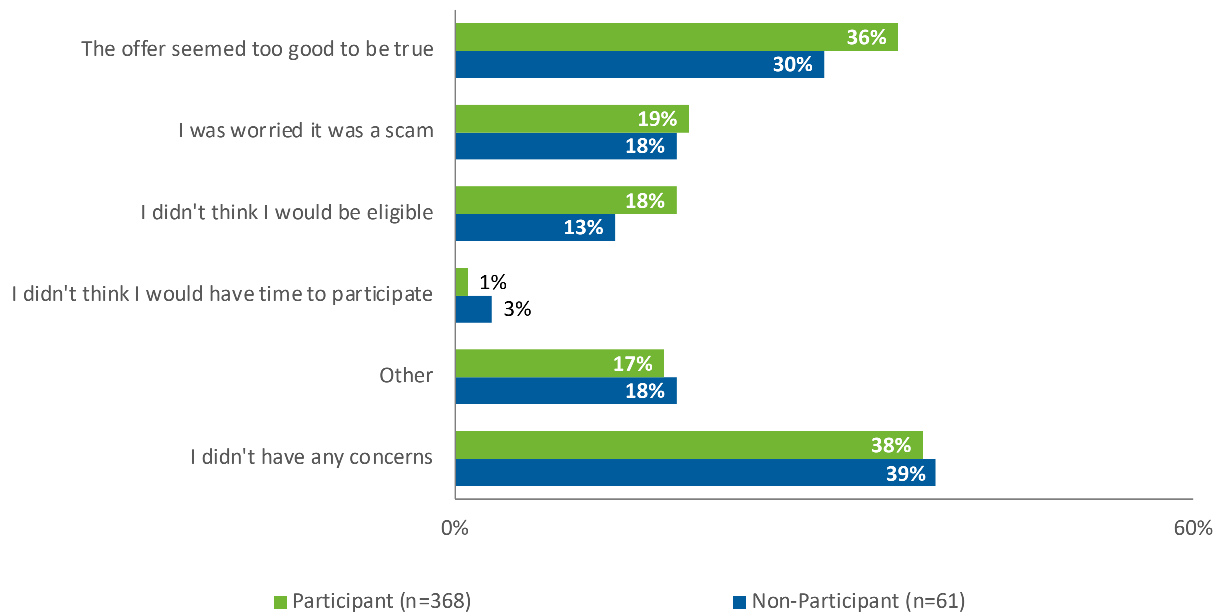
- Concerns surrounding future responsibility for maintenance, repairs, costs/taxes (10)
- General concerns with installation (7)
- Concerns about calculating solar panel and energy needs (5)
- Length or difficulty of process (paperwork or bureaucracy) (5)
- Potential effects (4)

Notably, non-participants were more likely to say they did not have any concerns (39%), but also wrote in that they had other concerns more often than participants. Eighteen percent of the

[22] Out of the 19 SASH respondents who stated that they were waiting to move forward with installing solar, 18 reported an answer about what they were waiting for to move forward. Reported answers included the process being stalled due to time and implementation lags as well as bureaucratic stalls (9), eligibility issues that prohibit them from moving forward (4), needing more information to move forward (2), and a lack of resources and assistance that they need to move forward with installing solar. (2).

respondents stated that they had other concerns and when asked to elaborate, reported concerns such as outreach and availability issues (3), personal reasons (3), worries about panel effectiveness (2), and eligibility issues (2).

Figure 19: Concerns When Deciding Whether to Participate (multiple responses allowed)



Solar-Readiness

Interviews and site visits with GRID found that one of the largest barriers to enrollment of eligible customers was the gap between the cost to install projects and the incentive received through the SASH program. Eligible customers' homes were often not solar-ready and required costly upgrades before solar panels could be installed. To keep the program at no-cost to the customer, GRID often tried to bridge this gap with external funding and TPO agreements, as discussed in Section 4.2.2.

This section reports on costs that were not inherent to the installation or materials reported, but were additional professional services costs that were required to make the homes solar-ready. The costs recorded from program data were often covered by grant funding, either through large partnerships with municipalities, or smaller, one-off grants from CBOs. In a few cases, participants would pay on their own, but these data were limited as the participant may initiate this service on their own. For example, a customer could be deemed eligible then at the site visit be told that their roof is of poor quality and would need to be repaired before solar panels could be installed. GRID will make a good faith effort to find external funding to pay for the roof repair, but if they are not able to, will tell the customer that they cannot move forward with SASH. At that point, the customer may initiate a roof repair on their own, then re-apply to SASH.

Our analysis of program data found that of all projects completed under SASH, 13 percent recorded some professional service that GRID helped pay for. Electrical service upgrades were the most common, with 595 projects, but roof-related expenses were the most expensive on average (Table 21).

Table 21: Professional Services Costs Recorded by GRID

Service Recorded	N	Minimum cost	Average Cost	Maximum Cost
Electrical service upgrade	595	$500	$2,394	$26,865
Professional engineer letter/stamp	321	$80	$161	$500
Electrical services other	208	$50	$664	$4,275
Re-roofing	88	$18	$9,029	$21,000
Other	24	$275	$1,021	$2,595
Roof repair	11	$1,200	$3,946	$7,167
Re-roof & Re-Install PV system	9	$500	$1,457	$3,564
Code Compliance	7	$125	$152	$170
Tree trimming / removal	6	$600	$1,250	$2,000
Equipment Rental	3	$250	$617	$1,000
Fencing	2	$200	$250	$300
Ground mount sub-structure	2	$750	$800	$850
Assessment	1	$150		
General Contracting	1	$500		
Permit Expediting	1	$175		
Service upgrade	1	$2,649		

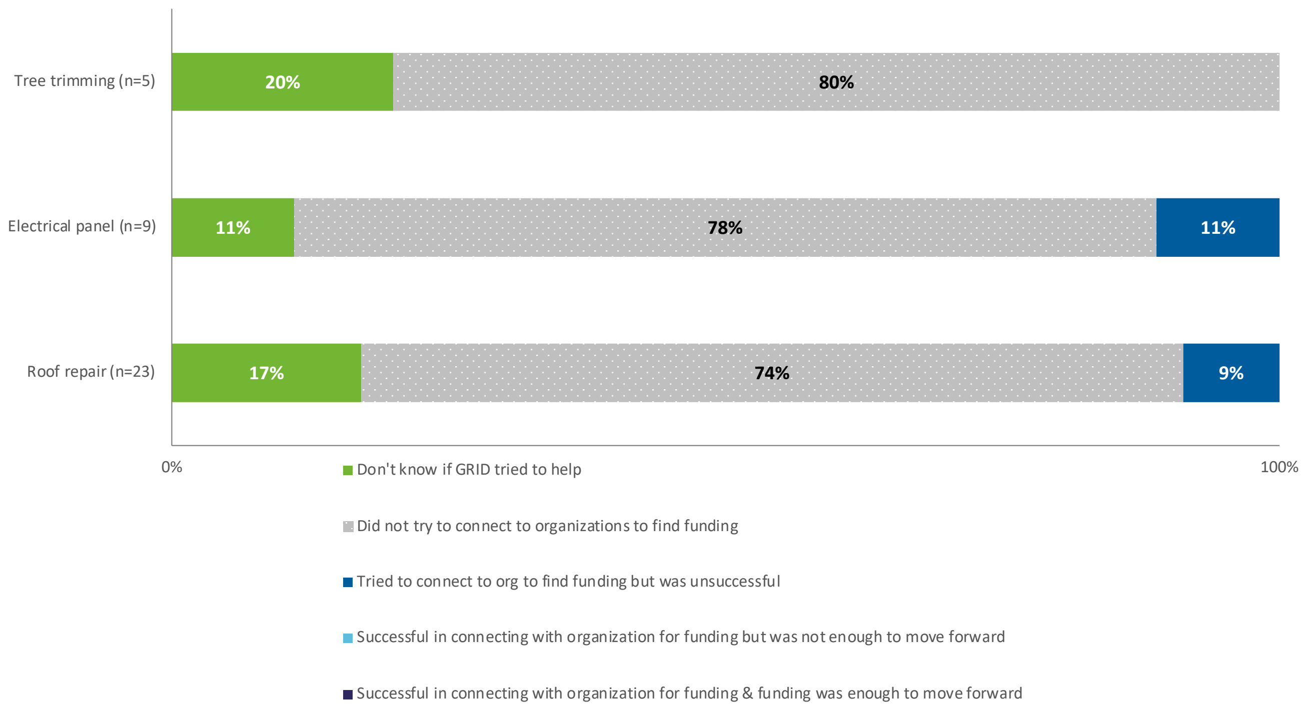
Interviews with GRID found that when they were not able to secure funding for the additional costs required, customers either cannot move forward with the program or must pay out of pocket before participating. The survey of program participants found that most customers that needed additional funding to complete their installation did not receive help from GRID (53%, Table 22).

Table 22: Self-Reported Services Needed in Order to Complete Installation (n = 82)

Service	Number of Respondents that Required a Service	Help from GRID	Paid on Own	Number of Responents that Provided Cost information	Average Total Cost
Electrical or panel upgrades	17	71%	29%	5	$1,860
New roof/Roof repair	23	17%	83%	19	$8,067
Tree trimming	7	29%	71%	4	$662
Did not specify	17	71%	29%	3	$11,500
TOTAL	**64**	**47%**	**53%**	**31**	**$6,718**

We also asked non-participants if there were services that prevented them from moving forward with the program. Out of all the respondents across all needed services, 77 percent reported that GRID did not try to connect them with any organizations to help with funding. No respondents reported GRID successfully connecting them with an organization for funding and funding being enough to move forward. Figure 20 displays attempts at finding funding and the extent of support, if provided, by service needed.

Figure 20: GRID Assistance for Other Funding



For the non-participants that needed additional repairs for their home to be ready for solar, the overall average estimated cost reported was $5,045. Table 23 shows the minimum, average, and maximum costs reported.

Table 23: Non-Participants' Cost Estimates to Upgrade Home for Solar (n = 31)

Service needed	Minimum	Average	Maximum
Roof repair (n = 17)	$1,000	$10,970	$27,500
Electrical panel (n = 9)	$1,000	$2,566	$10,000
Tree trimming (n = 5)	$1,000	$1,600	$3,000

Though the survey did not ask directly about respondents' feelings towards making the home solar-ready, there were non-participants that reported they did not want to make the required updates or repairs to their home, even if they had the means to. Seven respondents wrote in that they did not want to cut down shade trees, or that their neighbor's trees precluded them from participating.

Unpermitted Work on the Property

Another barrier reported by GRID staff was the existence of unpermitted work on the property. In our analysis, we found that only seven (of 368 total) surveyed participants reported needing to upgrade their home to bring it up to code. However, of all inactive customers that did not participate in the program, 13 percent listed code issues as one of the reasons (n = 1,728).

Unpermitted work can either impede an installation directly or serve as a deterrent to having an inspector in the customer's home. During the SASH solar installation process, an official from the municipality must inspect the solar project after completion before interconnection can occur. At this stage, if there is unpermitted work on the property (i.e., a deck or patio), the inspector has the right to enforce compliance – either by issuing a fine or having the homeowner remove the unpermitted structure. GRID staff are not involved in this process but allow customers to choose when participating in SASH if they would like to risk the inspector's enforcement, get the work permitted, or not move forward with the project.

Energy Usage

The evaluation also found two groups of non-participants for whom low energy usage is a barrier. One group of non-participants perceive their energy bills as too low for them to benefit from solar panels. This group self-selects out of the program because they do not think they will qualify or benefit.

The other group is comprised of non-participants who applied and were interested in the program but were disqualified due to their low energy usage. The minimum system size eligible for SASH incentives was 1 kW. Some low-income, eligible households already adhere to cost-saving energy-efficiency practices, and therefore their energy usage was too low to qualify for solar. These instances were not as common as eligibility or cost barriers but did occur; 4 percent of all inactive projects were disqualified due to low energy usage (n = 1,728). One outreach coordinator sympathized with these cases and said it was difficult to explain to someone who could really benefit from the program that they are being penalized for saving energy and money.

4.5.3 Enrollment in Related Programs

Part of the study's charge was to identify awareness among target customers of the various programs designed to serve them and whether the program helped increase enrollment in the other programs such as California Alternative Rates for Energy (CARE), Energy Savings Assistance (ESA), or the Self-Generation Incentive Program (SGIP).

The SASH program handbook required that GRID provide education sessions for all program applications and assist in referring them to providers of additional energy efficiency services. Interviews with GRID staff found that some regional offices had direct relationships with ESA program administrators and shared leads between the two programs, but this was not formally documented in the program handbook.

We looked at two additional data sources – IOU Customer Information System (CIS) data and self-reported enrollment from surveyed program participants – to understand if enrollment in other programs was happening alongside enrollment in SASH.[23]

IOU Data Findings: There was very little income data available from IOU data, so we were unable to estimate the number of CARE-eligible SASH participants. The data we analyzed from the IOUs capture CARE enrollment as of the date the data were retrieved. Other studies, such as the 2022 Low Income Needs Assessment, have found that many CARE participants enroll, but do not recertify their income and can fluctuate on and off the CARE rate. Pulling these data at different days of the year could produce different enrollment figures. In Table 24, we present the total number of CARE-enrolled participants and calculated the percentage of the total population. Enrollment in CARE among SASH participants varies by IOU, with higher rates of enrollment for SCE and SDG&E customers than for PG&E customers (56%, 43%, and 22%, respectively).

Table 24: CARE Eligibility and Enrollment Among SASH Participants

Utility	# Participants	# Enrolled	% Enrolled
PG&E	4,336	969	22%
SCE	4,017	2,246	56%
SDG&E	1,055	453	43%
Total	**9,408**	**3,668**	**39%**

SASH participants are also income eligible for ESA, a program that offers free energy-saving improvements. If the customer has previously participated in ESA, they may only be able to participate if previously installed measures have expired or if new measures are offered. Therefore, the number of total eligible households is likely smaller than the number of participants in SASH. In our analysis, we did not request premise-level participation data, so we could not calculate the total number of eligible SASH customers.

Overall, only 11 percent of SASH participants have also participated in ESA (Table 25). Notably, GRID's semi-annual reports include numbers of referrals and enrollments in ESA but include both participants and non-participants they have enrolled, while the evaluation only analyzed participants.

[23] Note that while the full number of completed SASH projects at the time of this evaluation (March 2022) was 9,501, we were only able to match 9,408 program participants to the IOU CIS data used for the analyses in this section

Table 25: ESA Eligibility and Enrollment Among SASH Participants

Utility	# Participants	# Eligible	# Enrolled	% Enrolled
PG&E	4,336	4,336	572	13%
SCE	4,017	4,017	3	1%
SDG&E	1,055	1,055	426	40%
Total	**9,408**	**9,408**	**1,001**	**11%**

The San Joaquin Valley DAC (SJV DAC) pilot offered electric appliances to customers who had to rely on propane and wood for heating and cooking. Eligibility requirements for the project varied over the course of the pilot, and for this analysis whether the consumer resides in an eligible community is the only requirement used to determine eligibility. The SJV DAC pilot was only approved in 2018, so we did not expect many SASH participants. We found that only 1 percent of SASH participants also participated in the SJV DAC pilot (Table 26). GRID staff noted that they had a close partnership with SJV pilot to share leads between the two groups, but IOU CIS data did not find many enrolled.

Table 26: SJV DAC Eligibility and Enrollment Among Participants

Utility	# Participants	# Eligible	# Enrolled	% Enrolled
PG&E	4,336	86	-	0%
SCE	4,017	354	2	1%
SDGE	1,055	-	-	NA
Total	**9,408**	**440**	**2**	**0%**

A small portion of SASH participants were enrolled in SGIP, a program that provides incentives to support installation of energy storage systems even though all SASH customers are eligible for the program by participating in SASH (Table 27). A rebate from the SGIP program could cover approximately 85 percent of the cost of an average storage system. The low enrollments may be due in part to the contractor-driven nature of that program.

Table 27: SGIP Eligibility and Enrollment Among Participants

Utility	# Participants	# Eligible	# Enrolled	% Enrolled
PG&E	4,336	4,336	7	0%
SCE	4,017	4,017	2	0%
SDGE	1,055	1,055	-	NA
Total	**9,408**	**9,408**	**9**	**0%**

Participants that meet additional qualifications, such as residing in a Tier 2 or 3 High Fire Threat District (HFTD) or have experienced two or more utility Public Safety Power Shutoffs (PSPSs), are eligible for rebates that cover close to 100 percent of the cost of an average energy storage system. No participants were enrolled in the SGIP Equity Resiliency Program, but Table 28 shows that 7 percent of all program participants were eligible for this higher rebate.

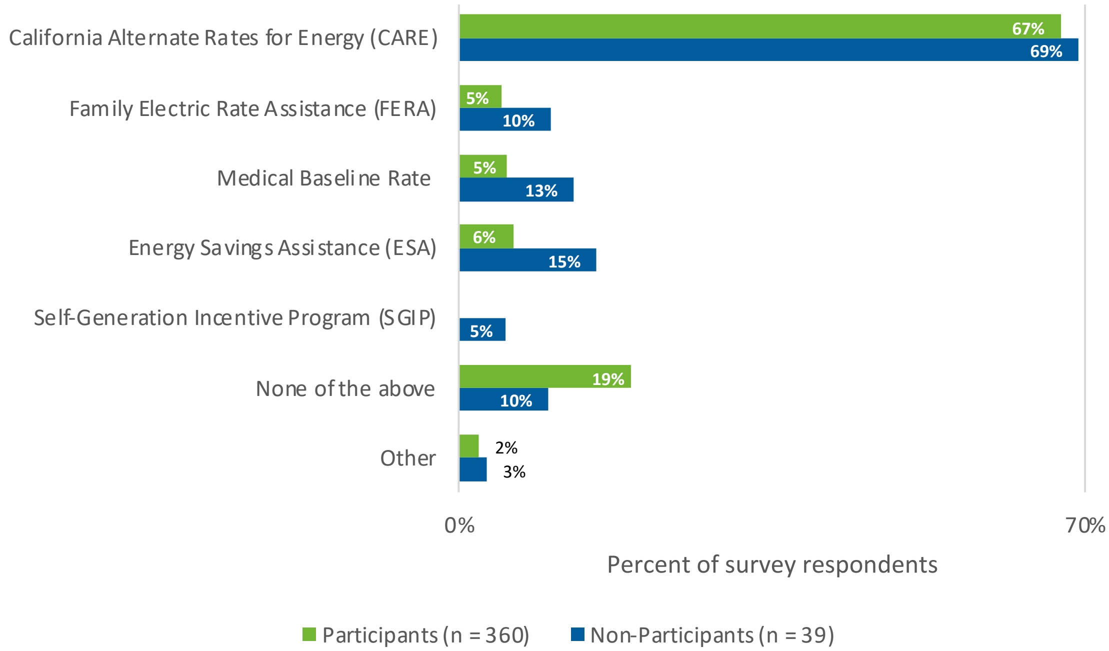
Table 28: SGIP Equity Resiliency Eligibility Among Participants

Utility	# of Participants	# Eligible for Equity Resiliency	% Eligible for Equity Resiliency
PG&E	4,336	288	7%
SCE	4017	159	4%
SDGE	1,055	194	18%
Total	**9,408**	**641**	**7%**

Interviews with GRID staff found that they were ramping up storage work but that funding ran out quickly. Staff members stated that the auto-qualification for SGIP is helpful but that their participants do not often overlap with the HFTD map, so they do not focus on it as much.

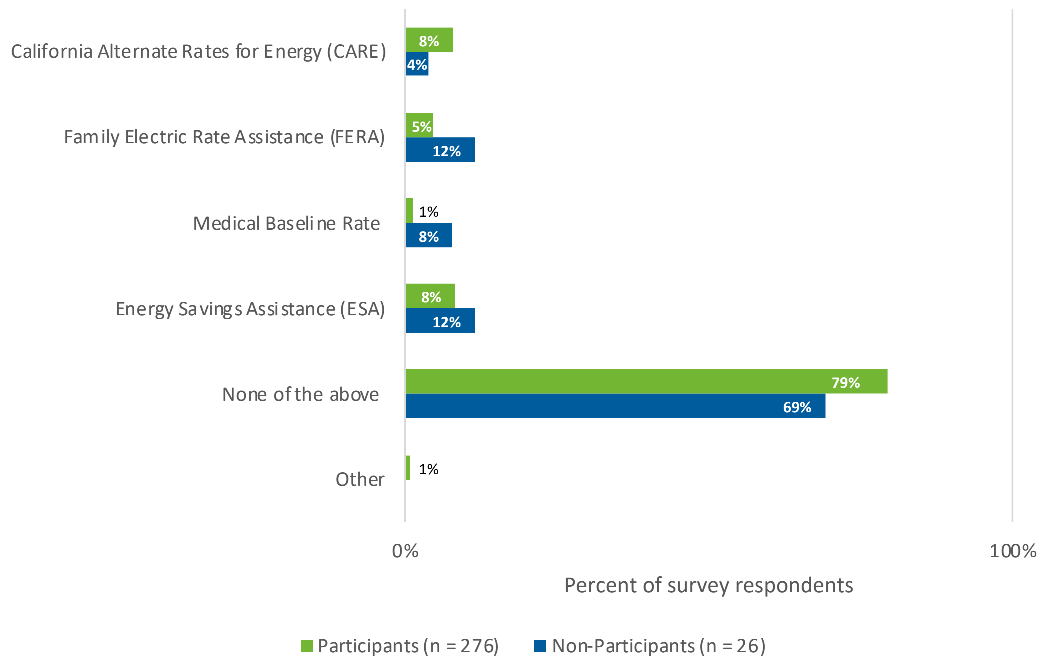
Self-Reported Enrollment in Other Programs: In addition to IOU CIS data, we also asked survey respondents about their enrollment in other energy programs. Figure 21 shows that many surveyed participants and non-participants (67% and 69% respectively) believed they were already enrolled in CARE before applying for the SASH program. The overall CARE enrollment percentage based on IOU CIS data (39%) is lower than what was reported in the survey. This could be due to the most involved participants responding to the survey. Interviews with GRID staff members also found that some customers believe they are enrolled in CARE but are not aware that they need to re-certify their eligibility every two years. Therefore, some survey respondents could be incorrectly reporting their current CARE enrollment status.

Figure 21: Enrollment in Other Energy Program Before Applying to SASH (multiple responses allowed)



Most respondents did not report enrolling in any other energy programs around the same time as applying for SASH, but of the few that did, most frequently reported that they enrolled in ESA (8% and 12%, Figure 22).

Figure 22: Enrollment in Other Energy Program Around the Same Time as Applying for SASH (multiple responses allowed)



4.6 Post-Installation Customer Experience

GRID offered a 10-year equipment and service warranty after solar installations through the SASH program, which is standard in the industry. For TPO systems, the customer received a 25-year warranty for which GRID services the system for the first 10 years, then the TPO company services the system for the remaining 15 years.

Some survey respondents (19%) reported having some issue with the system since installation. Of these, 54 expanded on the issues. The most common issues reported were:

- A need for panel replacement, addition, or maintenance (23%, 16);
- System needing updates and or an unspecified system malfunction (17%, 12);
- Specific component (e.g., inverter or monitor box) (14%, 10);
- Billing or customer service (7%, 5); and
- Roof issues – leaks, birds, cleaning (3%, 2).

Only three respondents reported costs of the post installation isues, which were an average of $417.

The survey also asked about any maintenance required for the panels. A few respondents (14%) reported that their panels required maintenance such as cleaning or washing the panels. Of those that shared costs (n = 10), the reported average cost for maintenance was $102.

In addition to survey responses, our evaluation captured a few anecdotal reports of service requests to GRID and Sunrun. One story is shared below to illustrate some challenges participants have had communicating with Sunrun.

> One participant reported that they were unable to get help for their breaker that keeps tripping since Sunrun installed a new inverter in 2020. The participant called GRID Alternatives for help, which referred her to Sunrun because it was a TPO system. The resident contacted Sunrun but did not understand how to move forward. Our evaluation team stepped in to try to understand the process, and found that the only way for the participant to get her breaker fixed and covered by Sunrun was to:
>
> 1. Take a photo of the issue and email it to Sunrun to start a ticket. Sunrun would decide whether to send a technician.
> 2. Schedule a "healthy system inspection." This would send a technician out to the site to diagnose whether it is solar related. If it is related, they will fix it without cost. If they deem it is not related, they will charge $190 for the visit and will not fix it.
> 3. Hire an independent electrician to determine if it is solar related. If the electrician deems it is and fixes it, Sunrun will reimburse the homeowner for the cost after the electrician submits an office report.
>
> In this case, the participant did not have an email address to start a ticket. Sunrun informed the evaluation team that there was no other way to submit a ticket. Additionally, the participant did not understand the process of reimbursement or feel comfortable paying out of pocket of repairs that may not be reimbursed.

We heard similar stories during our evaluation. After discussing the issue with GRID, they committed to reaching out to the participant to help explain the options for solar ownership better.

4.7 PV System Impacts

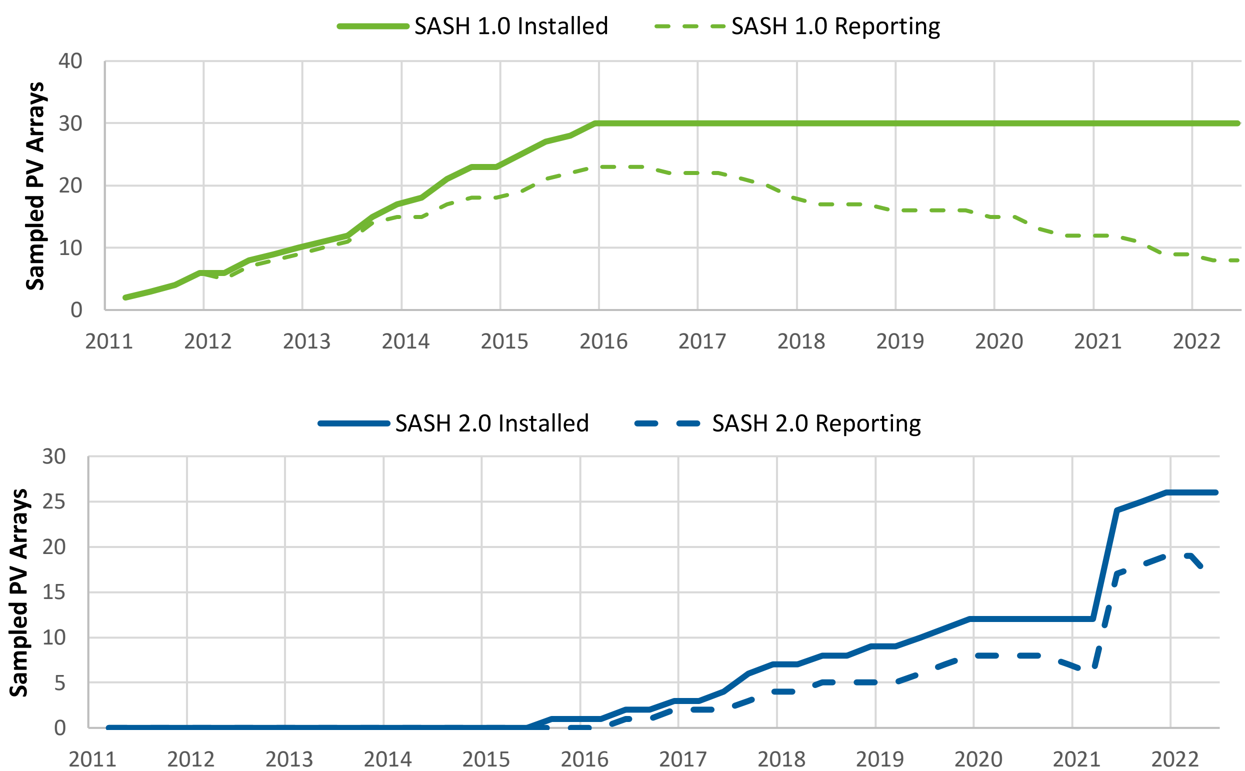
To assess PV impacts, the evaluation had a two-part goal: 1) verify total PV installed capacity achieved through the program, and 2) understand how this installed capacity performed compared to expectations and what factors may be most impactful on system performance. This section summarizes the data limitations, common reporting errors, and overall realization findings and impacts.

4.7.1 Data Limitations

In evaluating the impacts, we discovered several data limitations. We summarize the limitations here to provide context for the findings and go into more detail in Section 6.5.

The Evergreen team reviewed generation data from two different monitoring systems – Enphase-Enlighten and SolarEdge. Monitoring through private systems is the only way we can gain insight into the solar production for solar systems that share an import/export meter with a house. Figure 23 illustrates generation data availability across the sample of projects. Data reporting issues accumulated over time, so of a total of 30 SASH 1.0 projects in the sample, only eight were continuing to report generation data at the time of this evaluation.

Figure 23: Average Hourly Demand Impacts by IOU – July



Reporting errors do not necessarily indicate that the solar system is malfunctioning. One customer indicated during the on-site assessment that despite data missing from their Enphase-Enlighten portal, their utility bills continue to reflect that their PV system is generating. However, the prevalence of reporting errors limited Evergreen's ability to comment on the long-term performance of SASH 1.0 projects due to the inconsistency of monitoring system tracking of older systems. Table 29 outlines the daily data availability for the sampled projects that were monitored with Enphase-Enlighten and SolarEdge.

Table 29: Enphase-Enlighten Sample Daily Availability

Monitoring System	Projects Affected	Projects in Sample	Instances of Error	Total Days	Days with Error	Percent of Days Missing
Enphase-Enlighten	25	48	34	96,776	19,355	20%
SolarEdge	3	13	3	151	6	4%

Through the evaluation, we found that Enphase-Enlighten did not automatically identify outage events to GRID or the customer. It was the responsibility of the system owner to identify monitoring system errors and report to their respective monitoring system company. For homeowner-owned systems, that required the homeowner to monitor their production. For TPO systems, the contract with the TPO states that it was the solar company's responsibility to monitor, communicate, and fix any system outages. As discussed above, however, there were limitations to communication between Sunrun and the participants.

4.7.2 Program Data Errors

The Evergreen team found one data error in the program tracking database provided by GRID:

- **Hardware Replacement:** There was one instance out of eight field visits where a program participant replaced hardware provided through the SASH program with custom equipment. The model for this project would not calibrate to zero, indicating a misalignment between estimated reported energy generation and metered energy generation. This customer-owned project was selected for on-site assessment during which the customer indicated they replaced the original 230W solar panels with new higher-rated 300W panels.

The Evergreen team also found two instances of data errors in the Expected Performance-Based Buydown (EPBB) files that were received from GRID, as bulleted below.

- **Zero Degree Azimuth and Tilt Angles:** There were three instances out of 48 in the sample where documentation indicates energy generation with a 0-degree tilt angle and 0-degree azimuth angle. Google Earth observations clearly show solar panels are mounted on sloped rooftops. There are instances where an EPBB file and field report are delivered but the values therein do not match, indicating that EPBB files may not have been updated after field verifications were conducted. For the purposes of this analysis, non-zero angles were used for the evaluation.
- **Antiquated Solar Panel and Power Inverter Models:** EPBB output files result in an error when older hardware models or database entry mistakes are used in the EPBB tool. The online EPBB tool is periodically updated by adding and removing hardware options from the drop menus. There are seven instances out of 48 where sample projects have solar

panel modules installed that are no longer listed in the EPBB drop menu, incorrect equipment entry is suspected for one project's inverter model, and database typos occur in one project solar panel and four project inverters. EPBB files with any of these issues do not include the monthly estimated energy generation bar plot, and monthly energy generation for these projects is estimated using annual energy generation from the EPBB file and substitute hardware in the online EPBB tool.

4.7.3 Discrepancies Between EPBB and Tracking

The program tracking database and the EPBB files provided by GRID were generally aligned on estimated annual energy generation and Design Factor (DF). Nuances in program implementation may explain the minor discrepancies that the Evergreen team found. The following sections explain these instances in more detail.

Estimated Annual Energy Generation

The EPBB files and program tracking data aligned for 28 of the sampled projects, and all 48 samples were within 100 kWh of the annual estimate (Table 30). Projects with a higher energy generation difference were frequently included in the field verification activities conducted by GRID. This likely indicates that the EPBB database or the program tracking data are being updated post-verification, while the other is not. Out of the 48 projects in the sample, field verification reports were provided for seven projects. These field verification reports were developed by GRID and described adjustments to originally submitted project parameters for five projects. Revisions were suggested for azimuth angles, module quantity, shading factors, and mounting method. However, field verification findings are not always translated to the EPBB database. It is unclear why revisions are not always made in the EPBB database.

The two outlying samples where generation estimates are greater than 650 kWh have a system size larger than the maximum program allowance of 5.0 kW-DC.[24] When a system is installed that is greater than this threshold, additional energy generation is not recorded in program tracking. In other words, the tracking database will record energy generation for a PV system larger than 5.0 kW-DC as if it were a 5.0 kW-DC system. Energy generation for additional system capacity is not recorded.

[24] Note that the maximum allowable size for the SASH program was a 5.0 kW system. These systems may have been the result of additional panels purchased and installed by the homeowners after participation, but we could not confirm.

Table 30: EPBB and Program Tracking Data Discrepancies

	SASH 1.0		SASH 2.0		TOTAL	
EPBB-Tracking Energy Generation Diff. (kWh)	Project Quantity	GRID Field Verification Quantity	Project Quantity	GRID Field Verification Quantity	Project Quantity	GRID Field Verification Quantity
0	11	1	17	0	28	1
25	1	0	3	0	4	0
50	5	2	1	0	6	2
100	2	0	0	0	2	0
650	5	3	1	1	6	4
2,000	0	0	1	0	1	0
5,000	1	0	0	0	1	0
TOTAL	**25**	**6**	**23**	**1**	**48**	**7**

Table 31 describes the total difference in annual energy generation values for the sampled projects as recorded in the tracking database and the EPBB files. The total difference between the two sources is 2.1 percent.

Table 31: File and Program Tracking Estimated Total Annual Generation Difference

Program	Tracking (MWh)	EPBB (MWh)	Difference (MWh)	Differenc
SASH 1.0	113.5	109.4	4.1	3.6%
SASH 2.0	148.7	147.2	1.5	1.0%
TOTAL	**262.1**	**256.5**	**5.6**	**2.1%**

Design Factor

The CPUC uses the design factor (DF) to determine if a system meets the minimum requirements for eligibility. There are two methods used to calculate a project's DF:

- The method used during SASH 1.0 is the product of a design correction factor, geographic correction factor, and installation correction factor.
- The method used during SASH 2.0 does not consider the geographic correction factor.

The method used to calculate the DF is inconsistent between the EPBB file and the tracking database for 30 projects out of 48 sampled. All EPBB file DFs align with either the SASH 1.0 or SASH 2.0 calculation. A subset of 11 projects within the tracking database, however, reports a DF that does not correspond to known methods in the tracking database. It is unlikely a coincidence that four of the seven projects verified by GRID also have a tracking DF that does not identify with either calculation method. This suggests that EPBB files may have been updated to reflect the field verification while the tracking database remained unchanged.

The tracking database has one DF recorded for any given project. However, there is a calculation required to determine this value when a project has multiple orientations. An EPBB file is provided for each orientation subarray, which makes comparison of them challenging due to an opaque method of combining the subarray DFs into a single factor.

4.7.4 Overall Realization Rates

The Evergreen team calculated a realization rate for each project in the evaluated sample. The realization rate was calculated as the ratio between the verified normalized energy production and the program-reported energy production. Realization rates were calculated using the most recent 12 months of generation data available for each system, ending no later than June 30, 2022. A realization rate greater than 100 percent indicates that the solar array is producing more energy than originally estimated by the program via the EPBB tool.

The average annual sample realization rate is 105 percent across participating IOUs (Table 32). In other words, the solar arrays in the evaluation sample are generating 105 percent of the program's original estimate.

Table 32: Sample Realization Rates by IOU

IOU	Sample Quantity	Reported Energy Production (MWh)	Verified Energy Production (MWh)	Realization Rate
PG&E	14	56	57	103%
SCE	25	161	167	103%
SDG&E	9	40	44	111%
TOTAL	**48**	**257**	**268**	**105%**

Table 33 outlines the realization rate results by program, and Table 34 presents the realization rate by monitoring system type (Enphase-Enlighten and SolarEdge).

Table 33: Sample Realization Rates by Program

Program	Sample Quantity	Reported Energy Production (MWh)	Verified Energy Production (MWh)	Realization Rate
SASH 1.0	25	109	115	105%
SASH 2.0	23	147	153	104%
TOTAL	**48**	**257**	**268**	**105%**

Table 34: Sample Realization Rates by Monitoring System

Monitoring System	Sample Quantity	Reported Energy Production (MWh)	Verified Energy Production (MWh)	Realization Rate
Enphase-Enlighten	35	164	173	105%
SolarEdge	13	93	95	103%
TOTAL	**48**	**257**	**268**	**105%**

Realization rates for projects that were installed earlier were found to be lower than more recently installed systems. The realization rate of systems five to ten years old was 98 percent, as compared to 106 percent for systems zero to four years old (Table 35). This observation is likely due to a combination of two factors:

1. Solar PV system generation degrades over time due to normal wear and tear and exposure to outdoor elements.
2. New PV systems are more efficient with lower inherent loss factors as component designs have been improved.

Many systems had recent and ongoing data reporting issues that could mask greater rates of degradation (Appendix A: Methodology discusses how we determined analysis periods for individual projects). We used the most recent data available for a given project resulting in many project analyses occurring within two years of installation. We were unable to evaluate the current condition of many older systems (over two to four years old) because the data were simply not available. The timespan reflected in the data was too short for system degradation to show in energy generation data, but older projects are expected to show lower realization rates.

Table 35: Sample Realization Rates by System Age

Difference in Analysis Year and Installation	Sample Quantity	Reported Energy Production (MWh)	Verified Energy Production (MWh)	Realization Rate
0 – 4	36	213	225	106%
5 – 10	12	44	43	98%

TPO system and residence-owned system realization rates were found to be similar, within 2 percent of each other (Table 36).

Table 36: Sample Realization Rates by Ownership

System Ownership	Sample Quantity	Reported Energy Production (MWh)	Verified Energy Production (MWh)	Realization Rate
TPO	8	47	49	105%
Non-TPO	40	210	219	104%

4.7.5 Program Energy Impacts

We extrapolated the results of the sample analysis to the total program population to quantify the annual impact of the full SASH program, estimated to be 48,438 MWh per year. Table 37 and Table 38 present energy impacts by IOU and program respectively.

Table 37: Energy Impacts by IOU

IOU	Total Installed kW-Rating (kW-DC)	Energy Generation (MWh)	Percent of Energy Generation (%)
PG&E	15,449	20,275	42%
SCE	15,176	22,538	47%
SDG&E	3,582	5,625	12%
TOTAL	**34,207**	**48,438**	**100%**

Table 38: Energy Impacts by Program

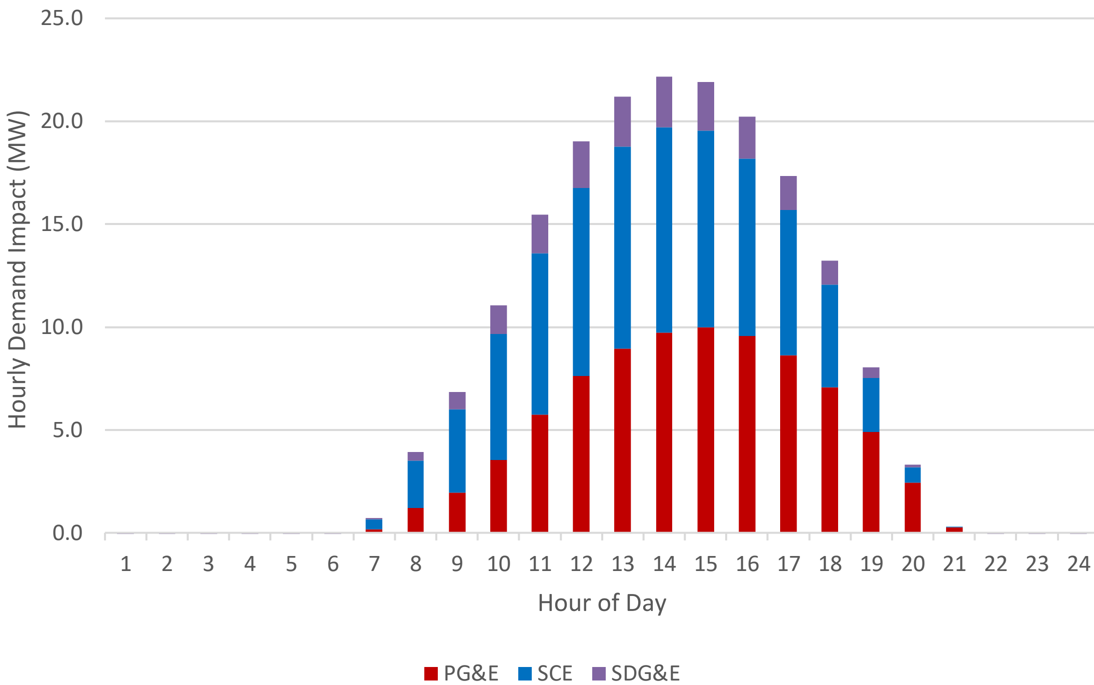
Program	Total Installed kW-Rating (kW-DC])	Energy Generation (MWh)	Percent of Energy Generation (%)
SASH 1.0	18,517	26,134	54%
SASH 2.0	15,690	22,304	46%
TOTAL	**34,207**	**48,438**	**100%**

4.7.6 Demand Impacts

The load shape of energy generated by PV shifts with the angle of the sun hourly and daily throughout each year. The load shape of SASH PV installations for an average July day is shown in Figure 24.[25] The maximum hourly demand impact in July is estimated to be about 22 MW, occurring in the 14th hour of the day, which is 1pm to 2pm.

[25] We checked other summer months to isolate the peak demand. The final peak demand analysis was evaluated on typical year data.

Figure 24: Average Hourly Demand Impacts by IOU – July



4.8 Customer Bill Impacts

This section provides an assessment of the impacts related to installing a solar system through the SASH program using billing and usage data. The objectives of this analysis were to:

- Estimate the
    - Gross annual savings in kWh and bills;[26]
    - Net annual savings in kWh and bills that are attributable to the program;[27]
    - Cumulative program impacts;
    - Persistence of energy savings; and
- Assess the relationship between energy generation and energy consumption by hour for a sample of participants with metered generation data available.

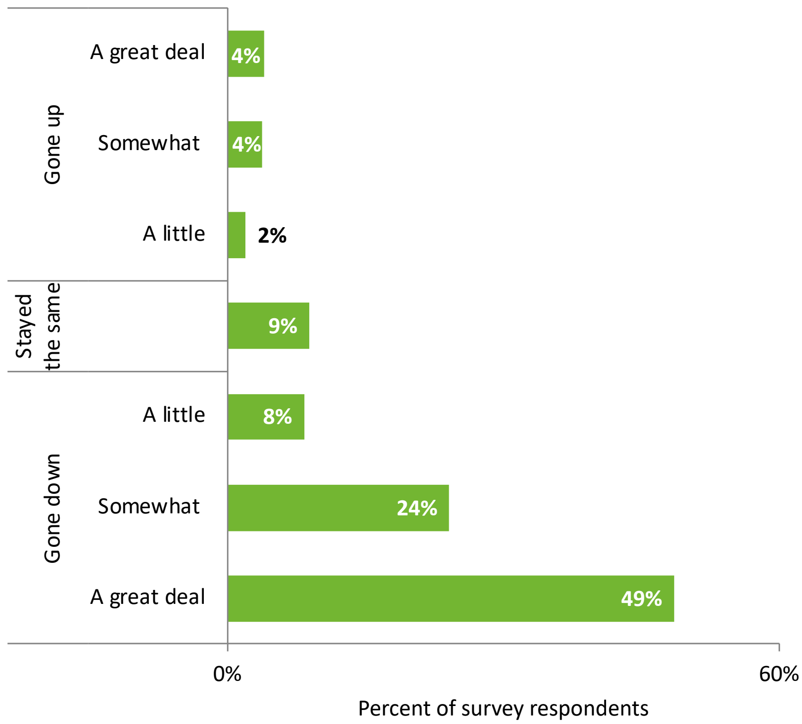
Findings from our billing analysis found that on average, participants saw bill reductions after participation. Figure 25 shows that most of the respondents (81%) reported that their bills have gone down. Only a few respondents shared that they believe their bills increased after installation

[26] Throughout this section, we will refer to "gross energy savings" as the savings found when comparing participants pre- and post-solar install kWh usage.

[27] Throughout this section, we will refer to "net energy savings" as the savings found when comparing participants pre- and post-solar install kWh usage relative to a matched comparison group of future participants over the same time period.

(10%).[28] While most participants exhibited substantial reductions in their electricity bills during the year after the solar installation, we confirmed that a small group of participants exhibited increases in their annual electricity bills after the solar installation.

Figure 25: Self-Reported Bill Impacts After Installation (n = 347)



4.8.1 Annualized Savings

In the rest of this section, we report findings from billing and usage analysis. We used the most granular energy consumption data available (monthly billing kWh and costs, daily and hourly interval kWh from advanced metering infrastructure [AMI] data) in a series of regression models to estimate the energy and bill savings attributable to the solar panels (in kWh and $). See Appendix A for details on the impact analysis methods, sample size, and regression model fit.

Savings by Program

The energy savings estimates from the installation of the solar systems for the post-period were calculated by combining the estimated gross regression coefficients with the weather conditions from the post-period and the Net-to-Gross (NTG) ratio.

[28] Energy usage increases may be due to a variety of factors including a change in the number of people in the home, or a change in equipment.

The gross energy savings estimates were calculated using participants' pre- and post-solar install kWh usage and contain both the decrease in kWh usage due to the energy being generated by the solar panels as well as any change in kWh energy consumption that happened after the panels were installed. When the solar generation credits start being issued, customer energy bills will drop, which often motivates them to use slightly more energy (e.g., increase cooling for comfort). However, in the survey, the participants said they received education on energy efficiency and started to see ways to save around their home around this time.

In general, we would expect to see an increase in energy consumption over the years, as the climate in California has become more extreme (e.g., hotter summers require more cooling) and new electronics or other electrical end-uses are added to the home. An increase in consumption from these types of external pressures will be exhibited by the comparison group. We calculated an NTG adjustment for each program by measuring the savings estimates of the solar installation relative to a matched comparison group of future participants. We estimated this NTG adjustment using gross and net savings for the 2013 program participants for the SASH 1.0 program and 2018 program participants for the SASH 2.0 program.[29] The net savings estimate tells us how much the participants saved *above and beyond* any change exhibited by the comparison group.

Table 39 and Table 40 in this section show the estimated gross savings, NTG adjustment, estimated net savings (in kWh or $ and as a percentage of baseline energy use), and the number of observations that went into the model by program and year of participation. The energy usage NTG adjustment ranged from 1.02 to 1.24, suggesting that without the program, we would have seen a small *increase* in energy usage and bills among participants over the study period (2010-2021) if they had not installed solar. The middle column in Table 39 and Table 40 provides the adjusted net savings estimate (for energy and electricity bill, respectively) with 90 percent confidence intervals. Across the programs, the annual net energy savings have gradually increased, both in kWh and as a percentage of baseline energy consumption. The gross energy savings were relatively stable across these programs, indicating that the increase in savings over time is mostly coming from an increase in *avoided* energy usage. Gross bill savings increased, likely due to changes in rates, as the value of each kWh saved has increased over time.

On average, SASH 1.0 participants are estimated to have a 60 percent decrease in energy usage (4.4 MWh annually) and a 127 percent decrease in their electric bills ($1,032 annually), while SASH 2.0 participants are estimated to have a 67 percent decrease in energy usage (5.0 MWh annually) and a 91 percent decrease in their electric bills ($904 annually). The dollar value of the bill savings will be impacted by the rate schedule. Customers on CARE have a 30 percent discount on each kWh, so their bill savings will show only 70 percent of the cost that they would have had to pay if CARE was not discounting their bill.

[29] For more detail on why we selected these program-years for the NTG adjustment, see Appendix A: Methodology.

Table 39: Estimated Annual Energy and Bill Savings Per Home

Program	Gross Estimated Annual Energy Savings (kWh)	NTG Adjustment (net / gross)	Net Estimated Annual Energy Savings (kWh, after NTG adjustment)	Percent of Energy Savings	N Observations
SASH 1.0	4,274	1.021	4,362 ± 13	60%	11,262,182
SASH 2.0	4,018	1.244	4,997 ± 12	67%	8,717,860

Source: Evergreen analysis of energy consumption of program participants and matched comparison group for program years 2010-2021. The NTG adjustment is based on analysis of the 2013 program participants for the SASH 1.0 program and 2018 for the SASH 2.0 program.

Table 40: Estimated Annual Bill Savings Per Home

Program	Gross Estimated Annual Electricity Bill Savings ($)	NTG Adjustment (net / gross)	Net Estimated Annual Electricity Bill Savings ($, after NTG adjustment)	Percent of Electricity Bill Savings	N Observations
SASH 1.0	$679	1.519	$1,032 ± 1	127%	11,242,660
SASH 2.0	$807	1.121	$904 ± 2	91%	9,951,743

Source: Evergreen analysis of electricity costs of program participants and matched comparison group for program years 2010-2021.

The solar system was intentionally undersized to motivate customers to consider efficiency. The program rules include a provision that "the maximum system size that can receive incentives would be based on an estimate of the household's annual load, assuming all weatherization and energy efficiency measures with a two-year payback or less are undertaken."[30] Notably, the rules do not include a specific benchmark, such as 80 percent of the baseline, to aim for. One downside to this rule is that there is no allowance for future loads from electrification, such as heat pumps and electric vehicles. In the survey, some participants expressed a desire for more panels (n=17 SASH). Specifically, one said that they "wish it [would] produce 100% of my electricity needs and not have a true up bill." Another mentioned electrification, as "We would like to move away from gas appliances. It would be nice if more panels could be added to keep up with these changes."

When shifting to net metering, many participants go from monthly to annual true up bills (19% of SASH participants mentioned this). As one participant put it, "The true up bill at the end of the year is really high and nowadays people are literally trying to make ends meet. Having a huge bill to contend with at the end of a year cycle is scary stuff especially when everything else is so expensive." **Even though solar has decreased their annual electricity bill, it also caused some**

[30] Decision 07-11-045 that established SASH. Retrieved from: https://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/75400-05.htm#P233_54557

customers to incur a single large bill that is difficult to predict. Some participants may be pursuing energy efficiency in the hopes of making their true-up bill more affordable.

Among survey respondents, of the 42 respondents who stated that their bills and usage decreased, the top two reasons included more efficient usage (38%) and maintenance of their panels and more mindful use of energy (29%). Other notable reasons include a decrease in the number of the people in the home (19%) as well as a greater sense of environmental consciousness (17%).

The net bill savings for SASH 1.0 exceed the baseline bill. This is possible because of the NTG adjustment. **In absence of the program, we would expect participants' energy bills to have increased by around 52 percent (or to 1.519 times the size). Instead of participant bills increasing, as the comparison group experienced, participants' bill *decreased* by $679 per year, as we expected.** The overall benefit of the program includes the gross bill savings as well as the avoided bill increases, which increases our savings estimate from $715 to $1,032 per year for SASH 1.0 and $807 to $904 for SASH 2.0.

Savings by Program Year

Figure 26 and Figure 27 show the net annual energy savings per home for each year of the SASH programs, the average size of the solar system installed during each year, and the variability across the years of installation. The left-hand column shows the overall program-level estimate, followed by individual estimates for each program year on the right.[31] The SASH 2.0 savings estimates are between four and five MW per home annually, except for in 2020 (which had a small sample size and therefore was more prone to error). The SASH 1.0 estimates are more variable across the years (between two and five MW per home annually).

[31] The program level results are not the average of the yearly results; the program level estimate is based on a pooled model, including participants from all program years to estimate savings at the program level.

Figure 26: Estimated Net Annual Energy Savings Per Home – SASH 1.0

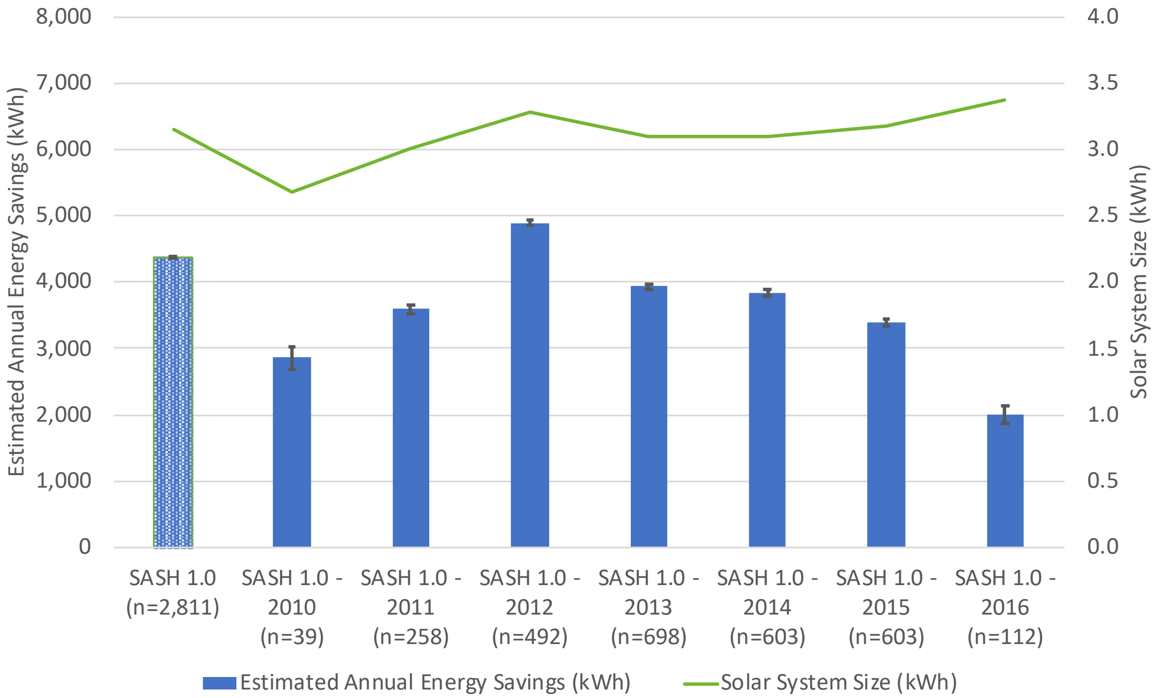


Figure 27: Estimated Net Annual Per Home Energy Savings – SASH 2.0

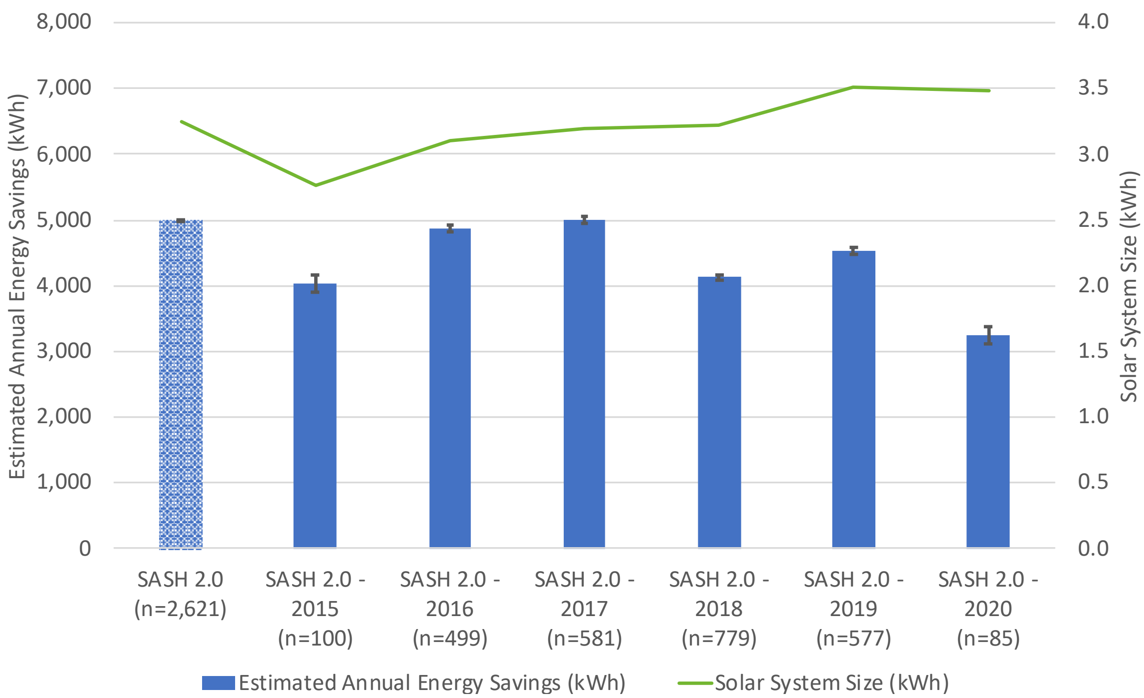


Table 41 shows the estimated annual gross energy savings per home, the NTG adjustment, the estimated annual net energy savings per home, the percent of energy savings, and the number of observations in the model, by program and year that the solar was installed. The estimated annual net energy savings per home fluctuates around three to five MWh per year, which is 45 to 71 percent of a participant's annual energy usage. The two program years that fall outside this range (2010 and 2016) both have small sample sizes, which are less reliable as they are more prone to error. Again, these systems were intentionally undersized to motivate participants to pursue energy efficiency to further reduce their bill.

Table 41: Estimated Annual Energy Savings Per Home

Program – Year	Gross Estimated Annual Energy Savings (kWh)	NTG Adjustment (net / gross)	Net Estimated Annual Energy Savings (kWh, after NTG adjustment)	Percent of Energy Savings	N Observations
SASH 1.0 – Overall	**4,274**	**1.021**	**4,362 ± 13**	**60%**	**11,262,182**
SASH 1.0 – 2010	2,798	1.021	2,856 ± 166	45%	206,705
SASH 1.0 – 2011	3,515	1.021	3,587 ± 62	54%	1,321,731
SASH 1.0 – 2012	4,791	1.021	4,890 ± 45	71%	2,302,679
SASH 1.0 – 2013	3,848	1.021	3,928 ± 39	54%	2,687,525
SASH 1.0 – 2014	3,765	1.021	3,843 ± 48	50%	2,202,920
SASH 1.0 – 2015	3,325	1.021	3,394 ± 50	46%	2,121,474
SASH 1.0 – 2016	1,960	1.021	2,001 ± 138	26%	396,612
SASH 2.0 – Overall	**4,018**	**1.244**	**4,997 ± 12**	**67%**	**8,717,860**
SASH 2.0 – 2015	3,236	1.244	4,024 ± 127	66%	343,844
SASH 2.0 – 2016	3,921	1.244	4,877 ± 52	67%	1,706,073
SASH 2.0 – 2017	4,022	1.244	5,002 ± 48	67%	1,969,646
SASH 2.0 – 2018	3,319	1.244	4,127 ± 40	56%	2,545,064
SASH 2.0 – 2019	3,640	1.244	4,527 ± 50	57%	1,882,463
SASH 2.0 – 2020	2,612	1.244	3,249 ± 123	44%	270,770

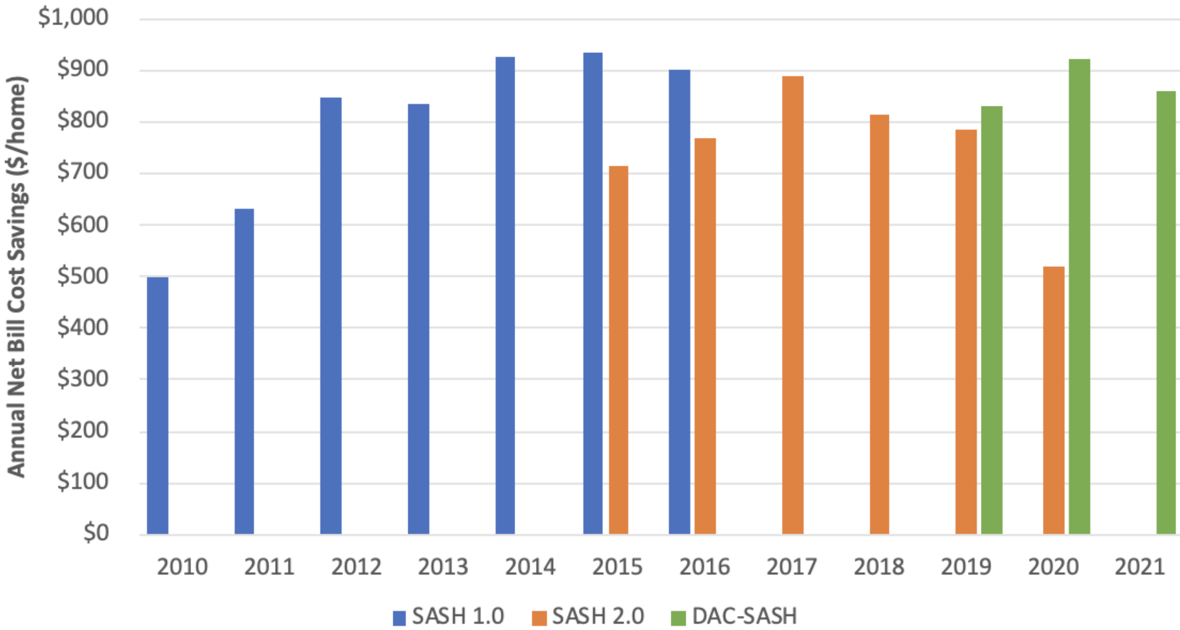
Table 42 shows the estimated annual gross electricity bill savings per home, the NTG adjustment, the estimated annual net electricity bill savings per home, the percent of cost savings, and the number of observations in the model, by program and year. The estimated annual net electricity bill savings per home fluctuates around $600 to $1,000 per year for the SASH programs. Two of the program years that fall outside this range (2010 and 2020) both have small samples, which are less reliable as they are more prone to error. There were a few changes in the solar industry over this time period. The gross bill savings likely fluctuate due to changes in annual generation, consumption, the Net Energy Metering (NEM) rate (as NEM 1.0 offered higher compensation for generation) and increases in rates.

Table 42: Estimated Annual Bill Savings Per Home

Program – Year	Gross Estimated Annual Electricity Cost Savings ($)	NTG Adjustment (net / gross)	Net Estimated Annual Electricity Cost Savings ($, after NTG adjustment)	Percent of Electricity Cost Savings	N Observations
SASH 1.0	**$679**	**1.519**	**$1,032 ± 1**	**127%**	**11,242,660**
SASH 1.0 – 2010	$328	1.519	$498 ± 17	69%	87,006
SASH 1.0 – 2011	$416	1.519	$632 ± 6	94%	1,220,255
SASH 1.0 – 2012	$558	1.519	$848 ± 5	122%	2,251,182
SASH 1.0 – 2013	$550	1.519	$835 ± 4	108%	2,601,807
SASH 1.0 – 2014	$609	1.519	$925 ± 5	107%	2,324,864
SASH 1.0 – 2015	$616	1.519	$936 ± 6	103%	2,244,770
SASH 1.0 – 2016	$594	1.519	$902 ± 17	89%	391,222
SASH 2.0	**$807**	**1.121**	**$904 ± 2**	**91%**	**9,951,743**
SASH 2.0 – 2015	$639	1.121	$715 ± 17	92%	436,399
SASH 2.0 – 2016	$686	1.121	$769 ± 8	89%	1,944,543
SASH 2.0 – 2017	$794	1.121	$890 ± 8	92%	2,209,077
SASH 2.0 – 2018	$726	1.121	$814 ± 7	82%	2,998,706
SASH 2.0 – 2019	$700	1.121	$785 ± 9	70%	2,093,526
SASH 2.0 – 2020	$464	1.121	$520 ± 23	45%	69,492

Figure 28 shows the estimated annual net electricity cost savings, after the NTG adjustment, by program and installation year. The bill savings attributed to solar installations gradually increased from approximately $498 per year in 2010 to a peak of $936 per year in 2015, consistent with the increase in annual energy savings. While gross bill savings gradually increased until 2019, the comparison group exhibited more substantial increases in electricity bills between 2010 and 2016. Therefore, the SASH 1.0 customers have larger net bill savings, as they *avoided* these increases in bills while *saving* money on their bill after installing solar. In addition, NEM 1.0 ended in 2017, which changed the payment structure for behind-the-meter-generation. Solar installed before the end of NEM 1.0 would have received more substantial bill credits for generation, leading to greater bill savings per kWh generated.

Figure 28: Estimated Annual Net Bill Savings per Home



Cumulative First-Year Savings by Program Year

Table 43 presents the number of homes that participated in the program during each year, the estimated annual first-year kWh savings per home for each year (from the impact analysis), and the overall projected first-year kWh savings by program year. This extrapolates from the impact analysis sample to the full population of program participants to provide an estimate of the cumulative program impact. To date, the SASH 1.0 program is estimated to have a first-year savings total of 22,665 MWh, and the SASH 2.0 program a total of 21,047 MWh. Solar panels have an expected useful life of 25 years, so these savings will continue beyond one year, as the panels will continue generating electricity. Please note that the energy savings depends on many factors (e.g., panel degradation, weather, and energy consumption).

Table 43: Estimated Cumulative Energy Savings

Program – Year	Number of Participating Homes	Estimated First Year Annual Energy Savings Per Home (kWh)	Annual First Year Energy Savings for All Homes (MWh)
SASH 1.0**	**5,196**	**4,362**	**22,665**
SASH 1.0 – 2009*	29	2,628	76
SASH 1.0 – 2010	199	2,856	568
SASH 1.0 – 2011	759	3,587	2,723
SASH 1.0 – 2012	1,341	4,890	6,557
SASH 1.0 – 2013	1,045	3,928	4,105
SASH 1.0 – 2014	868	3,843	3,336
SASH 1.0 – 2015	799	3,394	2,712
SASH 1.0 – 2016	151	2,001	302
SASH 1.0 – 2017*	2	4,855	10
SASH 1.0 – 2018*	3	4,182	14
SASH 2.0**	**4,212**	**4,997**	**21,047**
SASH 2.0 – 2015	193	4,024	777
SASH 2.0 – 2016	668	4,877	3,258
SASH 2.0 – 2017	797	5,002	3,987
SASH 2.0 – 2018	1,090	4,127	4,498
SASH 2.0 – 2019	957	4,527	4,332
SASH 2.0 – 2020	367	3,249	1,192
SASH 2.0 – 2021*	134	5,008	671
SASH 2.0 – 2022*	6	4,687	28

Source: Evergreen analysis of energy consumption of program participants and matched comparison group for program years 2010-2021.

* Regression models were not run for program years with fewer than 30 participants or less than a year of post-install data. The estimated annual savings for these program years are based on the overall average for the corresponding program, adjusted to reflect the average size of the solar system installed in the given year.

** The program level results do not add up to the sum of the yearly results because this is based on a pooled model, including participants from all program years to estimate savings at the program level.

Table 44 presents the number of homes that participated in the program during each year, the estimated annual first-year electricity bill savings per home for each year, and the overall projected first-year electricity bill savings by program year. The SASH 1.0 program is estimated to have a first-year electricity bill savings total of $5.4 million, and the SASH 2.0 program a total of $3.8 million. Similar to energy savings, these bill savings will continue beyond one year, as the panels will continue generating electricity. Please note that the dollar value of savings depends on many factors (e.g., panel degradation, weather, energy consumption, and utility NEM rates).

Table 44: Estimated Cumulative Bill Savings

Program – Year	Number of Participating Homes	Estimated First Year Annual Electricity Cost Savings Per Home ($)	Annual First Year Electricity Cost Savings for All Homes ($1,000)
SASH 1.0**	**5,196**	**$1,032**	**$5,361**
SASH 1.0 – 2009*	29	$559	$16
SASH 1.0 – 2010	199	$498	$99
SASH 1.0 – 2011	759	$632	$480
SASH 1.0 – 2012	1,341	$848	$1,137
SASH 1.0 – 2013	1,045	$835	$873
SASH 1.0 – 2014	868	$925	$803
SASH 1.0 – 2015	799	$936	$748
SASH 1.0 – 2016	151	$902	$136
SASH 1.0 – 2017*	2	$1,033	$2
SASH 1.0 – 2018*	3	$889	$3
SASH 2.0**	**4,212**	**$904**	**$3,807**
SASH 2.0 – 2015	193	$715	$138
SASH 2.0 – 2016	668	$769	$514
SASH 2.0 – 2017	797	$890	$709
SASH 2.0 – 2018	1,090	$814	$887
SASH 2.0 – 2019	957	$785	$751
SASH 2.0 – 2020	367	$520	$191
SASH 2.0 – 2021*	134	$987	$132
SASH 2.0 – 2022*	6	$924	$6

Savings by Customer Segment

Next, Table 45 provides the estimated energy savings by program and selected customer segment. The segmentation analysis revealed some important differences across segments:

- Each utility had similar estimated annual kWh savings; however, the average SCE participant's pre-install kWh usage was larger, resulting in a slightly lower percent of energy savings.
- The size of the solar system installed was related to kWh usage, as demonstrated by the percent of energy savings for the one-to-four kWh size bins being roughly 65 to 70 percent. An increase in solar size over time does not necessarily mean an increase in the percent of kWh savings over time.
- Homes that own their solar panels had slightly lower average pre-install kWh usage, resulting in a lower percent of energy savings when compared to TPO panels.

Table 45: Estimated Annual Energy Savings by Subgroup

Category	Sub-group	Est Annual Net kWh Energy Savings (After NTG adj)	Percent of Energy Savings	n
Overall		4,842	67%	5,432
Utility	PG&E	4,898	72%	2,762
	SCE	4,823	61%	2,125
	SDG&E	4,815	71%	545
Size	1 kWh system	2,330	65%	738
	2 kWh system	3,773	70%	1,768
	3 kWh system	4,245	69%	1,693
	4 kWh system	6,996	66%	1,106
	5+ kWh system	10,077	84%	127
Owner	TPO	4,835	64%	3,298
	Homeowner owned	4,752	70%	2,134

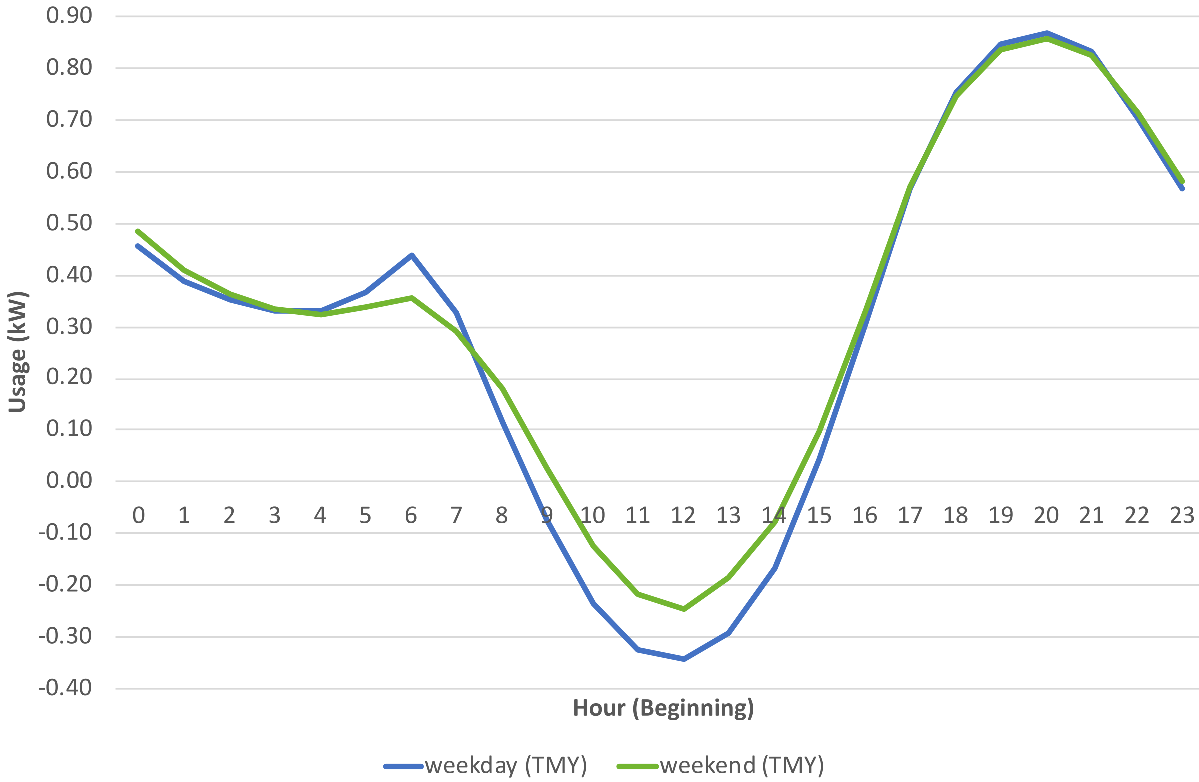
4.8.2 Timing of Savings by Hour and Day

This section provides estimates for the average energy usage following the installation of the solar panels by time-of-day and day-type.

Estimated Hourly Energy Usage

Figure 29 shows the estimated load shape for a normalized weather-year. After solar panels have been installed, the average customer in a weather normalized year has peak energy usage in hour 20 (0.87 kW on a weekday and 0.86 kW on a weekend), the lowest usage at noon (below zero kW when the panels are generating), and a smaller morning peak at 6 a.m. (0.44 kW on a weekday and 0.36 kW on a weekend).

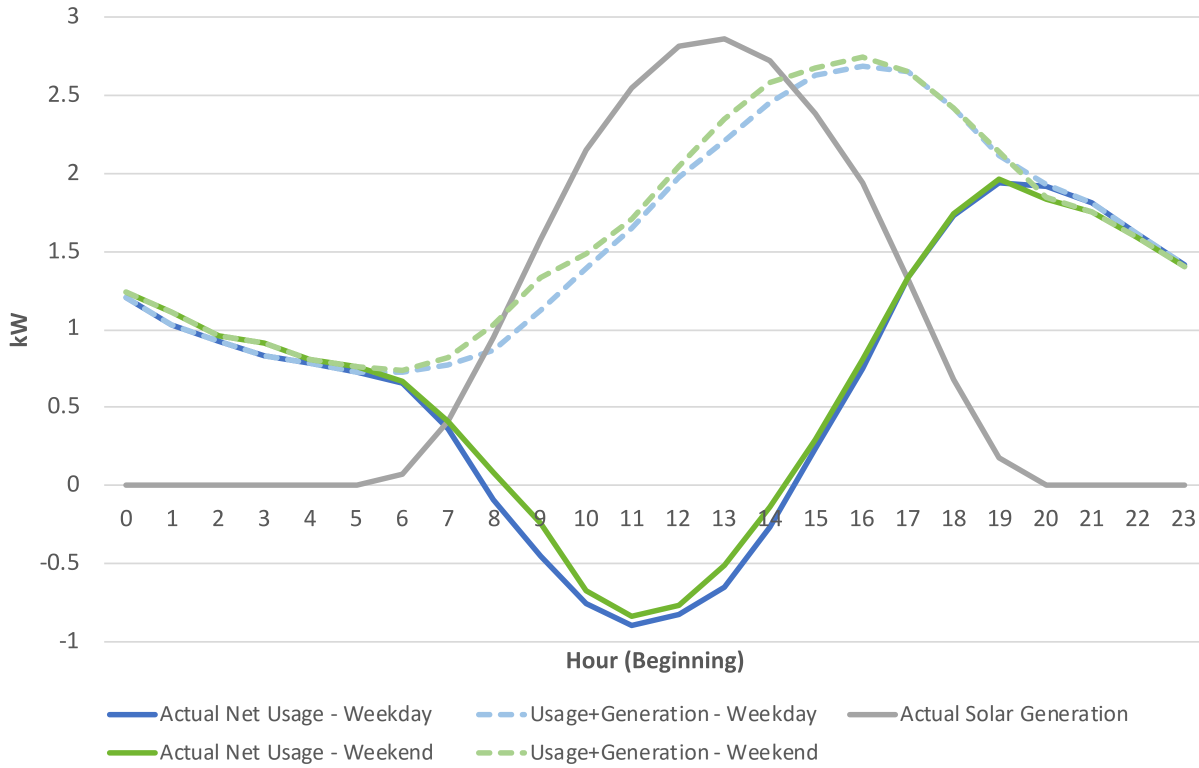
Figure 29: Estimated Average Post-Install Hourly Load Shape for a Normalized Year



Source: Evergreen analysis of energy consumption of a sample of 100 program participants for program years 2010-2021.

Figure 30 shows average net energy usage (solid green and blue lines), average generation (grey line), and average consumption (i.e., net usage + generation; dotted lines) plus generation load shapes for two weeks in July 2022 (July 12 – July 25, 2022). The average sampled participant in July 2022 has peak energy consumption in hour 16 (2.69 kW on a weekday and 2.75 kW on a weekend). The average solar panel is at its peak generation during hour 13 (2.86 kW). What the utility will experience is a peak in net usage (i.e., consumption from the grid beyond self-generation) during hour 19 (1.94 kW on a weekday and 1.96 kW on a weekend) and the lowest net usage at noon (-0.90 kW on an average weekday and -0.84 kW on an average weekend, when the panels are generating).

Figure 30: Average Post-Install Hourly Load Shape for July 2022



Source: Evergreen analysis of energy consumption of a sample of 100 program participants for program years 2010-2021.

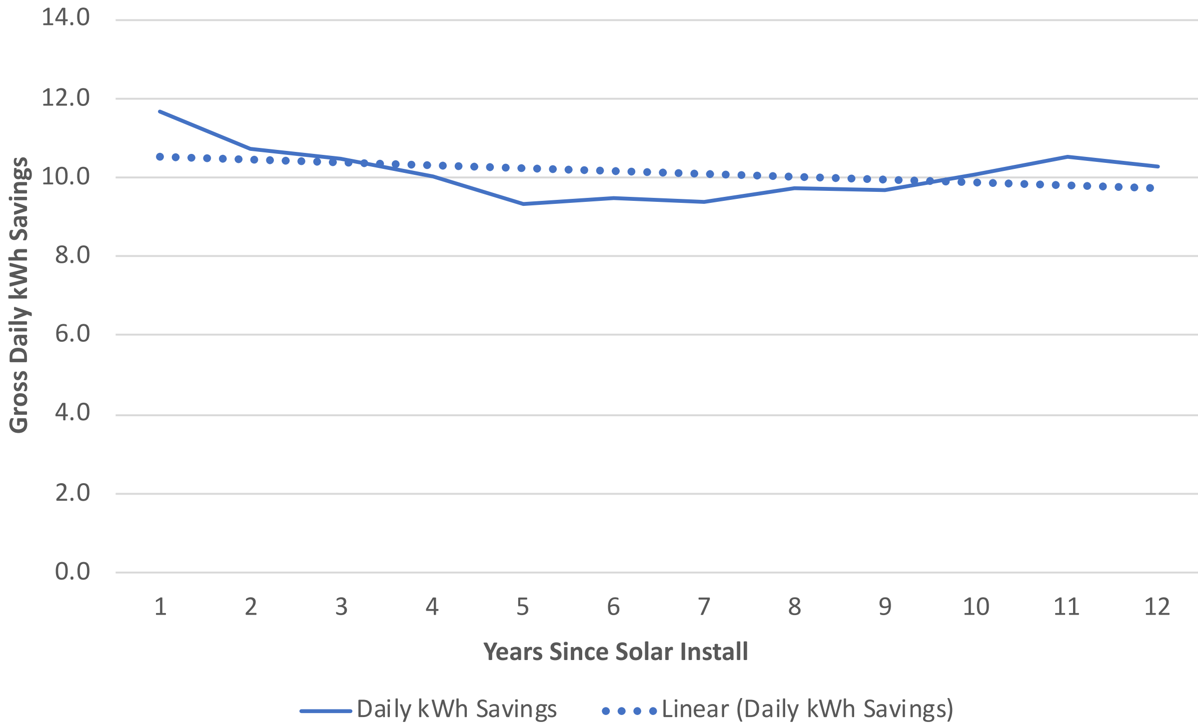
4.8.3 Persistence of Savings

This section provides estimates for the average savings attributable to the solar panels over time. Figure 31 presents the results of the modeled daily gross energy savings over time for the 2009 to 2011 SASH 1.0 program participants. We do not see evidence of a sudden drop-off of savings around year 10, when the inverters are expected reach the end of their useful life. The overall trendline suggests there is a 7.3 percent decrease in savings over 12 years, or 0.61 percent per year. This is likely a combination of panel degradation (which was expected to be ~0.5% per year),[32] system failure (e.g., inverter failure, disconnection), and increased energy consumption (e.g., installing additional electric appliances, purchasing an electric car). There was a slight decrease in savings initially that persisted until year five. This was expected, as customers received smaller electricity bills after installing solar; when electricity is more affordable, there is less

[32] The National Renewable Energy Laboratory INREL) estimated a degradation rate of around 0.5 percent per year but noted that it could be higher in hotter climates. Jordan, Dirk and Sarah Kurtz. "Overview of Field Experience – Degradation Rates & Lifetimes." NREL presentation at Solar Power International conference in Anaheim, CA, September 14, 2015. https://www.nrel.gov/docs/fy15osti/65040.pdf

incentive to conserve. However, savings leveled off in year six and then increased slightly until year 12.

Figure 31: Estimated Gross Daily kWh Savings Over Time



Source: Evergreen analysis of energy consumption of program participants for program years 2009-2020.

4.9 Cost Effectiveness

This section provides the cost-benefit ratios by IOU and SASH 1.0 and 2.0 for the Total Resource Cost (TRC) test, Societal Cost Test (SCT), and Ratepayer Impact Measure (RIM) test. These assessments replicated the format and general content requirements of the 2001 CPUC California Standard Practice Manual for performing economic analysis of demand-side programs and projects. Detailed methodology and input data are in Appendix A.

Cost-Benefit Test Results

Table 46 presents cost-benefit ratios by IOU and SASH 1.0 and 2.0. For the TRC and RIM tests, the cost-benefit ratios are less than one, meaning the costs exceed the benefits from the total resource and ratepayer perspectives.[33] These findings are to be expected given the high costs of providing near-full to full incentives for PV systems to program participants.

[33] Evergreen's findings are generally consistent with previous SASH 1.0 cost-benefit analyses, which found that the SASH program was not cost effective but increasing in cost-effectiveness over time. However, methods could not be replicated exactly.

For the SCT, which includes the additional benefit of the monetary value of carbon reduced, ratios for all IOUs are greater than or equal to one for SASH 2.0, indicating cost effectiveness. The SASH 1.0 SCT ratio for SCE (1.13) also implies cost effectiveness, and the SASH 1.0 SCT ratios for SDG&E and PG&E are approaching cost effectiveness (0.78 and 0.88, respectively). On average, ratios increased from SASH 1.0 to SASH 2.0, attributable in part to declining system equipment and installation costs and lower administrative costs.

Table 46: SASH Program Cost-Benefit Ratios

Program	IOU	TRC	SCT	RIM
SASH 1.0	PG&E	0.55	0.88	0.11
	SCE	0.74	1.13	0.08
	SDG&E	0.48	0.78	0.08
	Average	**0.59**	**0.93**	**0.09**
SASH 2.0	PG&E	0.60	1.00	0.10
	SCE	0.68	1.12	0.09
	SDG&E	0.69	1.10	0.09
	Average	**0.66**	**1.07**	**0.10**
Overall	PG&E	0.58	0.94	0.10
	SCE	0.71	1.12	0.08
	SDG&E	0.58	0.94	0.09
	Average	**0.62**	**1.00**	**0.09**

The finding that the program is relatively more cost-effective from the societal perspective is due to the use of a lower (societal) discount rate as well as the incorporation of the carbon reduced per PV system metric. The use of a lower discount rate relative to the TRC and RIM tests led to a higher net present value (NPV) of the benefits to the consumer and IOU. For example, for the SCT for PG&E SASH 1.0 (3% discount rate), the net present value sum of consumer and IOU benefits was $14,867 per PV installation, whereas for the TRC test for PG&E SASH 1.0 (6.93% discount rate), the NPV sum of consumer and IOU benefits per PV installation was $9,337.

Evergreen used 2009-2021 values of the Social Cost of Carbon to find the average monetary value of carbon reduced per PV system, which was added to total benefits. This amounted to an additional benefit of at least $2,000 for each IOU, and thus contributed to the finding of greater cost-effectiveness for the SCT.

In contrast to the high SCT values, Evergreen calculated an average RIM test ratio of 0.09 for SASH 1.0 and SASH 2.0. This implies that the program caused rates to increase for non-participants and that the program is not close to being cost effective from the ratepayer perspective. The finding of cost-ineffectiveness is not unexpected, as unlike the SCT and TRC test, the RIM test considers the consumer bill savings to be an additional cost to the utility. However, the RIM ratios observed are particularly low.

There are two notable limitations to Evergreen's cost-benefit analysis. First, we used a combination of E3's Avoided Cost Calculators to obtain avoided cost values by IOU from 2009 to 2035. While using a combination of calculators allowed Evergreen to consider avoided costs across the PV system lifetime, it likely led to additional fluctuations in values that were a product of the updates to the calculators themselves. Next, the monetary value of carbon reduction is the only non-energy benefit (NEB) considered, and it was only accounted for in the SCT. The "Carbon Reduced Over System Life (Tons)" was the only NEB-related metric provided by GRID. While it was feasible to obtain NEB estimates from the CPUC's Low-Income Public Purpose Test (LIPPT), incorporating additional NEBs (that were not directly linked to program data) would have risked overstating the true value of program benefits.

4.10 Environmental Benefits

GRID Staff reported that most participating customers were motivated to participate by lower energy bills. Part of the program's charge, however, was to educate customers on environmental benefits as well. This section explores the perceptions of environmental benefits and the actual calculated impacts.

4.10.1 Greenhouse Gas (GHG) Emissions Analysis

The Evergreen team estimated the GHG impacts of the SASH program PV systems in reference year 2021. This evaluation relies on avoided grid emissions rates developed by WattTime as part of the SGIP GHG Signal efforts.

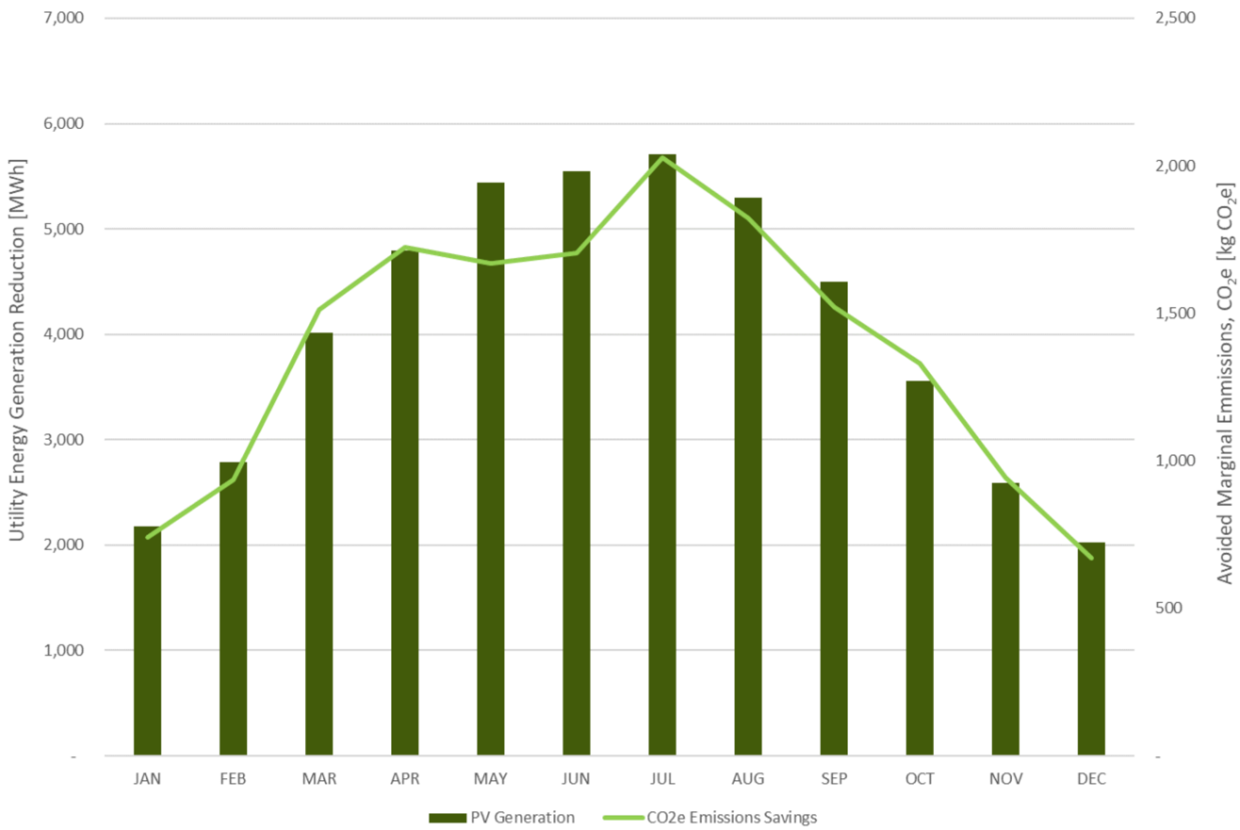
Program PV systems are estimated to reduce GHG emissions by 16,570 metric tons (Mtons) of CO_2 equivalent (CO_2e) or 16,601 Mtons of CO_2 using 2021 emission rates. Criteria pollutant reductions equate to 518 kg of methane (CH_4) reduction and 64 kg of nitrogen oxides (NO_X) reduction (Table 47).

Table 47: Distribution of estimated GHG impacts by IOU

IOU	CO_2 Emissions Savings (Mton CO_2)	CH_4 Emissions Savings (kg CH_4)	NO_x Emissions Savings (kg NO_x)	CO_2e Emissions Savings (Mton CO_2e)
PG&E	7,389	229	28	7,403
SCE	7,313	230	28	7,327
SDG&E	1,868	58	7	1,871
TOTAL	**16,570**	**518**	**64**	**16,601**

Figure 32 shows estimated GHG savings by month along with the estimated total PV system generation from SASH projects. Note that the magnitude of GHG savings is not directly aligned with the PV system generation alone. More GHG savings result from specific months due to the source-mix of the avoided electricity that would have been provided by the electric utility. July was the month with the highest share of top 200 demand hours and was also the month that provides the most GHG savings from SASH PV systems.

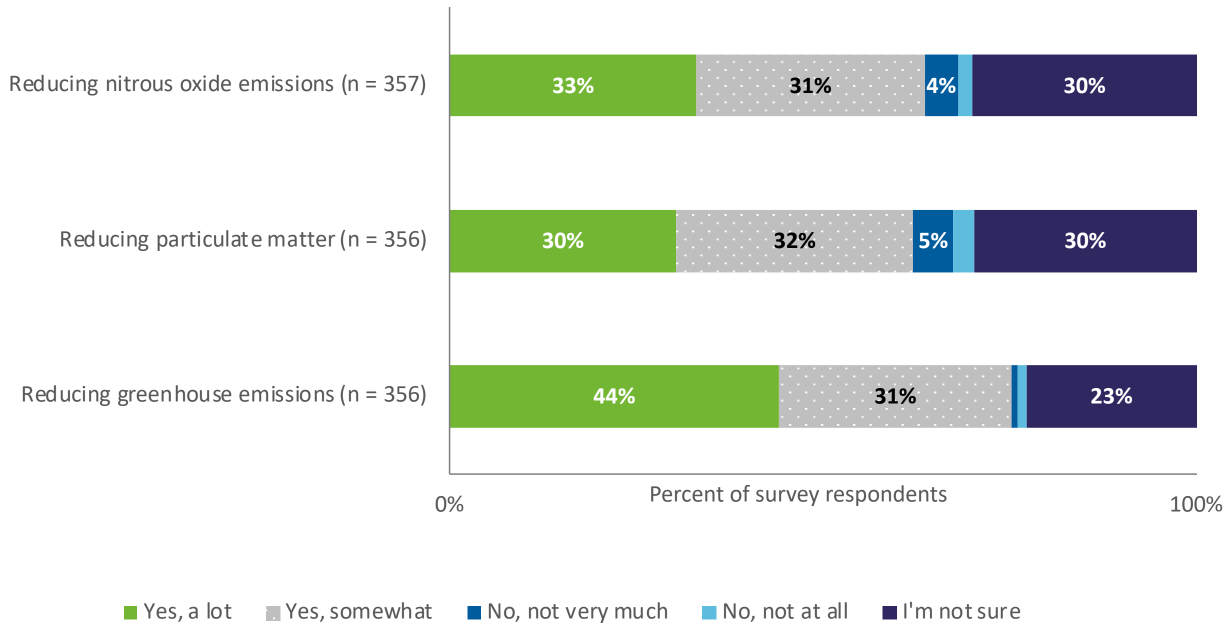
Figure 32: Estimated GHG Impacts and SASH Generation



4.10.2 Customer Perceptions

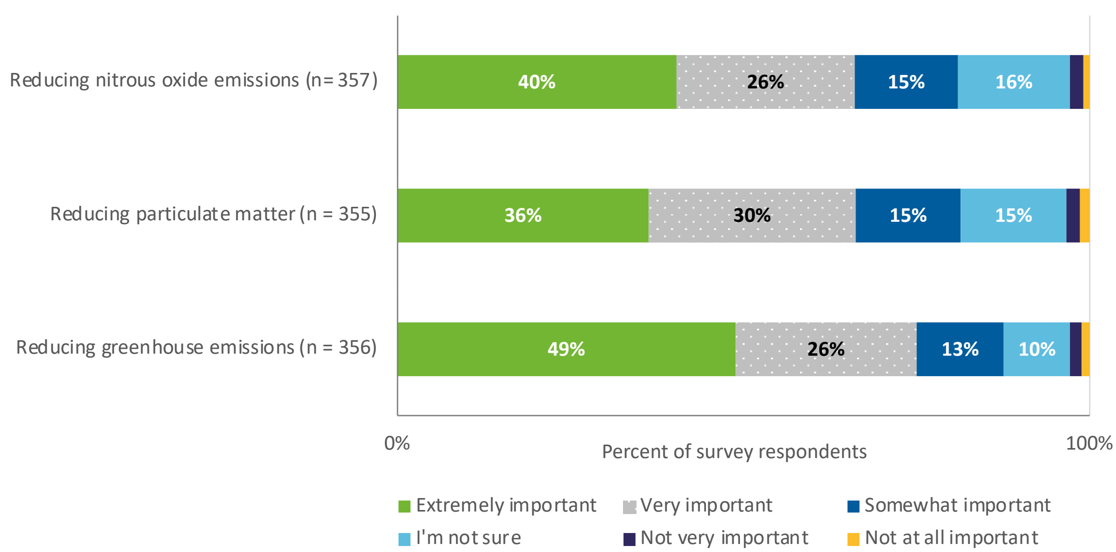
The survey found that over half of participant respondents believed that the SASH program was responsible somewhat or a lot for reducing nitrogen oxides emissions, particulate matter, and GHG emissions (Figure 33). Non-participant respondents were equally likely to report that the program could help in the reduction of emissions and provide environmental benefits.

Figure 33: Participant Perception of Program's Environmental Impact



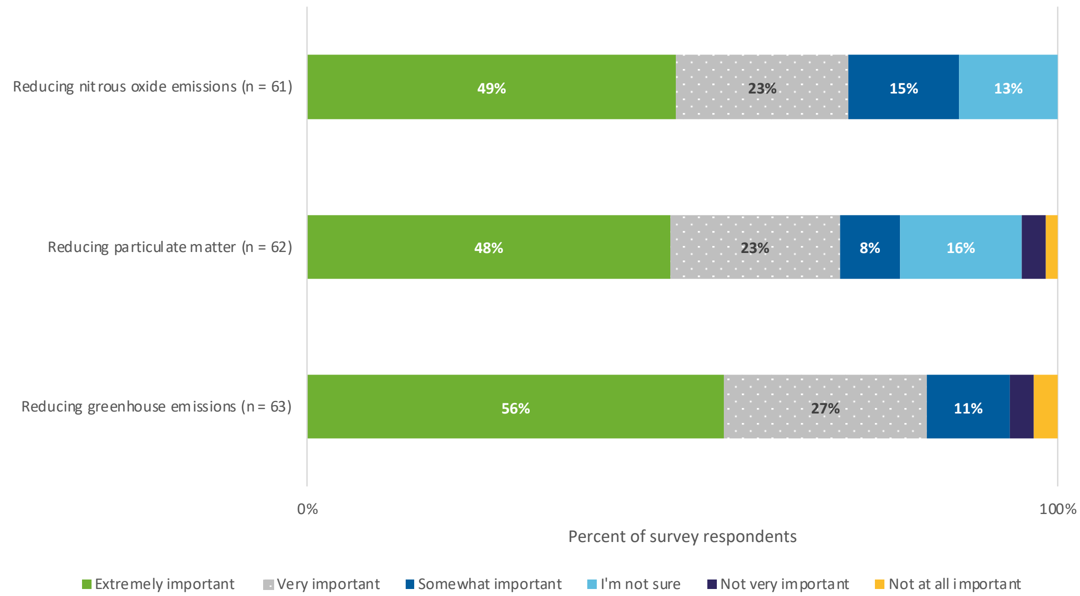
Although participants and non-participants had similar perceptions of the program's impact on environmental benefits, participants were more likely to report that those benefits were important to them personally. Figure 34 shows that most participants did report that the reduction of the emissions listed were important.

Figure 34: Importance of the Programs' Environmental Benefits (Participants)



In contrast, Figure 35 shows that more non-participant respondents said the benefits were not at all important to them, indicating that participants may have been more likely to care about environmental benefits than non-participants.

Figure 35: Importance of the Programs' Environmental Benefits (Non-Participants)



4.11 Workforce Development and Job Training

A defining feature of the SASH program was its integrated workforce development mandate. In this section, we present findings from the trainee web survey, the onsite field visits, and interviews with trainees to characterize the workforce development mandate of the SASH program to answer the following questions:

1. What job training programs were leveraged?
2. How many local jobs were created?
3. What were the longer-term job outcomes for trainees?

Findings related to training and volunteer outcomes, career progression, and barriers to participating in the trainings are below. Further findings from the trainee survey on program marketing and the value of different elements of the training program are in Sections 6.5 and 6.6.

4.11.1 Training Program Background

To promote green jobs in low-income communities, GRID administers Install Basic Training (IBT), a solar installation training program. GRID designed the IBT course with the help of a consulting firm, Accenture, and runs it out of its regional offices. The IBT courses provide classroom instruction, lab activities, and real-world experience on solar installations to participants. The goal of the IBT program is to provide an effective, efficient, and equitable pathway into the solar industry.

The IBT program was not funded by SASH and is still running though the SASH program has closed. The IBT program integrated well with the workforce development goals of the program. Each SASH installation required at least one trainee to be present to gain on-the-job experience. Trainees could either be volunteers or IBT members.

GRID often partners with municipalities or CBOs to offer trainings that provide a stipend for the IBT classes. This external funding allows for greater reach, as targeted communities may not be able to participate without compensation.

GRID also utilizes volunteers as part of its mission to educate local communities about solar opportunities. We differentiate between these two groups in our analysis due to the significant differences in experience for the participants.

GRID-provided data were often missing a trainee type (volunteer or trainee) so for analysis purposes, we used self-reported data from survey respondents to identify if they were IBT trainees (n = 48) or volunteers (n = 51). Table 48 shows the range of responses for trainees that were listed in GRID's database. In our analysis, we use the self-reported experience of the participants.

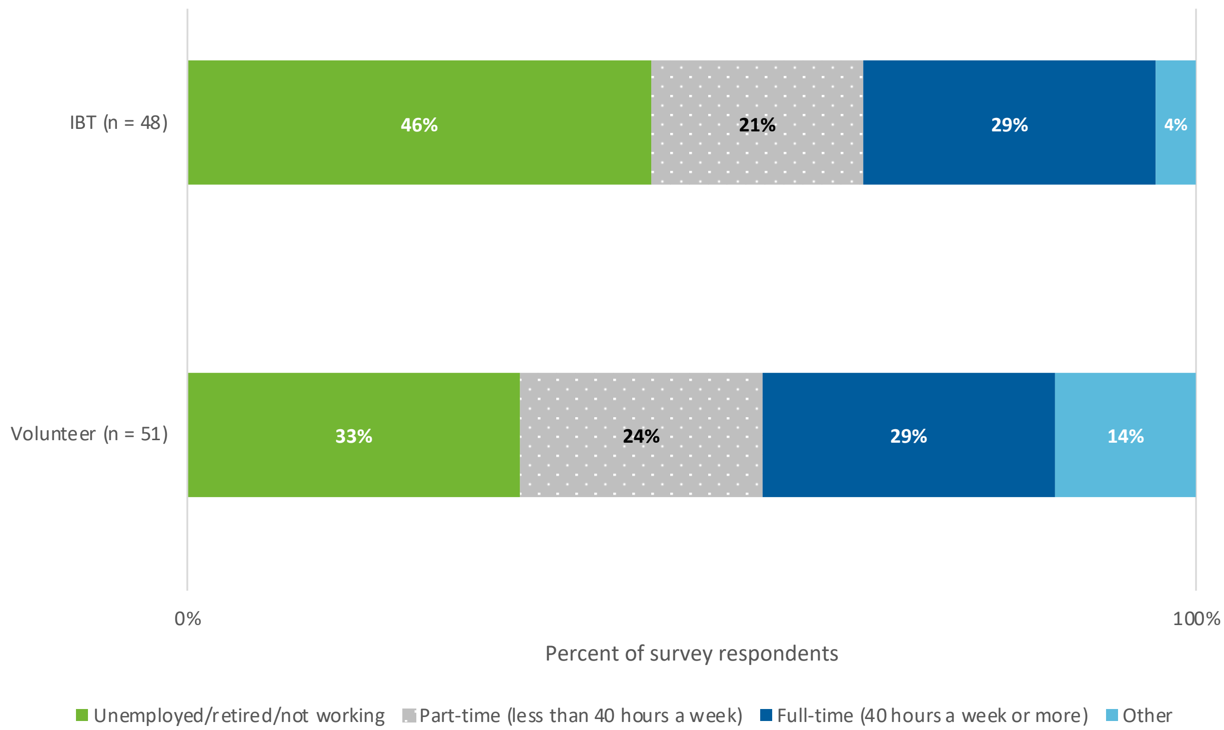
Table 48: Trainee Types Surveyed (n = 99)

<table>
<tr><th>Category for Survey Analysis</th><th>Program Data Trainee Type</th><th>N</th></tr>
<tr><td rowspan="6">IBT Trainee</td><td>Paid Cohort Trainee</td><td>5</td></tr>
<tr><td>Paid Intern</td><td>2</td></tr>
<tr><td>SolarCorps (paid internship with GRID)</td><td>3</td></tr>
<tr><td>Unpaid Cohort Trainee</td><td>12</td></tr>
<tr><td>Unpaid Intern</td><td>1</td></tr>
<tr><td>Not Reported</td><td>25</td></tr>
<tr><td rowspan="3">Volunteer</td><td>SolarCorps (paid internship with GRID)</td><td>2</td></tr>
<tr><td>Unpaid Cohort Trainee</td><td>1</td></tr>
<tr><td>Not Reported</td><td>48</td></tr>
</table>

4.11.2 Training and Career Outcomes

Most IBT participants and about a third of volunteers reported that they were unemployed, retired, or not working before participating with GRID (46% and 33%, Figure 36). The percentage of those who worked full-time before was the same for both groups (29% for both the IBT participants and the volunteers).[34]

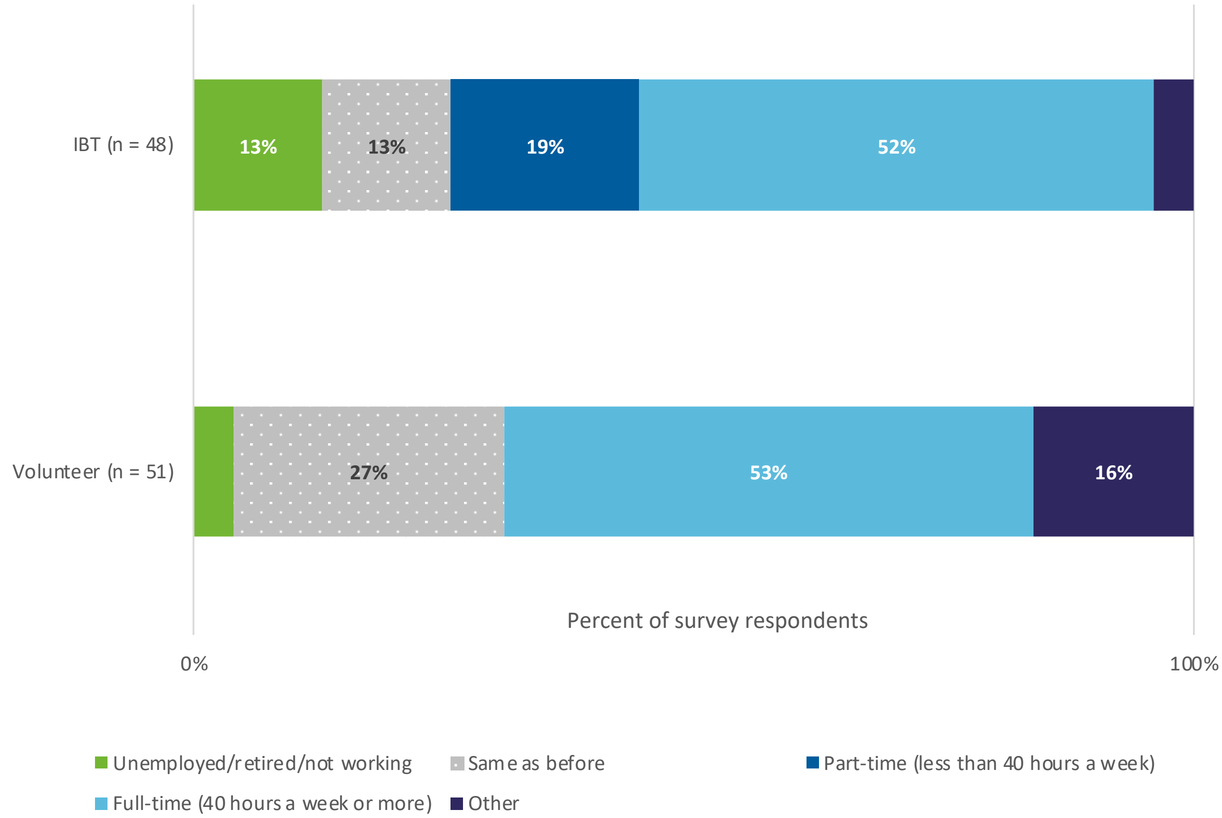
Figure 36: Employment Status Before Participation



After participation, respondents were more likely to report that they had a full-time job. As shown in Figure 37, participants in both groups (52% of IBT participants and 53% of volunteers) reported that they are now working full time. There was also a significant reduction of unemployment, with only 13 percent of those who attended the IBT course and 4 percent of the volunteers reporting as such.

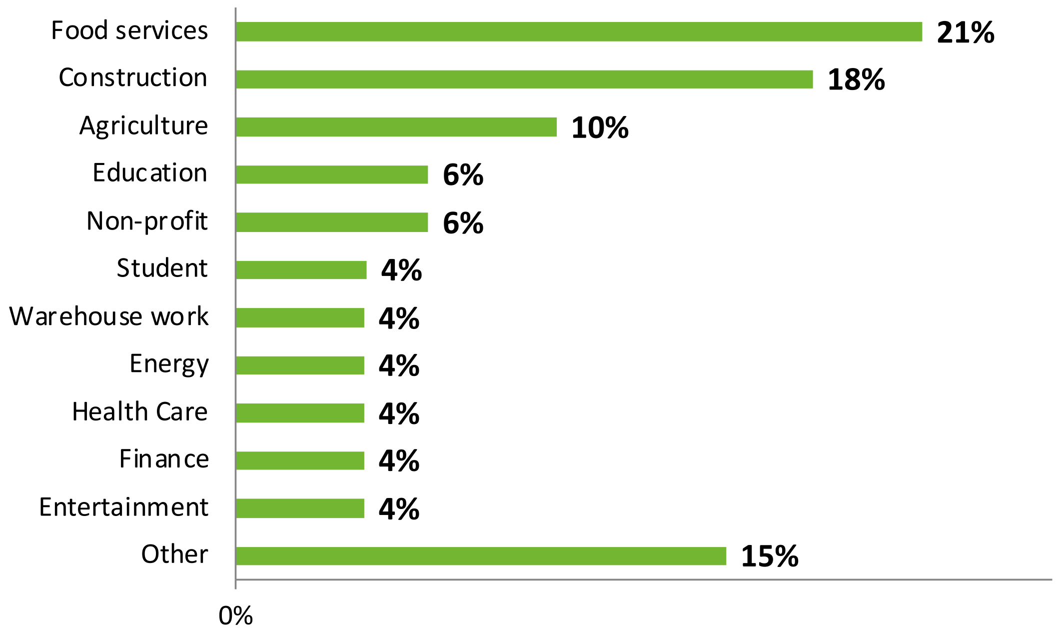
[34] Those that selected "other" were asked to specify. Answers from both sets of participants included involvement at educational institutions (5), commission-based and technical work (2), and incapacitation due to health reasons (1).

Figure 37: Employment Status After Participation



Most participants (92%) had not been employed in the solar industry before participating in the training. We asked participants to specify types of employment before GRID involvement. Respondents reported work experience before participating in GRID's course or installation programs. Twenty-one percent of respondents indicated that they worked in food services, while 18 percent said construction. Figure 38 displays all other responses chosen.

Figure 38: Type of Employment Before Participation (n = 51)

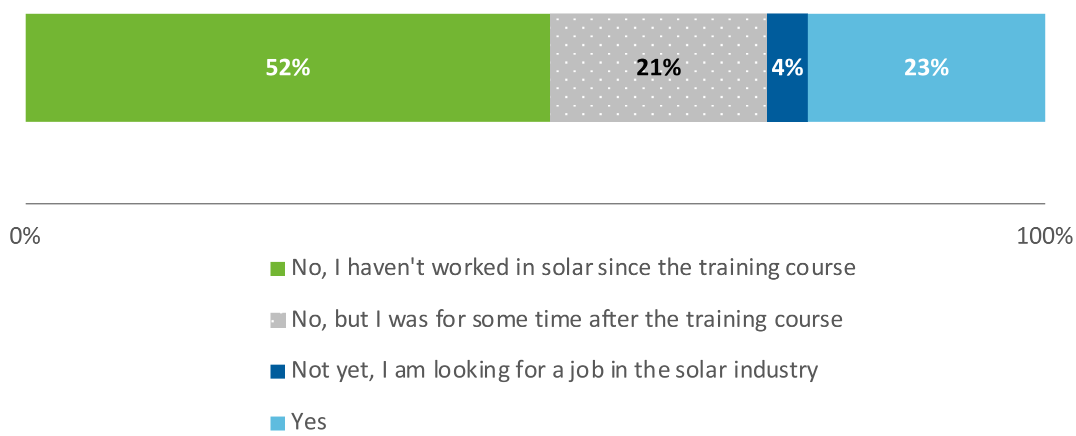


For those that selected "Other," respondents filled in free text to indicate that they were working in science research, technology, engineering, pharmacy, and fiber optics.

4.11.3 Career Progression

Figure 39 shows that over half of all respondents have not worked in the solar industry since the training course (52%). The other respondents either worked in the solar industry for some time, currently work in the solar industry, or are looking for employment in the solar industry. Compared to the pre-employment industries, however, the number of people in the solar industry did increase significantly after participation (8% to 23%), indicating that the program is doing a good job at increasing green jobs.

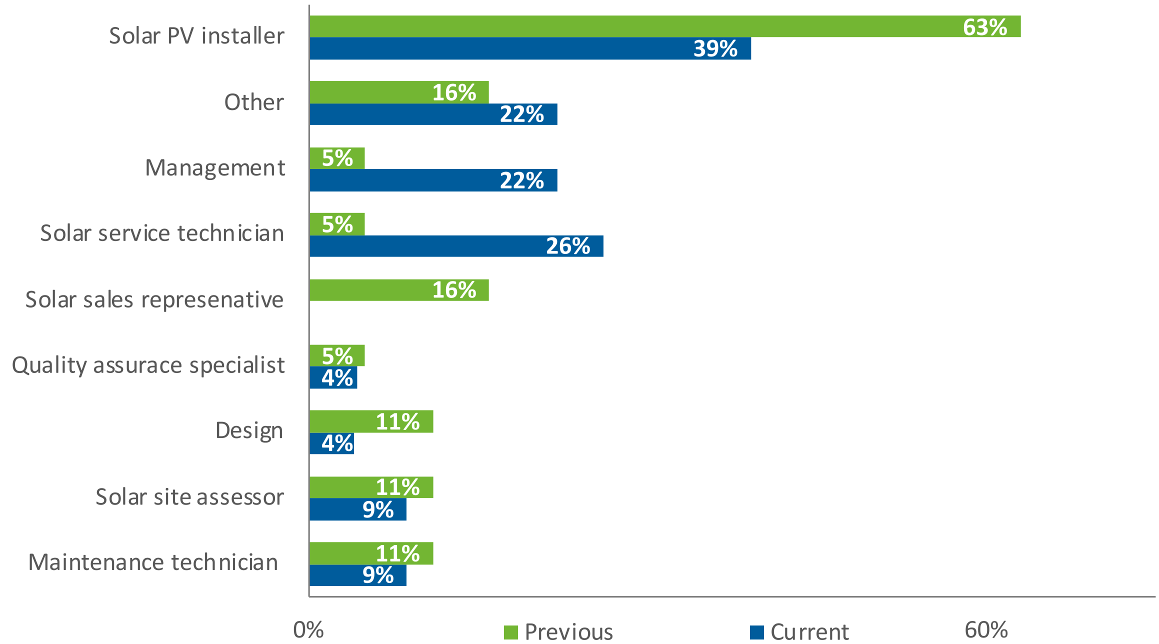
Figure 39: Solar Industry Employment Since Participation (n = 99)



Of the respondents now working in the solar industry (n = 23), the majority (70%) found employment within six months of participating in GRID's training or volunteer opportunity. In fact, 92 percent were employed in the solar industry within two years of GRID involvement.
Of respondents employed in the solar industry, there was a shift in their role after their involvement with GRID, as shown in Figure 40.

Sixteen percent of previous roles shared fit into the "Other" category. Less than a quarter (22%) of respondents with current roles in the solar industry fit into the "Other" category. The "Other" category comprises roles that were too sparse or specialized compared to the other respondents' replies or the multiple-choice options provided. For example, respondents with previous roles in the solar industry whose roles were categorized into "Other" shared responses such as "Business Development Officer" and "Installation Scheduler". Additionally, respondents with current roles in the solar industry whose roles were categorized into "Other" shared responses such as "Constructions Operations Specialist", "Foreman", and "instructor".

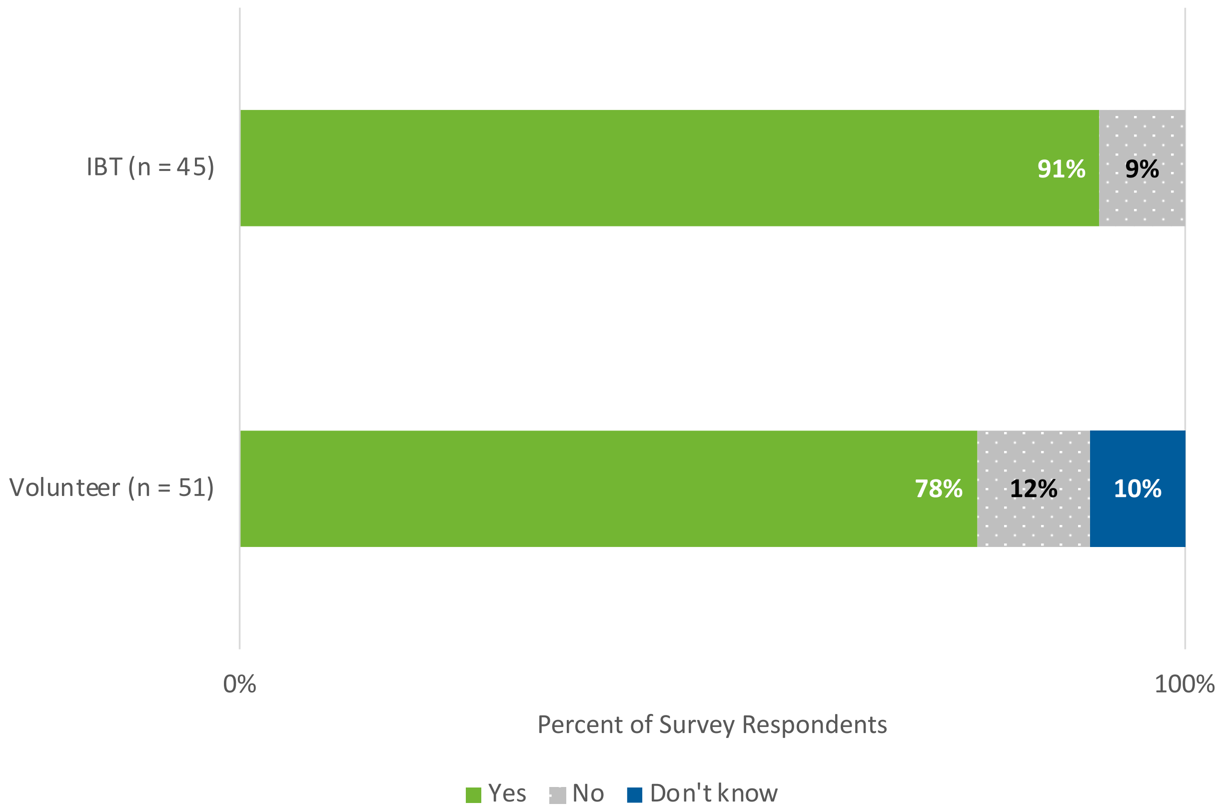
Figure 40: Roles in Solar Industry (n = 42)



Very few participants shared reasons for no longer working in the solar industry. Of those that shared (n = 3), the responses were "I am in the greenhouse building industry", "Back injury", and "Because I went back to my trade which is electrician".

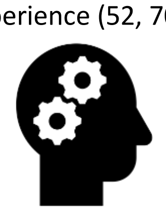
Both IBT and volunteer respondents mostly reported that involvement with GRID projects improved their career opportunities (Figure 41), with volunteers reporting "don't know" more frequently than IBT respondents.

Figure 41: Belief in Improvement of Career Opportunities after Participation



The participants who said 'yes' to whether they believed spending time with the SASH projects doing on-site installations improved their career opportunities in the solar industry were further asked to describe how the on-site training helped them do so. The 36 IBT participants and 34 volunteers gave several explanations as to how they believed their career prospects were improved, most of which are summarized by Table 49 below.

Table 49: Respondent Belief on How Participation Improved Career Prospects (n = 70, multiple responses allowed)

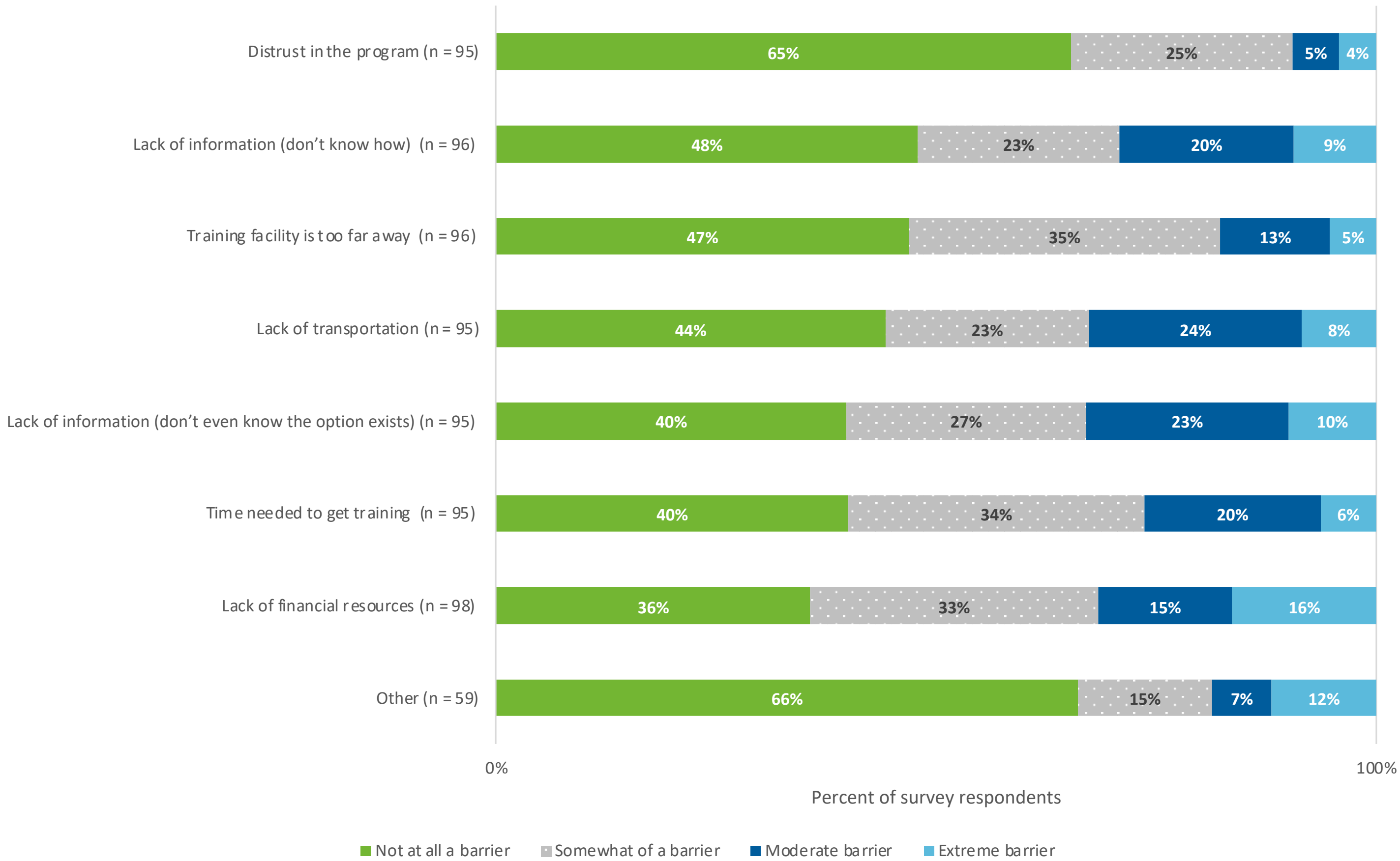
Gaining more technical knowledge and hands-on experience (52, 70%) 	"…It was very educational for my experience in construction." (IBT) "Before the on-site training I didn't know how to approach solar installations. After attending an on-site training for solar installation, I feel that I gained new techniques for and knowledge about solar panels and ways to mount them for the greatest results." (Volunteer)
Assistance with employment and	"When I went to apply in the solar field, they were impressed I had installed previously so they felt I would be an asset in the office environment due to my field knowledge." (IBT)

networking opportunities (34, 49%) 	“It 100% helped me find work. I met people who spent time teaching me more and directed me to courses that I could take outside of GRID, and by following their advice, I found work fairly quickly.” (Volunteer)
Personal development (8, 11%) 	“It made me more knowledgeable, and I could hold more conversations with employers on different aspects of the solar industry. It also made me more familiar with site assessment and solar equipment, which solar suppliers look for.” (IBT) “Installing solar with GRID inspired my career. I absolutely loved the vibe on the volunteer-based construction sites. Everyone wanted to learn and do their best work. The gratifying nature of the non-profit service with tangible results was inspiring.” (Volunteer)

4.11.4 Barriers to Participation

Participants in both courses were asked how much of a barrier various factors are to getting hands-on experience in the industry (Figure 42). Most respondents said that the options listed were “not at all a barrier”; however, a lack of financial resources, lack of time, and lack of information were most reported as moderate or extreme barriers.

Figure 42: Barriers to Gaining Experience in the Industry (n varies)



Those who chose 'other' barriers were asked to further specify; nine participants offered an answer. These answers included:

- Inclusivity issues due to gender and language barriers (5);[35]
- Personal motivation (2);
- The strenuous and unstable nature of the work environment due to a lack of breaks and constant schedule changes (2);
- Family and childcare responsibilities (1);
- Not having enough opportunities to do installations (1); and
- Transportation issues (1).

GRID's IBT program did a good job at connecting job trainees and the SASH installations to give participants hands-on experience that ultimately increased the number of people with jobs in the solar industry. The program helps trainees overcome barriers to obtaining a job on their own by

[35] Inclusivity barriers were identified as having "English speaking requirements" or "being female."

providing training, transportation, and experience. The SASH requirement to include job trainees helped provide those opportunities for the program and the individuals involved.

5 Conclusions

The goals listed in the decision to authorize the program did not specify a targeted number of kW installed, homes served, or guidance on the type of customers that should be prioritized through the Single-Family Affordable Solar Housing (SASH) program; therefore, the evaluation cannot conclusively say if the program successes listed above met the intended goals of the CPUC. The program did see many successes, however, and we discuss them in this section.

5.1 Program Accomplishments

Through the installation of 9,501 projects from 2009 to March 2022, the program realized the following accomplishments:

- 30,003 kW (CEC-AC[36]) total installed capacity with an average of 3.2 kW per home
- Estimated reduced greenhouse gas (GHG) emissions of 16,601 metric tons of CO_2 equivalent (similar to the average carbon footprint for one year for 738 California households), along with criteria pollutant reductions of 519 kg of methane (CH4) reduction and 64 kg of nitrogen oxides (NOx) reduction[37]
- Participation from customers in all eligible investor-owned utility (IOU) service territories, with 46 percent of projects in PG&E's, 42 percent in SCE's, and 11 percent in SDG&E's service territories
- $133.9 million in incentives paid out for installation projects with an average of $14,089 going to each project[38]
  - $92 million in incentives paid out for SASH 1.0 projects, with an average of $17,489 per project
  - $41.9 million in incentives paid out for SASH 2.0 projects, with an average of $9,876 per project

[36] A rating system used to determine the eligibility of a solar system by the California Energy Commission.

[37] https://rael.berkeley.edu/wp-content/uploads/2018/04/Jones-Wheeler-Kammen-700-California-Cities-Carbon-Footprint-2018.pdf

[38] Analysis of incentives was done on the 9,501 projects that were considered fully complete as of March 2022. There were additional projects that were installed but not yet interconnected, or where incentives had not yet been paid out. Those projects were excluded from this analysis of per-project incentive costs.

- $160 million total spent (administration, marketing and outreach [M&O], and incentives) out of a $160.7 million total budget with an average of $16,907 spent per project on administration, M&O costs, and incentives[39]
  - $108.7 million spent on administration, M&O, and incentives for SASH 1.0, with an average of $20,501 per project
  - $51.3 million spent for SASH 2.0, with an average of $12,050 per project
- Solar system performance slightly better than projected (105 percent of projected performance)
- Reports of lower bills (81% of surveyed customers)
- An average of 67 percent decrease in energy consumption (5 MWh per year) for an average total annual bill savings of $904 per year (91% reduction in annual bill costs)
- High customer satisfaction and appreciation for the services provided by the program
- Increased solar industry participation from volunteers and trainees after participation in trainings and/or volunteer opportunities created by the program (8 percent worked in the industry before the program and 23 percent reported working in the industry afterwards)

Overall, the programs were responsible for increasing the number of homes with solar rooftops and for providing an opportunity for low-income customers to benefit from solar power. The programs were not cost effective from a total resource or ratepayer perspective. However, this was expected given the cost of providing near-full incentives for PV systems to program participants. The programs were cost effective from a societal perspective, where the monetary value of carbon reductions outweighed the program costs.

5.2 Findings and Lessons Learned

While this program has ended, we identified lessons that may be helpful for similar solar programs in the future. This section is organized in the following subsections:

1. Lessons learned related to goals of the program
2. Lessons learned related to barriers to solar installation
3. Lessons learned for tracking and collecting valuable data in future programs.

5.2.1 Lessons Learned Related to Program Goals

As mentioned previously, the goals listed in the decision to authorize the program did not specify a targeted number of kW installed, homes served, or guidance on the type of customers that should

[39] Analysis of administration and M&O costs was done on the 9,559 projects that were started as of March 2022. These costs are reported on a semi-annual basis and include administration and M&O time spent before a project is fully completed.

be prioritized through SASH. However, five goals were clear from the decision authorizing the program:

1. Decrease electricity use by solar installation and reduce energy bills without increasing monthly expenses.
2. Provide full and partial incentives for solar systems for low-income participants.
3. Offer the power of solar and energy efficiency to homeowners.
4. Decrease the expense of solar ownership with a higher incentive than the General Market California Solar Initiative (CSI) program.
5. Develop energy solutions that are environmentally and economically sustainable.

Program Goals 1 & 3: Decrease electricity use by solar installation and reduce energy bills without increasing monthly expenses. Offer the power of solar and energy efficiency to homeowners.

Based on analysis of customer energy bills, SASH participants *avoided* the increases in bill costs observed in the matched comparison group, while *saving* money on their energy bill after installing solar. On average, SASH 1.0 participants experienced a 60 percent decrease in energy consumption (4.4 MW per year) resulting in total bill savings of $1,032 per year, while SASH 2.0 participants were estimated to have a 67 percent decrease in energy usage (5.0 MW per year), resulting in bill savings of $904 per year. The SASH program successfully reduced energy bills without increasing monthly expenses for most participants.

GRID referred customers to the Energy Savings Assistance (ESA) program as part of the SASH participation process to reduce energy usage alongside the installation of solar panels, but we found that only 11 percent of participants were enrolled in the program. GRID also provided energy efficiency education to customers to help them understand how to reduce their usage, and 55 percent of survey respondents that reported lower electricity usage believed their usage decreased due to a better understanding of energy usage in the home or a greater sense of environmental consciousness due to the program.

Lessons learned and implications are in the following table.

Lessons Learned		Implications	
	☐ Future programs should set measurable goals for bill savings and/or reduction in energy usage to better track successes.		A set numerical goal in terms of bill savings or reduction in energy usage would help to assess if future programs are doing a good job at meeting intended targets.
	☐ Future programs should send an annual follow up letter and email to customers reminding them of related programs.		Timing the referrals to related programs to happen after the main contact points for future programs (i.e., enrollment or installation) could help increase parallel enrollment if presented at a time when the homeowner is less overwhelmed. Additionally, including bi-annual reminders for CARE enrollment will help ensure customers stay on the CARE rate after their involvement.
	☐ Future programs should be sure to offer referrals to parallel programs to eligible customers who are not interested in participating.		This will ensure that the outreach time spent by Program Administrators (PAs) are still used to share information about other programs, regardless of participation in the intended program.

Program Goals 2 & 4: Provide full and partial incentives for solar systems for low-income participants. Decrease the expense of solar ownership with a higher incentive than the General Market CSI Program.

As of March 1, 2022, GRID had completed 9,501 SASH projects for a total of 30,003 kW (CEC-AC) for low-income households. GRID offered solar systems to be no-cost to low-income customers by combining the SASH incentive and leveraging other sources of funding external to the program. The SASH program succeeded in its goal to provide full and partial incentives, and to decrease the expense of solar ownership for this population.

Lessons Learned		Implications	
	☐ Future programs should research baseline adoption metrics among the eligible population, then set specific, time-constrained goals to measure success. ☐ Future programs should leverage GRID's model of administering SASH, utilizing local sources of grant funding to help cover full costs of installation so the program is no cost to low-income households.		A set numerical goal in terms of a targeted number of installations per year would help to assess if future programs are doing a good job at meeting their goals. Offering a no-cost program can help to combat customer trust issues.

Program Goal 5: Develop energy solutions that are environmentally and economically sustainable.

In market rate solar installations, there is a trend of increased energy usage after installation.[40] An analysis of SASH savings over time, however, found that there was not the expected drop off in savings from increased consumption, and the overall trendline suggests there is a 7.3 percent decrease in savings over 12 years (0.61% per year). This decrease is smaller than expected, suggesting that SASH was successful in developing solutions that are sustainable.

To evaluate cost effectiveness of the program, we used the Total Resource Cost (TRC) test, Societal Cost Test (SCT), and Ratepayer Impact Measure (RIM) test. For the TRC and RIM tests, the cost-benefit ratios are less than one, meaning the costs exceed the benefits from the total resource and ratepayer perspectives. These findings are to be expected given the high costs of providing near-full to full incentives for PV systems to program participants.

For the SCT, which includes the additional benefit of the monetary value of carbon reduced, ratios for all IOUs are greater than or equal to one for SASH 2.0, indicating cost effectiveness. On average, ratios increased from SASH 1.0 to SASH 2.0, attributable in part to declining system equipment and installation costs and lower administrative costs.

[40] In the CSI impact evaluation, PG&E residential customers increased their consumption by an average of 7.1 percent during the first year after installing solar. Though these systems were incentivized, it is a clear example of the pattern we expected to see, where solar installations often lead to increases in consumption

5.2.2 Lessons Learned Related to Barriers to Participation

Evergreen identified a set of barriers that have hindered installation progress but found that GRID did a good job of addressing these and became more effective over the years. The biggest barriers were:

1. Trust in a "free" program
2. Customers with homes that were not "solar-ready"
3. Tree location

Trust in a "Free" Program: Many participants and non-participants reported having heard about solar from external sales teams before GRID's outreach and were skeptical that the SASH program was truly "free." GRID used testimonials and case studies to try to reduce this distrust. Interestingly, participants were more likely to report this barrier (44%) compared to non-participants (22%), indicating that ultimately, GRID was effective in convincing the more skeptical group to participate. GRID leveraged partnerships with trusted organizations and municipalities, such as cities, job training organizations, and local libraries, as well as customer referrals, to build up credibility within the communities.

- Future programs should follow GRID's model and leverage partnerships with trusted organizations and municipalities, as well as customer referrals, to build up credibility within communities they are aiming to serve.

Customers Not "Solar-Ready": We found that some (13%, n = 1,280) eligible customers required additional services before they could participate in SASH. The most common service required was an electrical service upgrade ($2,394 on average, n = 595), and the most expensive service required was roof repairs ($3,946 on average, n = 88). To ensure that customers could participate in SASH at no cost, GRID fundraised to pay for these services but was not always able to. Many eligible non-participants surveyed (20%) reported that they could not move forward with participation due to these additional services needed.

- Future programs should consider implementing a fund for or permit incentives to cover additional services that may be required to allow customers that are not solar-ready to participate.

Tree Location: Eleven percent of non-participants said that they could not move forward with the project due to the cost of tree trimming required before installation. A solar installer also noted that they tried to balance the value of the shade of a tree in keeping cooling costs down on a home with the benefits of solar when scoping out a project. Other eligible non-participants also reported that they did not move forward with the program simply because they did not want to or could not remove shade trees (though we did not ask directly, 5% of respondents wrote in this response).

- Future programs should be aware that tree trimming (the need for or the desire not to do so) may create barriers to program participation.

6 Additional Findings

6.1 Additional TPO Model Details

6.1.1 Unaccounted Costs of Participating in the TPO Model

The costs of participating in the third-party ownership (TPO) model that were unique when compared to an ownership structure (not inclusive of costs of owned projects) are:

1. The pre-paid 25-year power purchase agreement (PPA) GRID Alternatives (GRID) paid to the TPO
2. Staff and administrative time spent coordinating the TPO relationships
3. Staff time coordinating the TPO model with homeowners

PPA Agreement Amount. GRID tracked the 25-year PPA cost on a per-project basis, but the agreement has changed over the years of its relationships with TPO companies.

Staff TPO Coordination Time. Staff and administrative time spent coordinating with TPO partners was not analyzed. Anecdotally, many staff members reported that the solar companies, Sunrun in particular, can be hard to communicate with. They often will not hear back about service questions, project concerns, or contract issues without multiple attempts to contact them.

Staff Homeowner Coordination Time. The final cost we considered in this evaluation is the cost of staff time explaining and serving as a liaison between the homeowner and the TPO company. During the evaluation, GRID staff reported that explaining the model was confusing to participants. Many participants require detailed walkthroughs of the contracts and multiple explanations before they feel comfortable. One example is the application – for TPO systems, both a contract for SASH and a contract with the TPO partner are required. The SASH contract through GRID emphasizes that the system install is at no cost to the customer. However, on Sunrun's contract, it states a dollar amount that the customer agrees to pay for the 25-year PPA. This contradiction confused potential customers. Customers were also confused beyond the application step and cited concerns when it came to servicing their equipment or contacting Sunrun for maintenance.

This evaluation could only quantify costs per project based on installation, materials, and professional services costs. The 25-year PPA cost was not provided in a disaggregated format for analysis in time for this report.

6.1.2 Unaccounted Benefits of Participating in the TPO Model

The benefits of participating in the TPO model that were unique when compared to an ownership structure (not inclusive of benefits of owned projects) are:

1. The payment from the TPO to GRID as the installation contractor
2. Less staff and administrative time searching for additional funding to cover the gap between the incentive and installation and equipment costs
3. Homeowner received monitoring and production guarantees

TPO Payment. Interviews with GRID found that though the TPO model can be complex, the net benefit provided by the agreement (funding to pay GRID as a contractor minus the cost of the 25-year PPA) helped GRID cover the gap between the incentive received through the SASH program and the total cost of solar. This evaluation did not capture the gross value of the TPO payment received but does capture the net value between the cost of the PPA and the payment from the TPO, provided in a separate, confidential memo to the CPUC Energy Division.

Staff Time Saved. GRID staff reported that they spent less time searching for external funding for SASH projects when they are TPO because the gap in financing is smaller; however, this staff time was not tracked or documented.

Homeowner Monitoring Benefits. Finally, the homeowner benefitted from TPO systems because of the monitoring and production guarantees. If a system went offline or underproduced, the TPO company would fix the system or pay the homeowner for the amount of guaranteed production. For owned systems, the homeowner was responsible for monitoring their systems on their own, and typically were not aware if their system was offline until they received their electricity bill. Though there were production and monitoring guarantees, our evaluation found that TPO systems were sometimes not reporting or being properly monitored.

6.1.3 Compare the Complexity of the TPO Model and the Benefits

Without full cost and benefit data, such as the cost of the PPA, the amount of staff time spent on TPO coordination and searching for other sources of gap financing, or the full amount the TPO pays GRID, we were unable to calculate the net benefit or cost of the TPO model. Summarizing the need for more data mentioned throughout this section, the evaluation would require the following:

- Collect full cost agreement for the 25-year PPA
- Collect GRID staff time spent on TPO coordination
- Track GRID staff time spend on searching for other sources of gap financing
- Collect full amount of TPO payment to GRID

Without these values, we could only report on GRID's perspectives and customer experiences.

Through onsite visits and customer survey responses, we found that customers were confused about their ownership model. Across all respondents, only 65 percent accurately reported the own/lease status of their solar panels. People who reported that they lease their system were more likely to report accurately (97% vs. 79%), as shown in Table 50.

Table 50: Reported vs Actual Ownership

Reported Ownership	Actual Ownership	n	%
Owned System (n = 159)	Own	125	79%
	TPO	34	21%
TPO (n = 119)	Own	4	3%
	TPO	115	97%
Not sure (n = 89)	Own	30	34%
	TPO	59	66%

There did not appear to be a correlation between the year installed and the number of people reporting their ownership correctly, indicating it was not a function of time causing people to forget (Table 51). Nor does it seem to be someone other than the person who was involved with GRID at the time of signing the contract responding to the survey, as would be more common in larger households (Table 52).

Table 51: Incorrect Ownership Reporting, by Year Installed

Year Installed	N correctly reported	Total N	% Correct
2010 – 2012	40	45	89%
2013 – 2015	43	59	73%
2016 – 2018	88	151	58%
2019 – 2022	67	110	61%

Table 52: Incorrect Ownership Reporting, by Household Size

Household Occupancy	N correctly reported	Total N for HH occ & responded to Q	% Correct
1 – 2	82	127	65%
3 – 5	104	161	65%
6+	35	50	70%

This confusion about TPO systems and owned systems was observed during evaluation field visits as well. During a homeowner orientation meeting, homeowners spent a lot of time asking questions about the ownership model and returned to the topic frequently. GRID staff interviews found that outreach coordinators would need to remind homeowners that their system is TPO throughout the process. Staff members say that even with this confusion, once the system was installed, customers were happy to benefit from the TPO model's offerings, such as guaranteed production, monitoring, and service and equipment warranties.

6.2 Additional Eligibility Findings

We used historic distance data to estimate the number of eligible households within a reasonable range from each GRID regional office. Table 53 and Table 54 show eligibility estimates for households within the maximum and averages distances travelled for projects by each regional office.

Table 53: Eligibility Estimates by GRID Office, Max Distance

GRID Regional Office	Distance Assumed (mi)	Households Served by IOU	HUD QT Households		Estimated Eligible Households		
			N	% of all IOU HH	N	% of HUD QT	% of all IOU HH
Bay Area	106	2,829,634	494,838	17.5%	73,210	14.8%	2.6%
Bay Area/North Coast	132	94,717	26,952	28.5%	3,516	13.0%	3.7%
Central Valley	146	930,904	153,525	16.5%	21,550	14.0%	2.3%
Greater Los Angeles	76	2,510,757	352,369	14.0%	60,384	17.1%	2.4%
Inland Empire	467	1,699,526	228,697	13.5%	34,012	14.9%	2.0%
North Valley	115	875,753	151,528	17.3%	17,674	11.7%	2.0%
San Diego	56	1,035,539	184,353	17.8%	25,731	14.0%	2.5%
No office within distance		13,504	5,975	44.2%	1,098	18.4%	8.1%

Table 54: Eligibility Estimates by GRID Office, Average Distance

GRID Regional Office	Distance Assumed (mi)	Households Served by IOU	HUD QT Households		Estimated Eligible Households		
			N	% of all IOU HH	N	% of HUD QT	% of all IOU HH
Bay Area	19	1,221,321	266,640	21.8%	33,897	12.7%	2.8%
Bay Area/North Coast	53	59,724	16,986	28.4%	2,683	15.8%	4.5%
Central Valley	44	393,438	54,953	14.0%	6,852	12.5%	1.7%
Greater Los Ang eles	22	1,550,627	222,982	14.4%	35,596	16.0%	2.3%
Inland Empire	68	2,443,730	334,956	13.7%	54,393	16.2%	2.2%
North Valley	32	540,423	92,737	17.2%	10,237	11.0%	1.9%
San Diego	12	597,084	140,482	23.5%	18,931	13.5%	3.2%
No office within distance		3,183,987	468,502	14.7%	74,587	15.9%	2.3%

Figure 43 displays these findings with more detail in Figure 44. Each census tract is colored by the estimated percent of households that are eligible for the program. Note that any tracts that are not HUD qualified are colored gray due to automatic ineligibility. Each GRID regional office has two rings, one with the average distance assumed (blue), and one with the maximum distance assumed (red).

Figure 43: Eligible Households by GRID Regional Offices

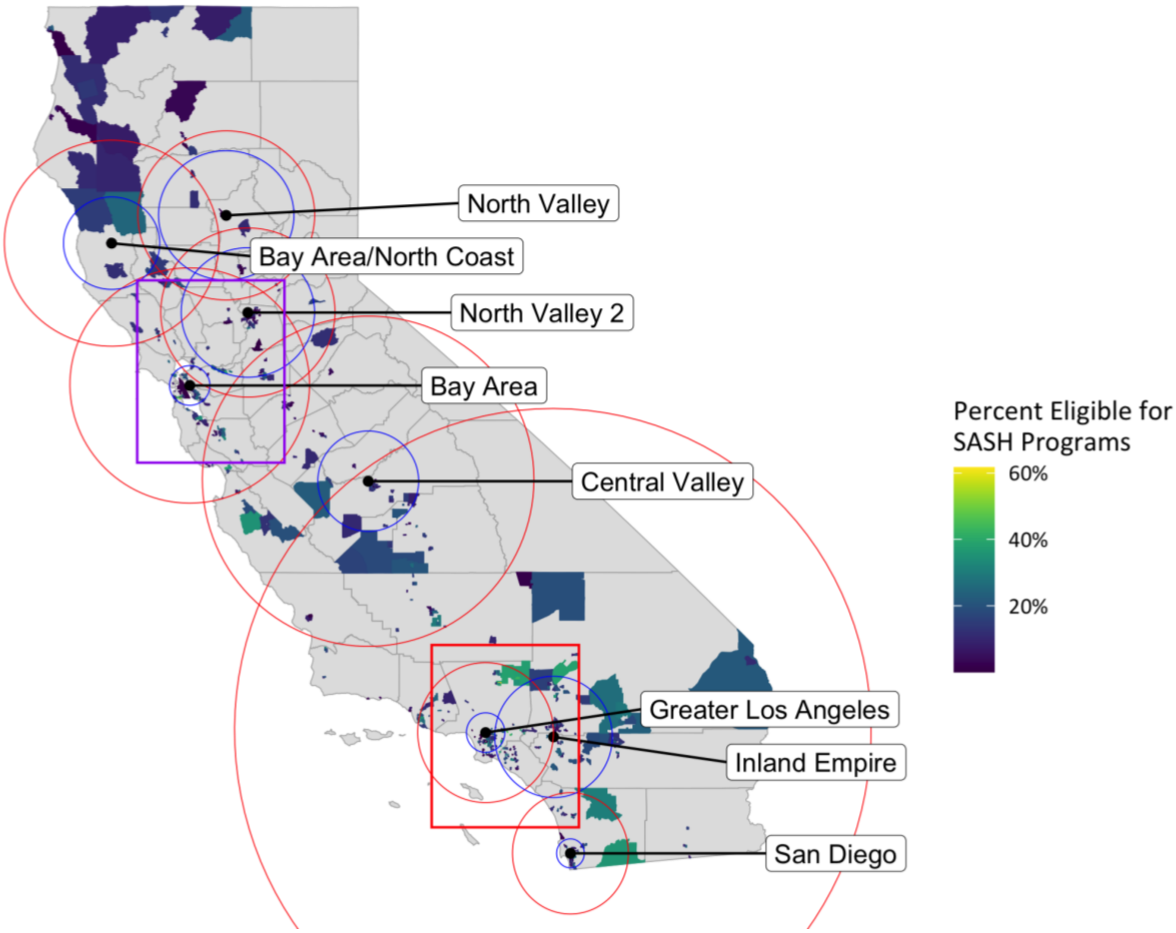
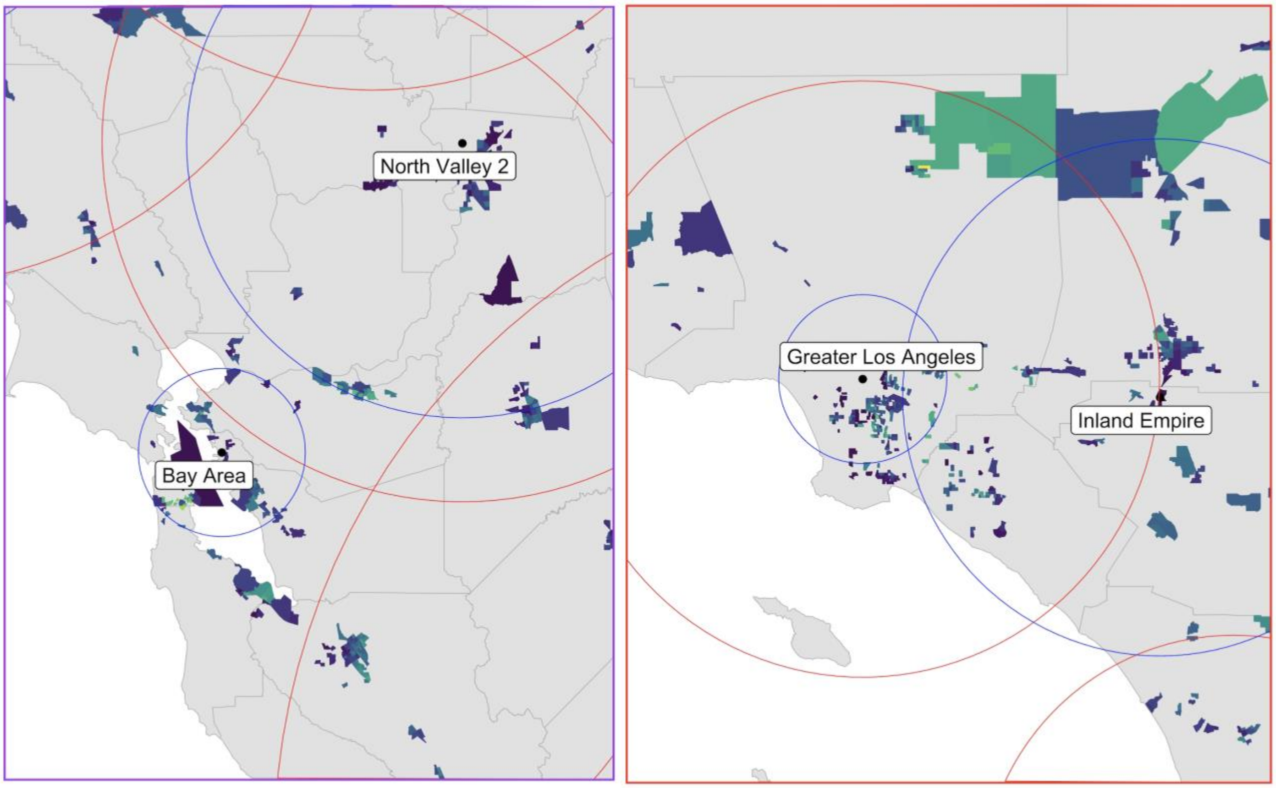


Figure 44: Eligible Households by GRID Regional Offices – Bay Area and Greater LA



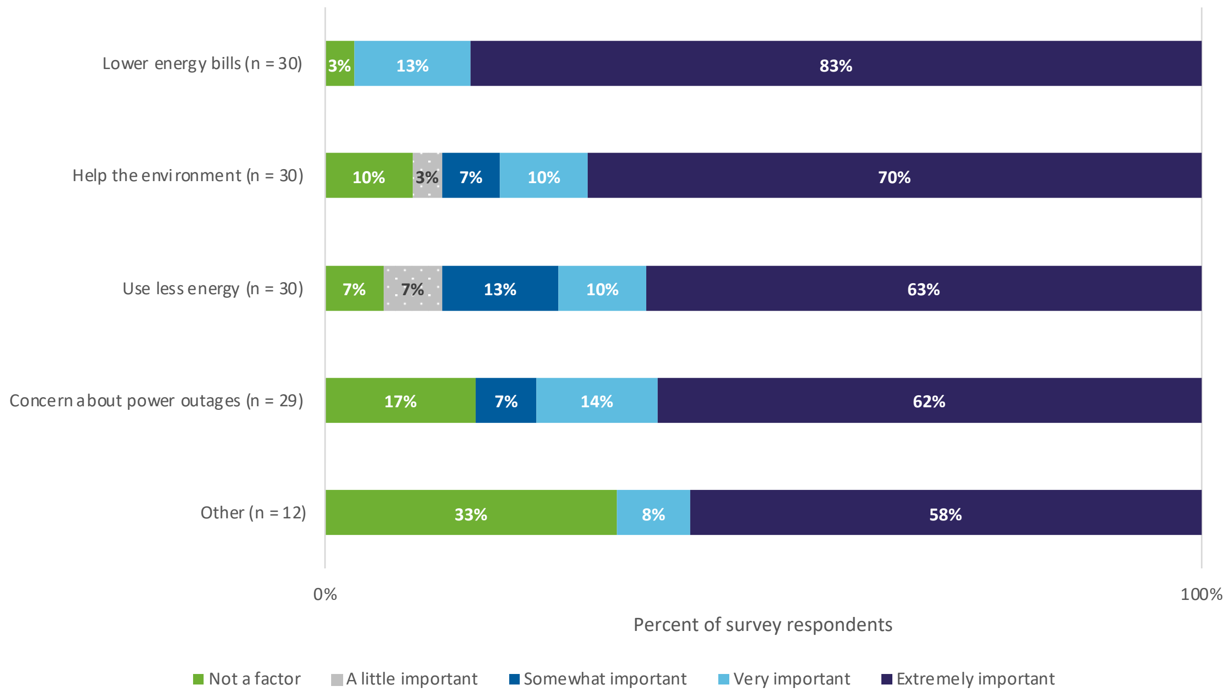
6.3 Market Adoptions of Rooftop Solar

We reviewed non-participant data from 10,728 customers across the three electric IOUs to estimate the market adoption rate of eligible customers.

Based on analysis of IOU CIS data of non-participants, the upper bound of market adoption in the eligible population is about 10 percent (11% for PG&E, 6% for SCE, 10% for SDG&E). Program eligibility was not confirmed in the IOU data, as home type, home ownership, and income level are not reliable variables within the CIS system. Therefore, to estimate the number of eligible customers, we filtered the data for households living in HUD Qualified Tracts that are also enrolled in or eligible for CARE, due to their income requirements being close to SASH. Notably, this is an overestimate because many households in HUD Qualified Tracts were not eligible for SASH, even if they are CARE-eligible.

According to the non-participant survey respondents that installed solar without the use of SASH (n = 30), all listed factors were "extremely important" in their decision to install solar panels on their roofs, with lowering energy bills having the highest percentage of respondents (83%), followed by the desire to help the environment (70%) and using less energy (63%, Figure 45).

Figure 45: Importance of Factors in Decision to Install Solar Panels (Eligible Non-Participants)



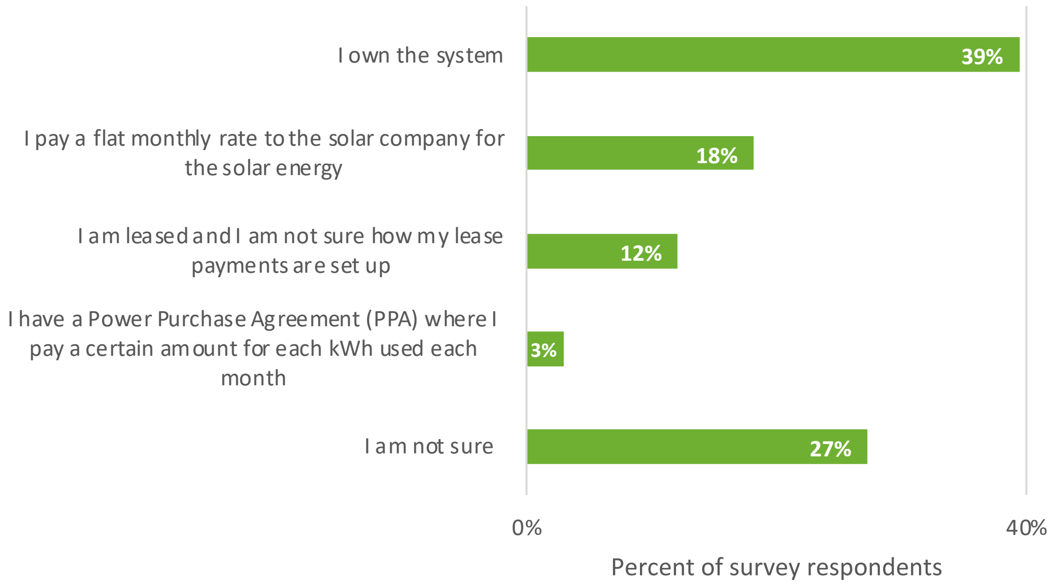
There were respondents (n = 4) who reported that there were other factors that came into play during their decision to install solar panels on their roof.[41] Some of these reasons include:

- Cost concerns due to rising prices (2)
- Low maintenance (1)
- The opportunity to create their own power (1)

Over a quarter of the non-participants that installed solar on their own reported that they were not sure how their solar system was set up (Figure 46). Of those that did understand how their system was set up, most respondents owned their system (39%).

[41] Twelve respondents selected "Other" as a factor. Of those, four selected "Not a factor," and did not write anything in. Another four responded that "Other" was important in their decision but did not write in the other factor. Here, four refers to the number of people that responded "Other" and filled in a response as to what the other factor was.

Figure 46: Description of Solar System, Non-Participants (n = 33)



We examined how this group of low-income homeowners was able to install solar and found that many reported paying for the system on their own with the help of a tax credit or another organization (Table 55).

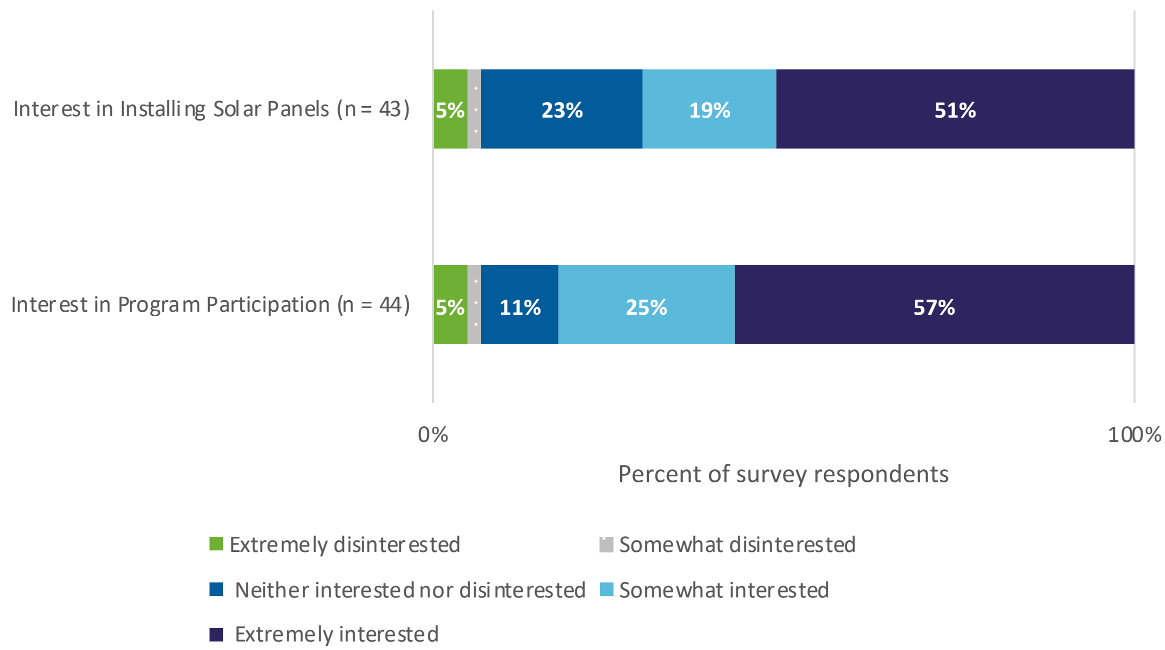
Table 55: Assistance Received (n = 19)

Type of Assistance	N	%
Received a tax credit	8	42%
Received help from another program or organization	6	32%
Paid on own	5	26%

6.4 Non-Participant Perspectives on Solar

We asked eligible non-participants about their interest in installing solar panels and their interest in participating in a program that helped with free solar installation. Many respondents reported that they were extremely interested or somewhat interested in installing solar panels on their home (51% and 19%, Figure 47), and that group increased when asked if they would be interested in a program that helped with free solar installation (57% and 25%). These findings indicate that a lack of interest in a program was a not a large barrier among eligible customers.

Figure 47: Reported Interest in Solar Panel Installation versus Participation in a Program to Install Free Solar Panels



The unaware non-participant respondents who reported an answer regarding their interest in having solar panels installed were further asked to elaborate on why they chose than answer (Table 56).

Table 56: Feedback about Solar Panels (Unaware Non-Participants, n = 40)

Interest	Topics	Quotes
Disinterested (8%)	Cost concerns (2) Personal (1)	"More expensive" "Not interesting at this time"
Neither Interested nor Disinterested (25%)	Personal (6) Cost concerns (3) Need more information (1)	"I have house repairs to contend with before I worry about solar" "Seems not very helpful for our bill" "Unsure how it would benefit me"
Interested (68%)	Lowering Costs (15) Environment and energy (10) Personal (6)	"I need to reduce electricity cost" "Solar panels can help our community's supply and good for the environment" "Save energy for my big family" "It's the future"

Respondents also provided free-text responses to explain their interest in a program that provides ***free solar*** (n = 39)**.** While the portion of respondents that were interested in a program for free solar is higher than the portion of respondents interested in solar generally, there were still people that were not interested (Table 57).

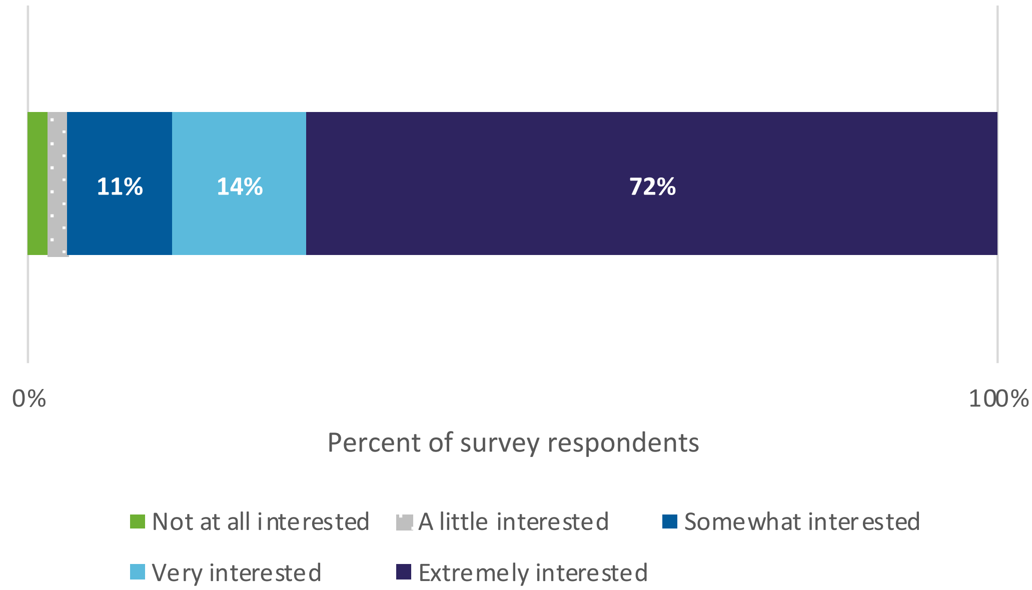
Table 57: Feedback about a Free Program to Install Solar Panels (Unaware Non-Participants, n = 39)

Interest	Topics	Quotes
Disinterested (8%)	Cost concerns (1) Personal (1) Need more information (1)	"Too expensive" "Not at this time" "Nesecito explicación DETALLADA (I need [a] DETAILED explanation)."
Neither Interested nor Disinterested (13%)	Trust (5)	"Cautious about underlying motivations of companies. Probably their presentation is similar to four others I have previously heard from."
Interested (79%)	Lowering Costs (11) Personal (9) Environment and energy (7) Need more information (7)	"Because the cost is expensive" "Energy efficiency is important to me as well as living comfortably within my needs" "I would not have the financial means to do so otherwise, this would help me reduce my bill and have a positive impact on the environment." "I'd like more information"

6.4.1 Motivation for Participation Amongst Non-Participants

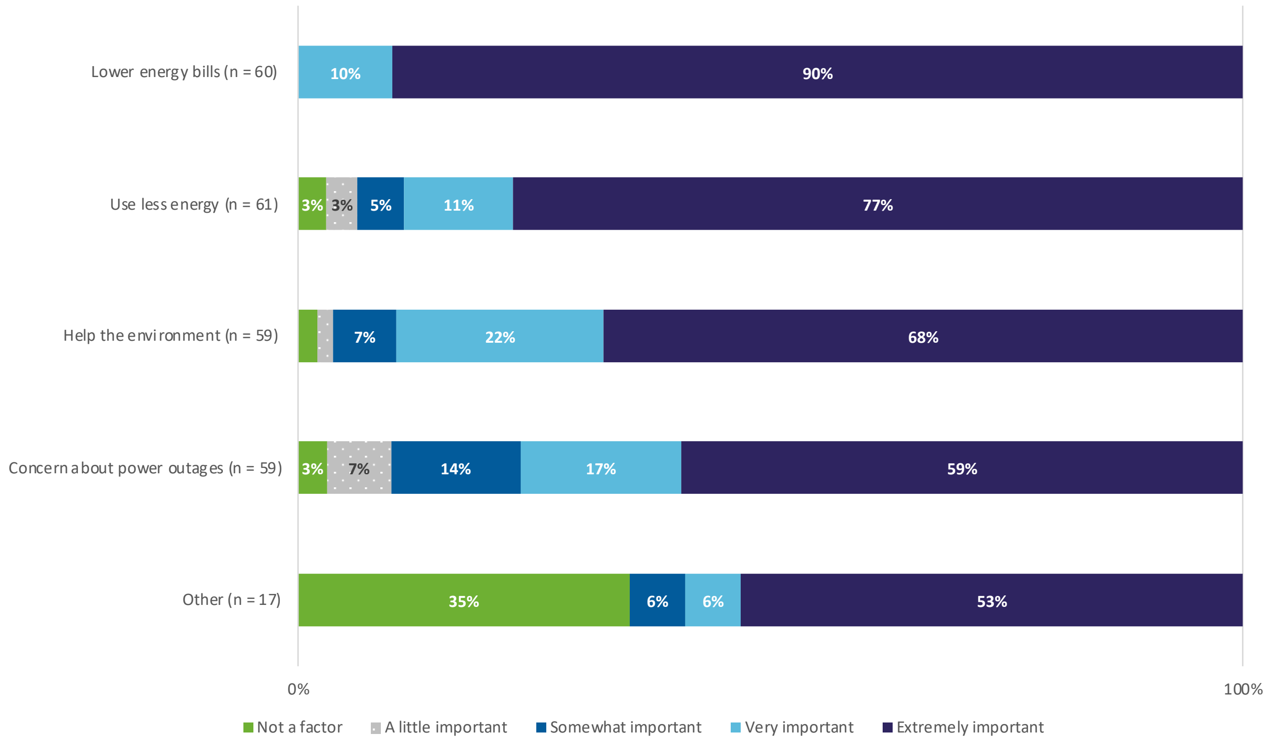
A lack of interest in the program does not appear to be a barrier. Most eligible non-participants responded that they were extremely interested in SASH when they first learned about the program (Figure 48).

Figure 48: Non-Participant Interest in SASH Program (n = 64)



According to the respondents, all listed factors were "extremely important" in their interest in participating, with lowering energy bills having the highest percentage of respondents (90%) followed by the desire to use less energy (77%) and help the environment (68%, Figure 49). Seventeen respondents responded that there were other factors that came into play in forming their interest to install solar panels on their roof, some of which included independent control over electricity usage, the opportunity to get a roof replacement, and cost effectiveness.

Figure 49: Importance of Factors in Interest in Participating



6.5 PV Monitoring System Errors

This section describes the data and documentation issues observed by the Evergreen team throughout the evaluation process in more detail.

6.5.1 Enphase-Enlighten System

The Enphase-Enlighten dashboard allows users to observe daily energy generation over the lifetime of the equipment. The Evergreen team was given administrative access to Enphase-Enlighten's system, so we were able to review for individual days when generation data were missing. Table 29 outlines the daily data availability for the sampled projects that were monitored with Enlighten, from project installation through June 30, 2022.

Table 58: Enphase-Enlighten Sample Daily Availability

Projects Missing Data	Total Instances of Reporting Error	Total Days	Days with Reporting Error	Percent of Days Missing
25 of 48	34	96,776	19,355	20%

Enphase-Enlighten monitoring systems continue to log energy generation during communication outages, then sometimes upload the backlog to the database when communication is reestablished; however, this delayed upload does not occur after every communication error. There are clear instances where communication was lost and generation data never uploaded to the system, such as when generation is zero (0) kWh on one or more days. As shown in Table 59, there are three types of data reporting errors that we observed in the Enphase-Enlighten portal:

1. Retirement of antiquated 3G cellular communication system;
2. Gateway communication errors; and
3. Microinverter reporting errors.

Table 59: PV System Reporting Communication Errors

Program	Antiquated Cellular Connection	Gateway Communication Error	Microinverter Error
SASH 1.0	-	11	5
SASH 2.0	1	5	1
TOTAL	**1**	**16**	**6**

Retirement of antiquated 3G cellular communication systems: Some of the communication errors observed during the evaluation were determined to be related to the ongoing phase-out of the 3G cellular network. Enphase-Enlighten systems use either a cellular network or Wi-Fi. In 2022, mobile carriers were actively discontinuing 3G wireless service, with completion expected by the end of 2023. Enphase-Enlighten monitoring systems that are connected to a 3G network must be reconfigured to resume communication. Affected customers have two options: (1) install a new modem that is compatible with modern wireless networks, or (2) connect the monitoring system to their home's wireless internet network. GRID reported that households with a TPO system were notified of this change in late 2021. Sunrun performed meter or cell modem replacements at no cost to clients for about 1,400 systems as of November 2022. It is unclear how homeowner-owned systems may have received notice, and it is believed that such notice may have only happened once through their Enphase-Enlighten portal and therefore, homeowners may not be aware of the change.

Gateway communication errors: This error indicates that the broadband Internet connection that the Enphase-Enlighten gateway uses to communicate to the Enphase-Enlighten servers is experiencing a problem. This condition does not affect a system's ability to produce power. When the connection is restored, the gateway will catch up with the transmission of all energy data it has stored. This error can occur if the internet service is experiencing an outage or when the router may be unplugged or turned off.

Microinverter reporting errors: Data reporting events are not recorded in the online portal, so determining the completeness of historical energy generation logs is a manual process and potentially inaccurate. To identify partial day outages, the team had to manually inspect generation data and plots of all PV systems, which are challenging to recognize. Outages are less obvious when the system is down for a partial day or when a fraction of the microinverters are not communicating properly, resulting in non-zero but lower than normal energy generation being displayed. We are unable to tell from the online portal whether the outage extends just to the communication system or if the system is truly not generating – see the customer bill impacts section for analysis of persistence.

There were 14 SASH 1.0 and five SASH 2.0 projects with a reporting communication error at the time of this analysis, and these could include one or more errors noted herein, all which limit communication to the Enphase-Enlighten servers.

6.5.2 SolarEdge Data Availability

GRID provided the SolarEdge-monitored PV system energy generation data in monthly increments from June 2021 through July 2022. We identified reporting errors for each sampled project when the generation for a single month was either zero (0) kilowatt-hours (kWh) or approximately 80 percent less than an adjacent month. Identified errors are summarized in Table 60.

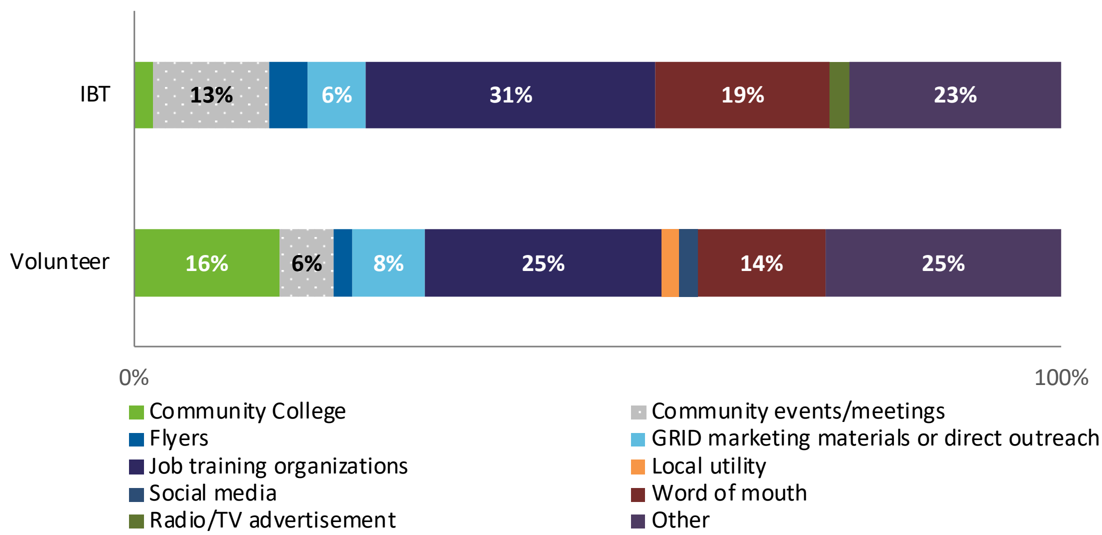
Table 60: SolarEdge Sample Monthly Availability

Projects Missing Data	Total Instances of Reporting Error	Total Months	Months with Reporting Error	Percent Missing
3 of 13	3	151	6	4%

6.6 Marketing for the Training Program

Interviews with GRID and onsite visits found that trainees learned about the IBT program in many ways. GRID staff emphasized the importance of local partnerships with job training organizations and community colleges, and surveyed trainees agreed. Respondents were provided a multiple-choice list. Job training organizations were the main avenue (31% IBT, 25% Volunteer) by which participants learned about the GRID opportunity. Figure 50 displays other options selected.

Figure 50: How Respondents Hear About GRID Training (n = 99)

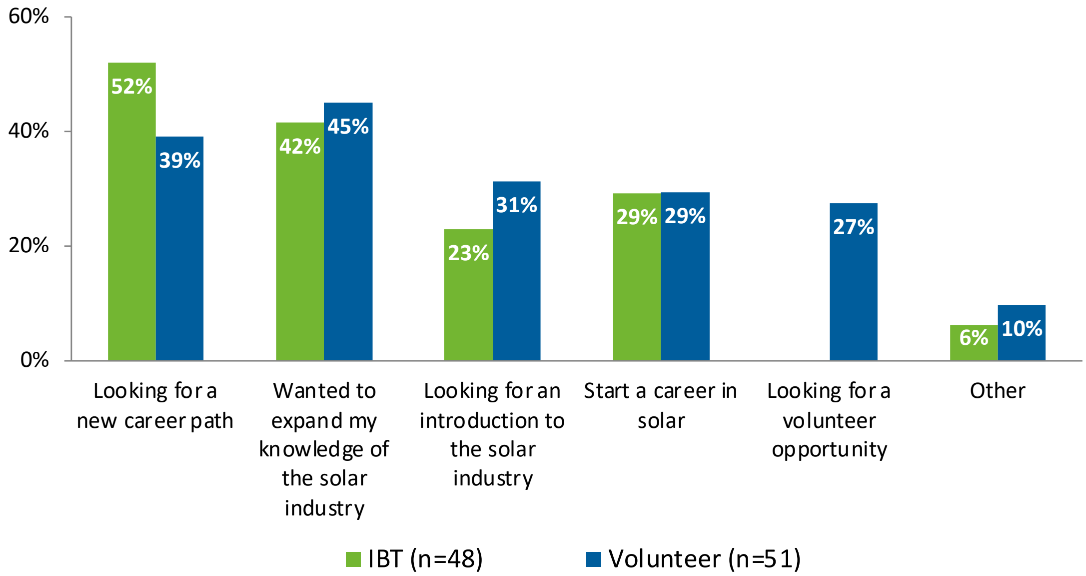


Of those that selected "Other," the most frequent sources cited were:

- IBT: Trade school or employment program (6%), internally (employed at GRID) (4%)
- Volunteer: Volunteer opportunity (8%), university or community college (2%), internally (employed at GRID) (2%)

Trainees reported different motivations for participating in the IBT or volunteer opportunities. About half (52%) of the IBT respondents shared that they were looking for a new career path, while many (45%) of the volunteer respondents noted wanting to expand knowledge of the solar industry (Figure 51).

Figure 51: Reason for Participation (n = 99)



These findings are congruent with how most respondents learned about the program, given that most participants heard about the opportunity from a learning/training source, and most were interested in participating for a new career or to build upon knowledge of the solar industry.

Some respondents provided additional free-response answers to what they were looking to gain through the training or volunteer opportunity.

Out of the IBT respondents:

- 26% of the responses mentioned career development;
- 24% specifically referenced preparing for or seeking a job in the solar industry; and
- 18% noted wanting transferable skills.

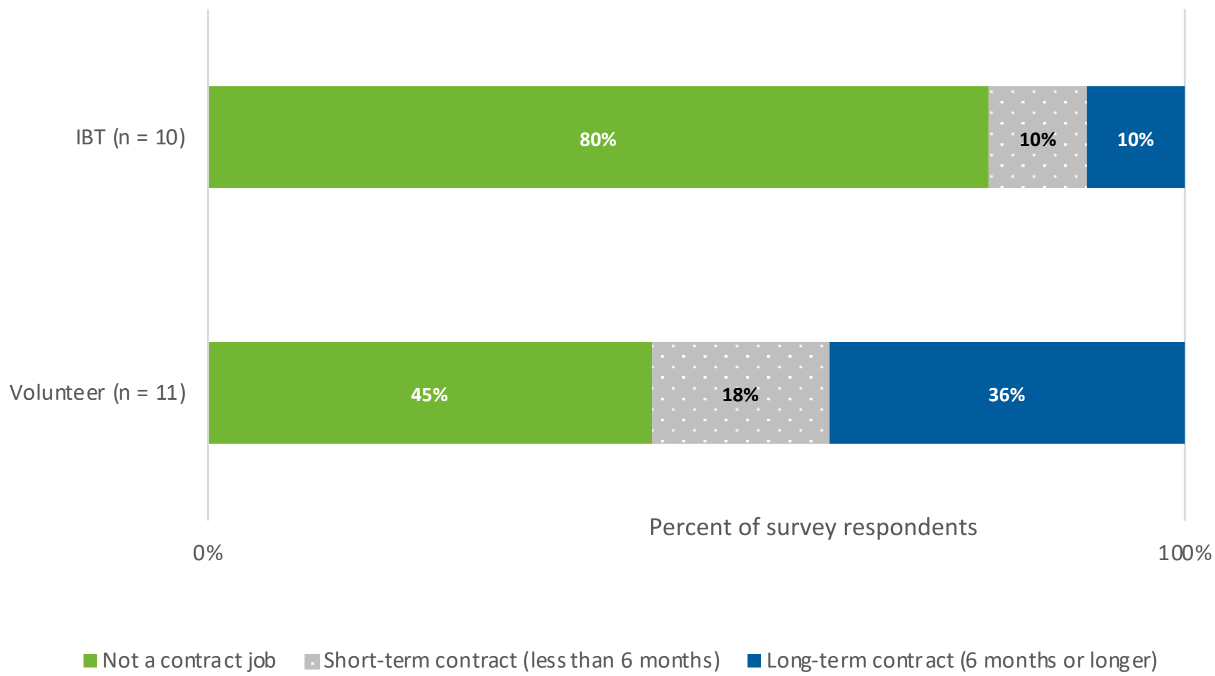
Of the volunteer respondents:

- 38% of the responses pertained to career development;
- 35% noted wanting transferable skills; and
- 29% specifically noted wanting to learn how to work with solar.

6.7 Other Outcomes from the Training Program

For trainees that were working part-time before participating with GRID, the majority of the IBT participants (80%) said that the work that they did was not contractually based, as shown in Figure 52. For the volunteers, almost half (45%) reported that their work was not a contract job.

Figure 52: Part-Time Job Type Before Participation



Of the seven IBT participants that reported having a part-time job after participation, most reported that it was not a contract job (71%). The rest (29%) had a long-term contract.

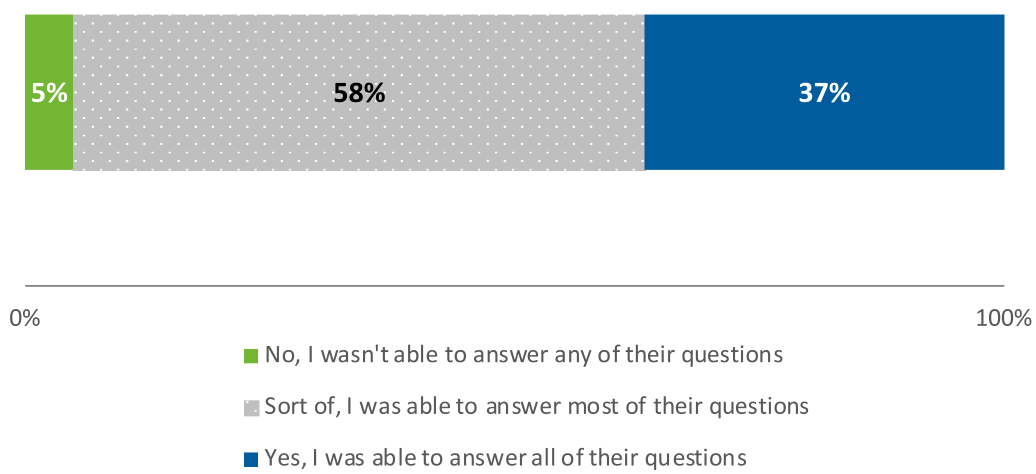
6.7.1 Professional Certifications

As part of the IBT training, participants receive a certification of completion. Half of all IBT respondents said they received some professional certification, while the other half reported that they did not. Of those who received a certification, over half (58%) received both the OSHA 10 and CPR certification. About a third (38%) received Design, Forklift, Auditing, Inverter, or PV 1-3 certifications and the remainder (33%) stated that they received a Certificate of Completion from the GRID training course. Out of the respondents who received a certification (n = 19), most (58%) have pursued or plan to pursue other professional certifications in the solar industry outside of what was received in the GRID training course.

6.7.2 Interactions with Residents

Most respondents (83%) had the opportunity to interact with residents of the homes that were getting solar installed. A little over three-quarters (77%) of respondents who interacted with residents noted that the residents had questions about the installation or overall process. Of the participants who encountered residents with questions, most were able to answer the questions to some extent. Figure 53 captures participant confidence levels fielding resident questions.

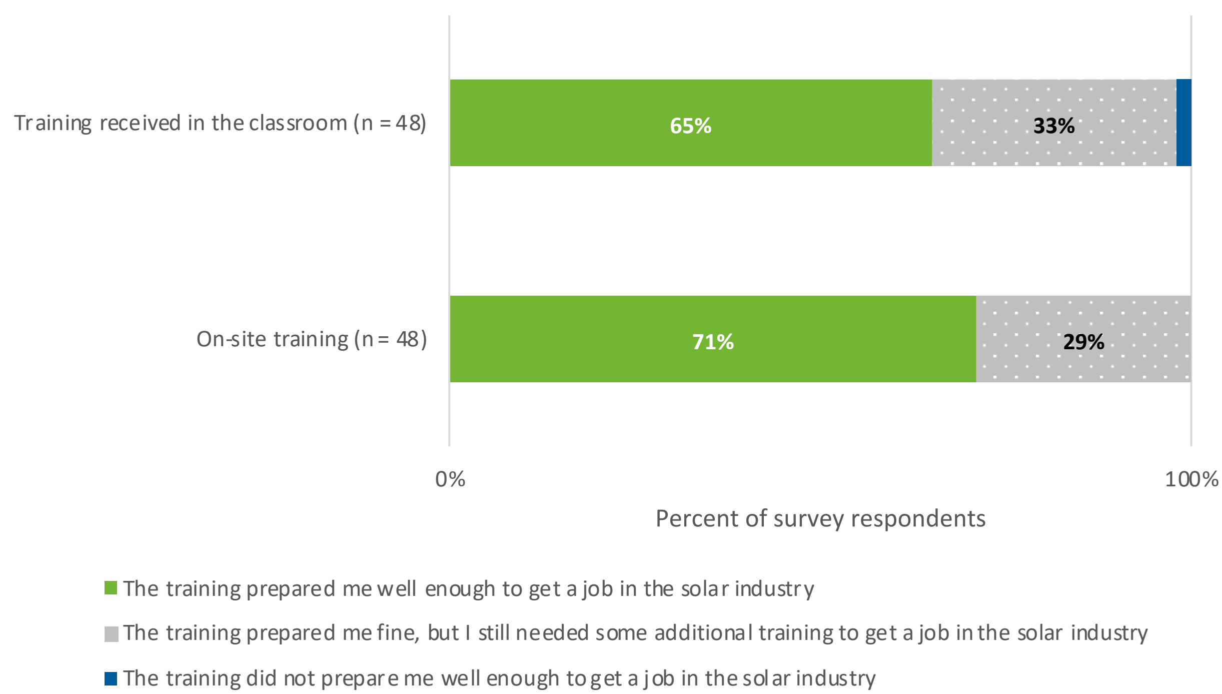
Figure 53: Confidence Answering Resident Questions (n = 57)



6.8 Value of Training Courses

IBT respondents were asked whether they felt that the training that they received on-site and in the classroom provided them with the knowledge and skills necessary to be successful in the solar industry. Participants mostly reported that both modes prepared them well enough to get a job in the solar industry; however, there were some that did not feel prepared (Figure 54).

Figure 54: Preparation by Mode of Learning



The respondents who reported feeling that the training they received was not enough for them to get a job in the solar industry were asked what they felt they needed to know to be successful. The 13 participants who reported an answer felt that they could have gotten better support to become successfully employed through the following methods:

- Greater access to learning opportunities and more installation and wiring hands-on experience (12)
- Greater access to employment and networking opportunities (3)

One of the respondents also mentioned the difficulty in gaining access to such experiences due to the pandemic.

Respondents were then asked to select the types of networking and employment opportunities received during GRID training, with multiple selections allowed (Figure 55). The most frequented opportunity selected by participants at 66 percent was 'on-site networking opportunities with other participants and corporate sponsors', closely followed by 'referrals to companies who were hiring for installation and other positions in the solar field' (51%). Those who chose 'other' were asked to specify. The answers reported included attaining full-time employment with GRID themselves and recommendations by their colleagues for future employment opportunities.

Figure 55: Opportunities Received During Participation (n = 47, multiple responses allowed)

Most respondents reported that GRID's training course provided them with the opportunities and resources needed to obtain a job in the solar industry extremely well or very well (81%).

Those who reported that the course did not do well in providing them the necessary resources were asked about what the training course could have provided them that would have helped them to obtain employment in the solar industry. Seven participants reported an answer including:

- More hands-on training (2)
- More electives to bypass any onboarding during the hiring process for GRID and other related jobs (1)
- Uniformity in the quality of the GRID training programs offered (1)
- Unconditional support despite not being on the field or a related job (1)

The respondents were also asked whether they would have known how to seek the skills necessary for employment in the solar industry if they had not participated in the GRID training course, to which the majority (79%) said 'no', indicating that the training course is largely instrumental in helping people enter the solar industry.

Appendix A: Methodology

Each of the research activities is described in more detail below.

1.1 Program Material & Documentation Review

Evergreen requested and reviewed the following information from the Program Administrator (PA), GRID Alternatives:

- Program organizational and management structure
- Program information systems, including the PA workflow management systems
- Existing PA database for applicable information
- Training events and tracking information
- Marketing, education, and outreach materials, plans, and a list of partnering organizations
- Accounting and disbursement methods, including contractor payment/compensation processes
- Program costs

We also reviewed the PA's website to collect publicly available reports, and reviewed the following legislative, policy, and research documents:

- Foundational documents for SASH including Senate Bill (SB) 1, D.07-11-045, Assembly Bill (AB) 217 (Bradford 2013), and D.15-01-027
- SASH Program Handbook
- PA invoices
- PA implementation plans and budgets
- PA semi-annual reports

1.2 Customer Web Surveys

The web surveys collected information from volunteers and trainees, as well as from participants and non-participants. This section details the sample and survey approaches for the program participant survey, non-participant survey, and trainee survey.

1.2.1 Program Participants

We defined program participants as customers that had completed a solar project as of March 1, 2022. The survey gathered the following:

- Program marketing and enrollment effectiveness
- Customer satisfaction
- Effectiveness of programs in addressing barriers to participation
- Perception of their community's needs and strategies and steps to increase adoption amongst neighbors, community members, and other low-income homeowners
- Awareness/participation in other related programs and technologies such as storage
- Environmental/social benefits

Survey Sample

We conducted a total of 368 surveys with program participants via a web survey. We drew our participating customer sample from PA tracking data and received contact information for 9,501 SASH program participants, for a response rate of 4 percent.

Survey Approach

Some SASH contacts had no email address listed (31%), so we deployed a multi-modal approach with mailed postcards and email recruitment (see Appendix F for postcards and Appendix E for survey instruments). The survey invite was sent in both English and Spanish, and respondents could take it in either language, with an option to call in and take the survey over the phone in their preferred language. Eligible survey respondents also received an incentive of $25 for completing the survey.

1.2.2 Program Non-Participants

We conducted a total of 154 surveys with eligible non-participants via a web survey. We drew our participating customer sample from PA tracking data and received contact information for 25,904 customers. Since we conducted the DAC-SASH and SASH evaluations simultaneously, we fielded the non-participant survey to customers and allowed respondents to screen into the survey whether they were eligible for DAC-SASH or SASH. In total, 773 customers responded to the survey; Table 1 shows the eligibility of survey respondents that we used for survey analysis and reporting in this report. Only DAC-SASH eligible respondents (n=121) were included in the DAC-SASH report, and SASH eligible respondents (n=154) were included in this report (SASH).

Table 1: Eligibility of Non-Participant Survey Respondents

Assumed Sample	Sample Size	Completed Survey	Ineligible	DAC-SASH Eligible	SASH Eligible
DAC-SASH	24,480	654	470	116	68
SASH	1,424	118	27	5	86
Total	**25,904**	**773**	**497**	**121**	**154**

For non-participating customers, we targeted eligible, aware non-participants and eligible, unaware non-participants. Aware customers are households that have interacted with the PA and were deemed eligible but did not move forward with participation. Unaware customers are IOU customers that had never heard of the program. We include both types of eligible non-participants to explore the full range of participant barriers (e.g., lack of awareness and issues with program requirements and the participation process).

We designed the non-participant survey so that responses from participants and eligible non-participants were comparable. Topics addressed include:

- Program marketing and enrollment barriers;
- Customer satisfaction (aware only);
- Effectiveness of programs in addressing barriers to participation (aware only);
- Perception of their community's needs and strategies and steps to increase adoption amongst neighbors, community members, and other low-income homeowners;
- Awareness/participation in other related programs and technologies such as storage; and
- Environmental/social benefits.

Survey Sample

For aware non-participants, we drew our sample from PA tracking data for customers deemed eligible but inactive. For unaware non-participants, we drew our sample from utility customer information system data (screening out the participating customers).

Determining eligibility for the program was the biggest barrier to collecting survey responses. Eligibility criteria, such as home type, income, and tenure, are not readily available in IOU CIS data. Evergreen used Census analysis to target regions with higher concentrations of eligible households to encourage a higher eligibility rate than a random sample of all IOU customers. The sample requested was stratified by rural and urban customers and by selected and unselected tracts for high concentrations of eligible customers. Once we received IOU data, we set soft targets by IOU, CARE/FERA status, and language (Table 2).

Table 2: Unaware Non-Participant Customer Survey Soft Targets (SASH)

Customer Segment		SASH Target	Total Completed
IOU	PG&E	42	62
	SDG&E	19	26
	SCE	34	66
Any Spanish		7	7
CARE/FERA Enrolled		28	59
Total		**95**	**154**

Survey Approach

We used the same multi-modal approach as the participant survey, with slightly different language for aware and unaware customers (Appendix F: Survey Recruitment Postcards).[1] Additionally, we opened the survey with screening questions to identify the home type (i.e., single-family), homeownership, and income eligibility to ensure that our completed survey responses were from eligible non-participants. Eligible respondents received a $25 incentive for participation.

1.2.3 Trainees and Volunteers

We fielded the trainee web survey in late September 2022. We received 1,637 contacts of trainees or volunteers who participated in either DAC-SASH or SASH solar installations. Of those contacts, 1,543 had email addresses, 1,332 were deliverable via email, and 114 completed the survey (9% response rate). Table 3 shows the sample frame received from the PA and the completions across the groups.

[1] To protect against low response rates in the unaware population, we partnered with M. Davis and Company (MDAC) to conduct Computer-Assisted Telephone Interviewing (CATI) surveys. We initially planned to use the CATI surveys to supplement our web survey sample but ran into high costs per survey completed due to the low incidence rates. This provides an additional data point on the challenge of confirming eligibility using external data such as Census or IOU CIS data.

Table 3: Trainee Sample Frame

Group	Type	Count	% of Sample	Survey Respondents	% of Respondents
Trainee Type[2]	Cohort (IBT)	246	15%	22	9%
	Intern	29	2%	3	3%
	SolarCorps	45	3%	5	4%
	None Listed	1,317	80%	84	74%
Project Region	Greater Los Angeles	486	30%	38	33%
	Bay Area	349	21%	22	19%
	Central Valley	336	21%	26	23%
	Central Coast	282	17%	18	16%
	North Valley	84	5%	5	4%
	Inland Empire	82	5%	3	3%
	San Diego	13	1%	1	0%
	Bay Area/North Coast	5	0%	1	0%
Number of Installations Attended	One	670	41%	48	42%
	Two – five	727	44%	38	33%
	More than five	240	15%	28	25%
Project Type	SASH Only	1,341	82%	90	79%
	DAC-SASH Only	136	8%	10	9%
	Both	160	10%	14	12%

Our survey instrument was designed with two tracts to capture the experiences of formal trainees who attended the PA's curriculum (Install Basic Training (IBT)) and volunteers.

Topics addressed include:

- Training value in career progression;

[2] Respondents' self-reported trainee type was often different than the program data. Here, we report the program data composition, and in the trainee findings section, we investigate the differences.

- Job outcomes;
- Experience with installations;
- Interactions with residents; and
- Geographic specific training differences.

Sample Design

We developed the sample using trainee tracking data from the PA. Most contacts (80%) did not have trainee type listed, as the field was added in 2019, so we could not stratify based on trainee type. Due to the low cost of distribution and expected low response rate, we emailed all viable contacts to recruit into the survey.

Survey Approach

Similar to the customer surveys, we distributed the survey via email with the option to call in to take the survey over the phone. Eligible respondents received a $25 incentive for participation. The survey instrument is in Appendix E.

1.3 Qualitative Data Collection - Field Visits and In-Depth Interviews

We complemented the quantitative data collection with three qualitative data collection efforts to provide additional context and deeper insights into the issues highlighted by the survey data and market characterization. The qualitative data collection consisted of:

- Field visits to three different PA regional offices across California
    - Greater LA
    - Inland Empire
    - North Valley
- In-depth interviews with various stakeholders
    - IOU staff
    - PA staff
        - Executive Director
        - Regional Staff Members
        - Tribal Liaison
    - CPUC tribal liaison
    - M&O partners
    - TPO partners

1.3.1 Field Visits

Evergreen completed in-person field visits to conduct research across three regions. The field visits covered observations of program processes and how the program is being implemented, customer interactions with PA outreach and installation staff, observations of solar installations, and training.

We selected three different regional offices for field visits with different activities planned for each. Table 4 details the dates and rationale for selection.

Table 4: Sites Selected for Field Visits

Site	Activities Planned	Rationale for Selection	Dates
North Valley – Sacramento	IBT Training Class, Onsite solar installation observations, in-person customer interaction observations and staff interviews	Large volume of projects in the Stockton area	May 23 – May 24, 2022
Greater Los Angeles	ME&O Event, in-person customer interactions	High cost of living area, unique construction barriers	July 20, 2022
Inland Empire – Riverside	Onsite solar installation observation, in-person customer contract signing, introductory customer onboarding	Subcontractor Program Participant (SPP) model, higher volume of tribal projects	Aug 16 – 18, 2022

On-Site Solar Installations (Installers, Trainees, and Customers)

SASH requires three volunteers from the Installer Basic Training Certificate Program to be involved in the solar installation process. Evergreen conducted in-person field visits to a solar installation to both observe and to interview the volunteers and the installers. On site, we interviewed the trainees on the following topics:

- Training experience
- Installation experience
- Program barriers and benefits

One resident was on-site during the visits and answered questions about their experience as well. This conversation covered:

- What customer expectations are as far as bill reductions
- How they heard about the program and why they decided to apply
- What barriers they might have faced before installation and any work they had to do to get their home ready

- What they understand about environmental benefits of the program
- If they have heard of or applied for any leveraged programs
- What they expect in terms of bill savings

Trainings (Trainers and Trainees)

We attended a full day of the Install Basics Training class and conducted mini-interviews with trainees. These discussions informed questions for the trainee web survey. The objectives for conversations with trainees were to:

- Understand how trainings fit into the trainee's broader career objectives
- Understand what installation experience they have
- Confirm that local volunteers and residents are trained in PV installations
- Confirm that residents are receiving green job training skills
- Understand the value of training materials and training sessions

Marketing and Outreach Events (M&O Organizations and Prospective Participants)

Evergreen attended two M&O events with PA staff to observe customer interactions and M&O staff strategies and approaches. We also had discussions with staff members on marketing and outreach topics to inform other data collection efforts. These discussions asked:

- Which name is being used to market the program and are customers more familiar with GRID or the CPUC when discussing the program
- How marketing strategies are developed
- Partner views on needs of certain customer segments
- Concerns regarding consumer protection
- Barriers to and drivers of participation (geographic boundaries, program understanding, income levels)
- Co-enrollment in other programs
- Value of leads received from GRID, if any
- Suggestions for improving ME&O to increase participation

1.3.2 In-Depth Interviews

At the beginning of the project, Evergreen staff conducted telephone and online video interviews with eight PA staff members, including the executive director. These interviews covered the staff members' organizational and administrative background, their perspectives on evaluation topics and questions, and the progress and performance of the program to date. Takeaways from these interviews informed the design of the survey, other interviews with stakeholders, and other data collection efforts. Table 5 shows the stakeholders contacted for in-depth interviews.

Table 5: Stakeholder Interviews Conducted

Stakeholder	Contact Information Source	Number of Interviews
GRID - 7 regional offices and 1 main point of contact	GRID	8
IOUs	CPUC	4
M&O Partners (CBOs)	GRID	3
CPUC Tribal Liaison	CPUC	1
Solar Companies (TPO partner/ Sunrun, and others)	GRID	1

The interviews gathered feedback from entities involved in administering, promoting, and installing solar projects on the following topics:

- Program marketing and enrollment effectiveness
- Customer satisfaction
- Effectiveness of programs in addressing barriers to participation
- Use of gap funding
- Effectiveness in educational follow-up visit provided after installation
- Promotion of other related programs
- Customer awareness of environmental/social benefits

To develop topics for each interview, Evergreen referenced the research plan table that maps evaluation metric categories to data sources. Evergreen also reviewed the Research Plan for any additional research issues in-depth interviews could help to address. See Appendix D: In-Depth Interview Guides for more detail.

1.4 Eligibility and Program Penetration Analysis

The goal of this analysis was to create a general picture of the SASH eligible population in California. Analysis of these secondary data sources resulted in the following:

- Characterization of the SASH eligible population in California based on the most recent data available

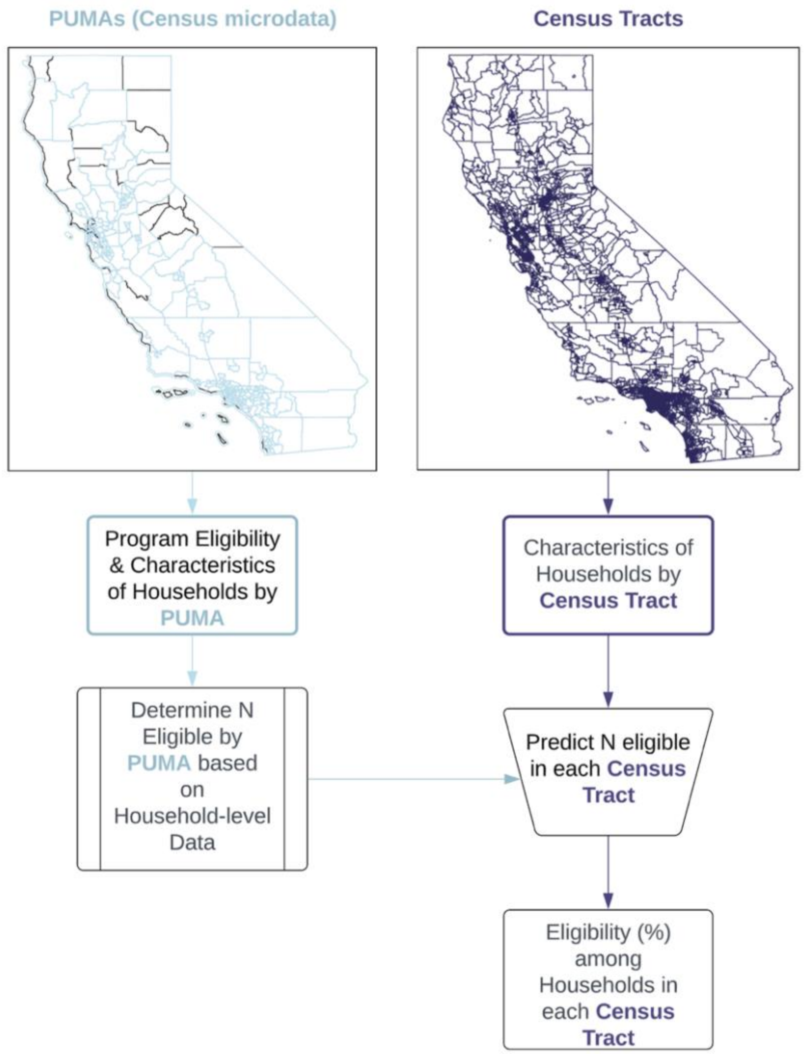
- Geographic distribution of eligible households (IOU service territory, climate zone, disadvantaged community, PA regional office area, etc.)
- Program penetration rates for SASH
- Characterization of the underserved, eligible population (i.e., languages spoken at home)

Evergreen utilized data from multiple existing sources to develop a statewide characterization of the SASH eligible population.

- 2019 US Census and American Community Survey (ACS) data by Census tract
- 2019 US Census Public Use Microdata Sample (PUMS) files
- 2022 IOUs' Customer Information System (CIS) data

Figure 1 provides a flow chart summarizing our approach, including the three distinct data sources (listed below the maps). The result of this analysis yielded estimates of the population of eligible households in the state of California by tract that receive electric service from one of the participating IOUs. In the remaining section, we detail how we calculated each step.

Figure 1: Flow Chart of Method for Estimating the Eligible Population



1.4.1 Eligibility for SASH

Evergreen used U.S. Census data to identify the eligible population within the state. While this public data source is only available aggregated or anonymized (with less geographic granularity), it provides the best available characterization of IOU customers in the absence of conducting costly primary customer research.

The American Community Survey (ACS) is conducted by the US Census Bureau on an annual basis and provides detailed statistics about the social and economic needs of local communities. The ACS Public Use Microdata Sample (PUMS) files provide a wealth of information, with anonymized survey responses from individual housing units and weights to allow for custom tabulation.[3] This trusted public data source provides an opportunity for Evergreen to clearly define and characterize the population of households eligible for participation in SASH in each region. However, the data has been anonymized, meaning that it is not possible to identify specific households that are eligible, and that should be targeted for participation.

Table 6 provides a list of specific fields available in the 2019 ACS PUMS files that we utilized for the analysis. We compared each household's income with the county-level area median income (AMI), then characterized the eligible population as owner-occupied, single-family housing units. Note that with PUMS data, we cannot determine if the sampled population identified as eligible resides within a HUD QT or not. In the next section, we explain the geographic adjustments we made to the sample to better estimate eligibility within the applicable geographies (HUD QTs).

Table 6: Data Utilized from the ACS PUMS

Field Name	Description	Intended Use
TYPE	Type of unit (to exclude institutional and group housing)	Determine eligibility for SASH
TEN	Tenure (own vs. rent)	
SVAL	Specified owner unit	
BLD	Units in structure	
NP	Number of persons in housing unit	Calculate household income as a % of AMI
HINCP	Household income	
PAP	Presence of persons 60 years and over in household	Characterize the population
SCHG	Current grade-level attending	
FS	Indicator for receiving food stamps/SNAP	
HHL, LNGI, LANP	Household language, limited-English speaking household, language spoken at home	
DIS	Indicator for disability in the household	
AGEP	Age	
FES	Family type	
HUPAC	Household presence and age of children	

[3] US Census Bureau. *American Community Survey Public Use Microdata Sample (PUMS) Documentation*. Accessed October 2022. https://www.census.gov/programs-surveys/acs/microdata/documentation.html

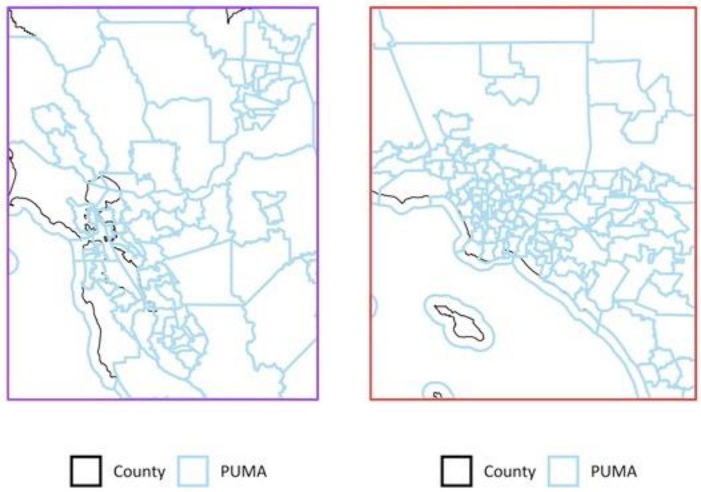
Field Name	Description	Intended Use
ACCESS	Indicator for access to the Internet	
SSP	Social security income indicator	
YBL	Year when structure was first built	

Geographic Adjustments

To maintain respondent privacy, the PUMS data extracts do not list Census tracts or block groups for each household; instead, the extracts list Public Use Microdata Areas (PUMAs). Figure 2 shows a map of the state of California with the ACS PUMAs outlined in blue and counties outlined in black. PUMAs are designed to follow county boundaries, with each area representing at least 100,000 people. In more densely populated areas, PUMAs are very small, as shown in the Bay Area (purple box) and Los Angeles (red box) cutouts in Figure 3.

Figure 2: California State Public Use Microdata Areas (PUMAs)

Figure 3: Bay Area and Greater LA Public Use Microdata Areas



Evergreen used R software to overlay the geographic boundaries of the California service territory with the sampling regions of the public data (i.e., Census tract, PUMA, county). This step is critical in tabulating the eligible population within comparable geographic regions.

After we adjusted our estimates of the total population to focus IOU service territory, we compared our estimates of the eligible households in each region against the number of program participants to determine the current program penetration.

1.4.2 Linear Regression Modeling

We developed and estimated statistical regression models to explain the variation in household income-eligibility across PUMAs and what characteristics (that we may also observe at the tract and county level) might predict higher or lower rates, holding all other variables constant.

The final set of explanatory variables included in the regression models are a subset of the variables shared across data sources (i.e., PUMS vs. Census data at the tract level) and were selected based on their incremental relationship to the respective dependent variable.[4] Many pairs of variables within the Census data sets were highly correlated—that is, they have a strong

[4] For instance, we tested a variation of the models to account for differences in urban vs. rural geography across PUMAs via the proportion of the population currently residing in metropolitan (as opposed to non-metropolitan) regions. This metric was developed by the U.S. Department of Agriculture Economic Research Services (USDA ERS) by PUMA. The coefficient on this variable was small and statistically insignificant for all eligibility models. Hence, it was not included in the final specification.

positive or negative linear relationship. Because of this, they have the same or very similar relationship with the dependent variable, which can lead to problems in the estimation of the econometric model. For this reason, the final model specification shown in Equation 1 is limited to a subset of variables selected for their explanatory power and ease of interpretation. We explored a variety of model specifications, including the use of interaction terms.

Equation 1: Linear Regression Model of Eligibility in PUMAs

$$\ln(Eligible_i) = \alpha_i + \beta_1 \ln(LT20k_i) + \beta_1 \ln(Inc35k_i) + \beta_3 \ln(Inc50k_i) + \beta_4 \ln(Inc100k_i) + \beta_5 \ln(GT100k_i) + \beta_6 \ln(Owner_i) + AvgSize_i + \varepsilon_i$$

Where:

$Eligible_i$ = Number of households eligible for assistance, in PUMA region i
$LT20k_i$ = Proportion of households with annual income less than \$20,000
$Inc35k_i$ = Proportion of households with annual income between \$20,000 and \$35,000
$Inc50k_i$ = Proportion of households with annual income between \$35,000 and \$50,000
$Inc100k_i$ = Proportion of households with annual income between \$50,000 and \$100,000
$GT100k_i$ = Proportion of households with annual income greater than \$100,000
$Owner_i$ = Proportion of households that are owner occupied
$AvgSize$ = Average number of people in each household
$\ln(\,)$ = Natural logarithm transformation
α, β = Coefficients estimated
ε = Random error term

Next, we applied these coefficients (which were estimated in the model) to tract-level data from the ACS to estimate the number of eligible households within each Census tract in California, as shown in Equation 2.

Equation 2: Estimated Eligibility in Census Tracts

$$\ln(Eligible_c) = \hat{\alpha}_i + \hat{\beta}_1 \ln(LT20k_c) + \hat{\beta}_2 \ln(Inc35k_c) + \hat{\beta}_3 \ln(Inc50k_c) + \hat{\beta}_4 \ln(Inc100k_c) + \hat{\beta}_5 \ln(GT100k_c) + \hat{\beta}_6 \ln(Owner_c) + AvgSize_c$$

$$Eligible_c = e^{\ln(Eligible_C)}$$

Where:

$Eligible_c$ = Number of households eligible for assistance, in Census Tract c
$\hat{\alpha}, \hat{\beta}$ = Coefficients estimated in the regression model (of PUMAs)
$LT20k_c, Inc35k_c, \ldots$ = Characteristics of region c
e = Mathematical constant, the inverse of the natural log, $\ln(\,)$

Our final estimates were at the Census tract level because the SASH program had a geographic eligibility component at the tract level – participants must live within a HUD qualified Census tract.[5]

1.4.3 Program Penetration

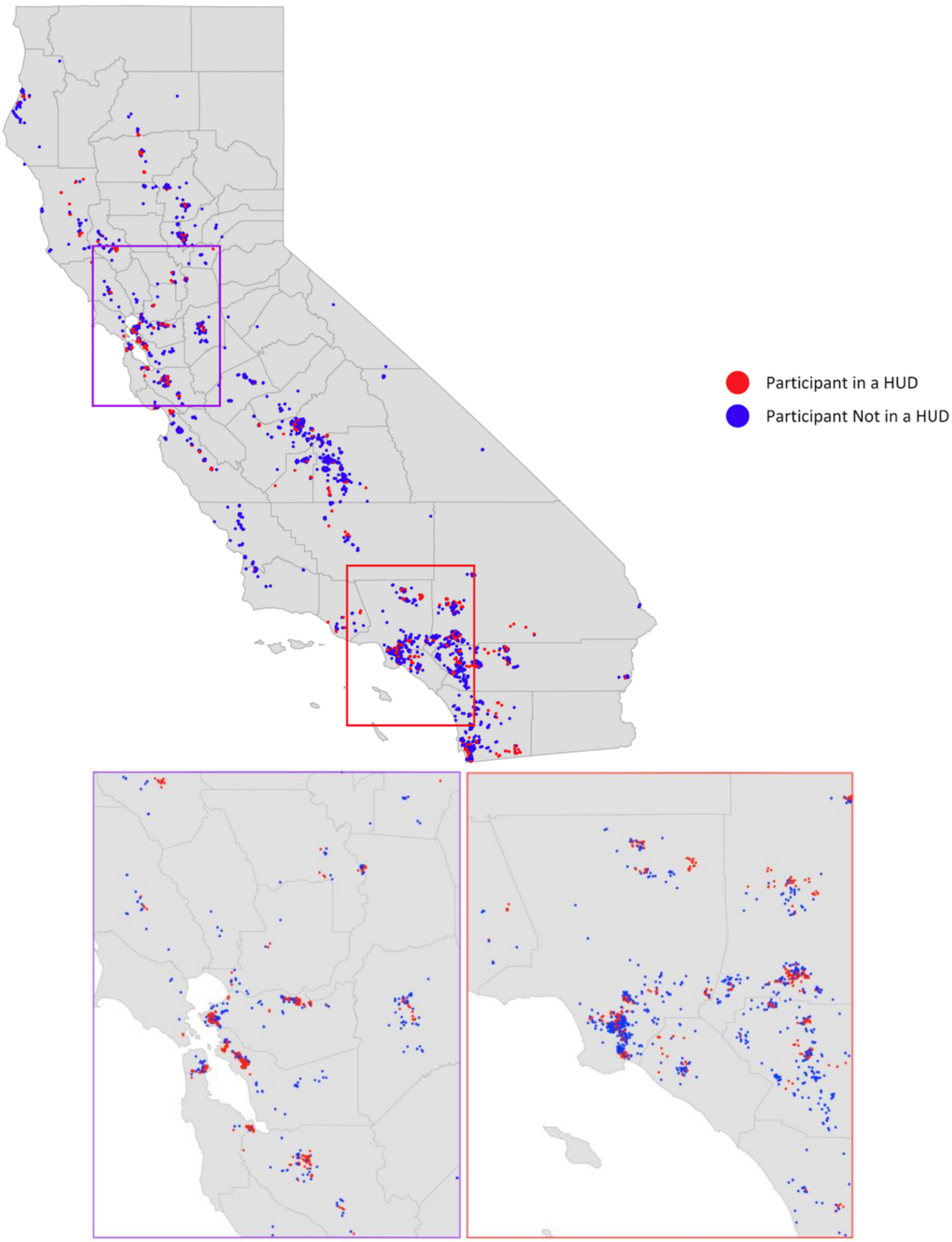
For this phase of the analysis, we defined "participants" as households that were marked as completed in the PA database of all SASH projects as of February 2022. Note that some households may have had a system installed by February 2022 but were not counted if the PA had not received the incentive from the IOU.

We compared the number of program participants to our estimates of the eligible households in each region to determine the current program penetration rate. Comparing this metric across regions allowed us to compare characteristics of areas with low penetration with areas with higher penetration.

Figure 4 shows the location of every program participant in California. These data were used as the basis for our count of total participants to calculate penetration. The purple and red boxes are zoomed in to show more detail in the Bay Area and Greater LA Area.

[5] SASH participants could qualify by living in a home designated as affordable housing by the California Public Utilities Code 2852 and not be constrained geographically. There is, however, little information on statewide databases of these properties and their other characteristics that would be necessary to determine program eligibility.

Figure 4: All SASH Program Participants



1.5 Secondary Analysis – Billing and PV Impact Analysis

For the impact analysis, we used regression analysis to estimate the energy savings attributed to a solar panel installation above and beyond any natural change observed in a control group comprised of future participants (i.e., eligible households who later decided to install solar through the program).

1.5.1 Data Cleaning and Exclusion Criteria

Table 7 provides a summary of every data source we utilized for the impact evaluation, the fields provided, sample coverage (e.g., number of premises and range of dates), and how the data were used. After receiving each data source, we conducted data quality checks before preparing the data for analysis (e.g., flagging outliers and identifying and addressing missing values).

Table 7: Data Sources for the SASH Evaluation

Data Source	Unique Fields	Coverage	Intended Use
PA Program Tracking Database	Service Account ID, rate code, and home location, Solar system details (program, year of participation, system size, TPO flag, and first completion date)	n=10,467	Comparison group selection, segmentation (customer and home characteristics), Install date for the regression models, segmentation (customer and solar system characteristics)
IOU Monthly Billing data	Electricity costs, kWh usage, billing period start and end date	n=9,844 premises 2008-2022	Comparison group selection, monthly regression models for estimates of energy and cost savings
IOU Daily Advanced Metering Infrastructure (AMI) Usage Data	Daily electricity consumption	n=9,761 premises 2008-2022	Comparison group selection, daily regression models for estimates of energy savings
IOU Hourly Advanced Metering Infrastructure (AMI) Usage Data	Hourly electricity consumption	n=100 premises (includes some DAC-SASH participants) 2008-2022	Hourly regression models for estimates of energy and demand savings
National Oceanic and Atmospheric Administration (NOAA) Weather Data	Hourly interval outdoor air temperature	n=68 stations 2008-2022	Weather normalization (actual weather)
Typical Meteorological Year (TMY3) Weather Data	Typical weather conditions, based on historical outdoor air temperature	n=68 stations	Weather normalization (typical weather)

Participant Attrition

Table 8 shows the number of participants who were excluded from the impact analysis and the reason for their removal. Most notable were the records that did not have 12 months of pre-install or 12 months of post-install data (30%), including those for which we did not receive any billing or AMI data at all (6%).

We also removed 507 sites because they did not have a non-participant record with sufficiently similar weather, defined by annual cooling degree-days.[6] The purpose of requiring a match on cooling degree-days was to ensure that the participants home and their matched comparison home are in similar climates. As we are looking at the persistence of energy savings over 10 years, we wanted to ensure that the participant and matched comparison site were from a similar climate zone, experiencing similar changes in weather patterns over the study period. By ensuring their climates are similar, we can distinguish changes in consumption caused by changes regional weather patterns (i.e., climate change) from changes in the participants' reactivity to weather (e.g., lowering of thermostat set points to increase comfort).

In the end, we were able to retain 58 percent of SASH participant sites for the regression models.

Table 8: Participant Attrition Affecting the SASH Impact Analysis

Exclusion Criteria	Sites Dropped	Remaining Sites	%
In Tracking Database	-	9,408	100%
Missing Solar Install Date	10	9,398	100%
Account had Multiple Premises	2	9,396	100%
No Billing or AMI Data Were Provided[7]	549	8,847	94%
Less than 12 Months Pre- or 12 Month Post-Install	2,817	6,030	64%
Duplicate Account	1	6,029	64%
No Bill Cost for Pre- or Post-Install Months	89	5,940	63%
Did Not Result in a Matched Home for Climate Similarity Reasons	507	5,433	58%
Possible Master Meter (Relatively Large Usage)	1	5,432	58%
In Regression Models	-	5,432	58%

[6] We defined sufficiently similar cooling degree days as those within 20 percent of the total annual, 20 percent of the total summer, and 20 percent of the total cooling degree days in the year prior to participation.

[7] Some of the data that were requested for this evaluation were archived or unavailable, leading to significant delays in obtaining the billing data for analysis. The evaluation team moved forward with the best available data from all three utilities.

Table 9 shows some of the home characteristics for the full list of homes found in the tracking database compared to the homes that were used for the impact analysis. The distribution by utility and owner, and the average PV size is similar for the two groups.

Table 9: Characteristics of Participating Homes

Source	Program	Participating Homes	Percentage				Average Size
			TPO	PG&E	SCE	SDG&E	
Tracking Database (all participants)	SASH 1.0	5,196	0%	43%	46%	11%	3.0
	SASH 2.0	4,212	80%	50%	38%	12%	3.3
Impact Analysis	SASH 1.0	2,811	0%	49%	42%	9%	3.1
	SASH 2.0	2,622	81%	53%	36%	11%	3.2

Identifying Outliers

Evergreen identified outliers in kWh energy consumption (i.e., individual observations) as well as customers with unusual energy consumption patterns. An outlier was defined as any individual kWh reading that was more than three times the distance of the interquartile range (IQR) from the median interval measurement for that customer.[8] A little over 50 percent of the sites in the SASH analysis had at least one flagged outlier in the kWh data used for the regression models, with the most extreme site having 25 percent of its daily kWh data flagged in the data used for the models (this was still sufficient to proceed with modeling) and the average site in the SASH kWh datasets having less than 1 percent of its daily kWh data flagged.

We estimated baseline models with and without these flagged outliers to assess the relative model fit; we concluded that removing outliers (1% of the daily observations on the gross kWh regression models) led to a slight improvement in the model fit; for this reason, outliers were removed in the models presented in this report.

1.5.2 Billing Impacts

We conducted an analysis of pre and post participation billing data to:

- Estimate monthly bill reduction outcomes for program participants
    - Compare estimates across those who own their systems and those who are engaged in a TPO construct

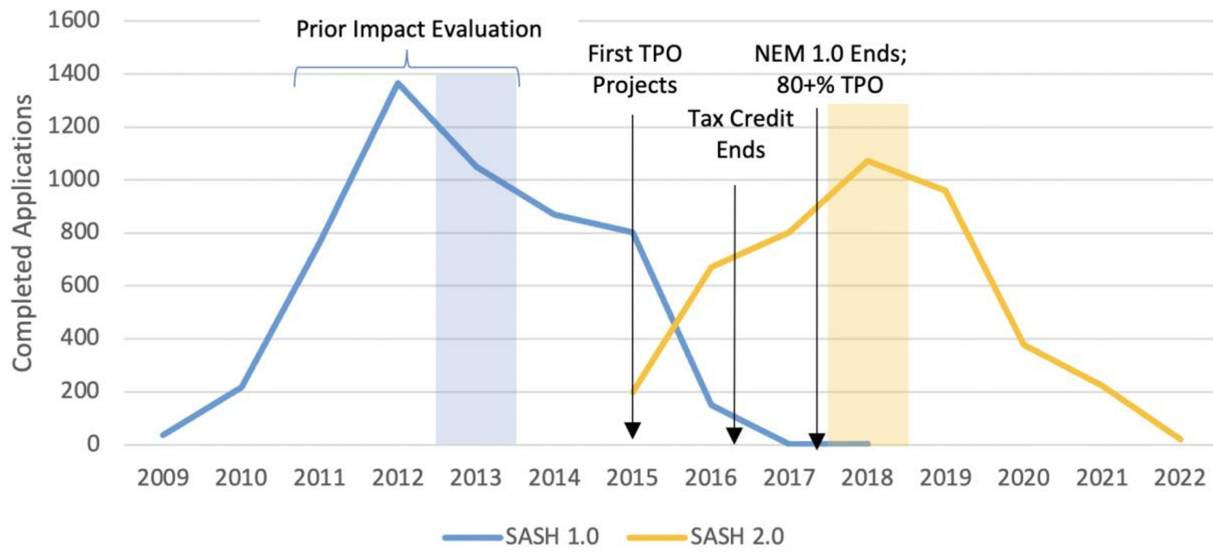
[8] This definition of an outlier is based on CalTRACK rule 2.3.6. The IQR is a measurement of variability. The rank-ordered data are divided into four equal parts called quartiles. The IQR measures the distance between the first and third quartiles, corresponding to the 25th and 75th percentiles, containing the middle 50 percent of observations.

- Estimate changes in post-participation customer energy usage patterns

Figure 5 provides a summary of the participation in the SASH program since inception, based on the public tracking data. SASH 1.0 started in 2009, peaked in 2012, and ended in 2018. SASH 2.0 overlaps with the first installation in 2015, peak in 2018, and ends in 2022. We also include indicators of significant events in the industry: the first TPO project installed in 2015, the end of the 30 percent tax credit for solar installations in 2016, and the end of NEM 1.0 on June 30, 2017. These events were not part of the program design, but they have an impact on the incentives and motivations for participation, which may have led to a shift in the participant population.

To estimate net impacts for SASH 1.0 and 2.0, we wanted to use a comparison group comprised of future participants to ensure that the participant and their matched comparison align on their eligibility (income limit and home ownership) as well as their propensity to adopt solar (including both the interest and feasibility). The only downside of this approach is that we do not have future participants available for every program year, as the programs have ended. Instead, we selected a year of participants from each program to feature in the net-to-gross estimate. The projects completed in 2010 were not expected to have significantly different bill impacts than those completed in 2016 for SASH 1.0. Hence, we proposed to focus on a few years from each program for the net impacts (measuring savings *above and beyond* any change observed in the comparison group), including 2013 for SASH 1.0 (blue shaded area) and 2018 for SASH 2.0 (yellow shaded area). This ensures we have sufficient sample for meaningful analysis, while minimizing the uncertainty introduced with a long study timeframe – where external events and long-term changes in energy consumption are more likely to have a statistically significant impact on bills.

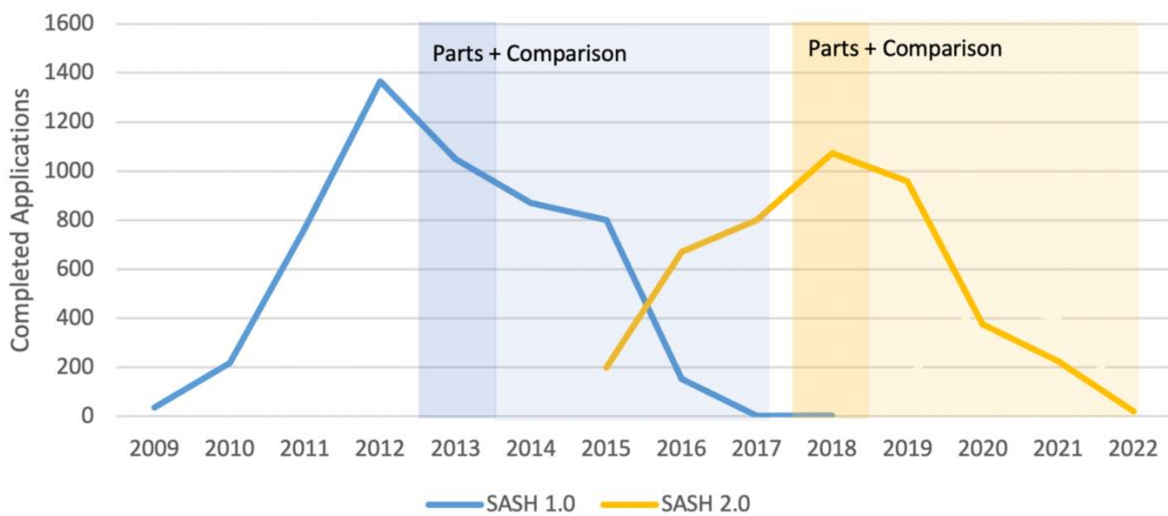
Figure 5: Annual Participation in SASH



Source: Evergreen analysis of completed applications pulled from CalDGStats in February 2022

SASH 1.0 and 2.0 used a comparison group comprised of future participants. The 2013 participants in SASH 1.0 were matched with a participant from 2014 or later, while the 2018 SASH 2.0 participants were matched with a participant from 2019 or later as shown in Figure 6. The gross savings from the 2013 and 2018 participants provide an estimate for the overall impact of the program on participants, while the net savings estimate savings *above and beyond* any natural change in that is observed in the comparison group, comprised of similar eligible customers who do not (yet) have solar.

Figure 6: Selected Participants and Comparison Groups from SASH



Source: Evergreen analysis of completed applications pulled from CalDGStats in February 2022

We requested monthly billed electricity usage (kWh) and charges ($), daily interval AMI data (kWh), rate code, and some basic information from each customer account such as zip code, climate zone, home type, and tenure. We requested data for all participating customers that received incentives through the PA during all the study years (2009-2018 for SASH 1.0, 2015-2022 for SASH 2.0). We used the comparison homes to measure any significant changes in energy consumption due to program participation, rather than external factors like changes in building codes or the COVID-19 pandemic shelter-in-place orders.

As a first step in this process, we created a matched comparison group of future participants with similar energy consumption and bill costs as the participants before the solar installation. Each selected comparison customer came from a location that had similar cooling degree days as the matched participant. While it would have been preferable to limit the comparison group to eligible non-participants, IOU data do not reliably provide home ownership data. All we know is the average income and ownership rates within the region and whether the individual customer is enrolled in CARE/FERA, which is available to everyone below 200 percent of the Federal Poverty Line (FPL). We prioritized finding a strong match on the two metrics we were attempting to measure: bill cost and fuel consumption, while only considering non-participants that had cooling degree days that were within 20 percent of the participants cooling degree days during the pre-period. Non-participants with self-funded solar and Net Energy Metering (NEM) were allowed to be selected into the comparison group, as solar adoption can occur without program assistance. The comparison group was used to help control for the impact of the COVID-19 pandemic and other external factors that changed over time.

Net Daily Regression Model

We used the model specification in Equation 3 to estimate the net daily savings impacts (kWh and $ per day) for homes that participated under each program and year separately (i.e., the same specification but a different set of coefficient estimates for 2012 SASH 1.0 versus 2018 SASH 2.0).

This model includes heating degree days (HDD) and cooling degree days (CDD) to control for variability in weather. The coefficients on $CDD * Treat$ and $Daylight * Treat$ control for any difference between the treatment and control groups prior to the installation of solar panels. The coefficients on $Post$, $CDD * Post$, and $Daylight * Post$ are intended to absorb the impact of the COVID-19 pandemic and any other changes over time that are shared across the treatment and control groups. The regression includes a series of monthly indicator variables to help control for variability in energy usage across the year that is seasonal but unrelated to temperature, such as energy usage for cooking and lighting. We tested the inclusion of additional interaction terms, dropping any that were not statistically significant and that did not improve the model fit.

Equation 3: Net Daily Fixed Effects Regression Model

$$kWh_{i,t} = \alpha_i + \sum_{Month=1}^{11} \beta_{Month} Month_t + \beta_C CDD_{i,t} + \beta_H HDD_{i,t} + \beta_D Daylight_{i,t} + \beta_P Post_{i,t} + \beta_{CP} CDD * Post_{i,t} + \beta_{DP} Daylight * Post_{i,t} + \beta_{CT} CDD * Treat_{i,t} + \beta_{DT} Daylight * Treat_{i,t} + \beta_{TP} Treat * Post_{i,t} + \beta_{CTP} CDD * Treat * Post_{i,t} + \beta_{DTP} Daylight * Treat * Post_{i,t} + \varepsilon_{i,t}$$

Where:

$kWh_{i,t}$ = Actual daily energy usage for customer i during time interval t [9]
α_i = Customer specific fixed effect (i.e., baseline consumption)
$Month$ = Month of the year dummy variables (Feb to Dec, omitting Jan)
CDD = Cooling degree days calculated from a baseline temperature of 65°F
HDD = Heating degree days calculated from a baseline temperature of 65°F
$Daylight$ = Hours of daylight (between dawn and dusk) during time interval t
$Treat$ = Dummy variable (0, 1) for customers assigned to the treatment group
$Post$ = Dummy variable (0, 1) for the period after the solar was functional [10]
$\beta_{TP}, \beta_{CTP}, \beta_{DTP}$ = Average impact post install for each additional CDD and daylight hour
ε = Random error assumed to be normally distributed

The resulting model fit is presented in Table 10 and Table 11. These tables show the sample size, number of observations, and R-squared values of the final daily kWh and daily cost net regression models by program and participation year.[11] The R-squared values of the daily models ranged from 0.36 to 0.47, which is in line with what we have seen for this type of program evaluation with diverse participants and a long study period.

Despite the low R-squared values, nearly all coefficients and resulting estimates of the savings impacts were statistically significant. We estimated many variations of these models, and the R-squared values observed in these final model specifications were some of the highest that we observed. Removing daily outliers slightly improved the R-squared values but had no statistically significant impact on the coefficient estimates.

[9] Actual daily costs for customers were also estimated using this model.
[10] A customized install date was used for customers in the treatment group and an assigned install date was used for the control group.
[11] An R-squared value is a statistical measure of how close the data are to the fitted regression line. The R-squared value can range from 0 to 1, where the value of 1 means the model exactly matches the data feeding into the model.

Table 10: Daily kWh Net Regression Model Fit by Program and Year of Participation

	Sample Size				
Program - Year	Total	Treatment	Control	N Observations	R-sq
SASH 1.0 - 2013	1,396	698	698	1,014,537	0.435
SASH 2.0 - 2018	1,558	779	779	1,125,301	0.472

Source: Evergreen analysis of energy consumption of program participants and matched comparison group.

Table 11: Daily Costs Net Regression Model Fit by Program and Year of Participation

	Sample Size				
Program - Year	Total	Treatment	Control	N Observations	R-sq
SASH 1.0 - 2013	1,396	698	698	1,009,795	0.415
SASH 2.0 - 2018	1,558	779	779	1,120,496	0.360

Source: Evergreen analysis of electricity costs of program participants and matched comparison group.

The estimated regression coefficients from this model, combined with average weather conditions from the year of participation and number of daylight hours, produce estimates for electricity savings (kWh) that result from being treatment by the program (i.e., installing solar), as shown in Equation 4. These are net savings, impacts above and beyond any natural change observed in the matched comparison group.

Equation 4: Estimated Annual Net Savings Impact

$$Savings_{ITT} = \hat{\beta}_{Treat*Post} * Days_{Year} + \hat{\beta}_{CDD*Treat*Post} \sum CDD_{Year} + \hat{\beta}_{Daylight*Treat*Post} \sum Daylight_{Year}$$

Where:

$\hat{\beta} =$ Coefficients estimated in the regression model [12]

$Days_{Year} =$ Count of days in the year of post participation

$\sum CDD_{Year} =$ Sum of cooling degree days during the year of post participation

$\sum Daylight_{Year} =$ Sum of daylight hours during the year of post participation

Gross Daily Regression Model

We used a similar model specification in Equation 5 to estimate the overall energy savings (kWh) and bill cost ($) impacts for homes that participated under each program and year separately (i.e., the same specification but a different set of coefficient estimates for 2012 SASH 1.0 versus 2018 SASH 2.0).

Like the net impact model, we included a series of monthly indicators, HDD, CDD, and hours of daylight. A series of year indicator variables were included to help control for variability in energy usage over time (e.g., changes in appliance standards). We tested the inclusion of additional interaction terms, dropping any that were not statistically significant and that did not improve the model fit. The impact of solar is seen in the *Post* indicator and interactions between *Post*, *CDD*, and *Daylight*.

Equation 5: Gross Daily Fixed Effects Regression Model

$$kWh_{i,t} = \alpha_i + \sum_{Month=1}^{11} \beta_M Month_t + \sum_{Year=1}^{14} \beta_Y Year_t + \sum_{Year=1}^{13} \beta_I YearSince_t + \beta_V COVID_{i,t} + \beta_C CDD_{i,t} + \beta_H HDD_{i,t} + \beta_D Daylight_{i,t} + \beta_P Post_{i,t} + \beta_{CP} CDD * Post_{i,t} + \beta_{DP} Daylight * Post_{i,t} + \varepsilon_{i,t}$$

Where:

$kWh_{i,t} =$ Actual daily energy usage for customer i during time interval t [13]

$\alpha_i =$ Customer specific fixed effect (i.e., baseline consumption)

$Month =$ Month of the year dummy variables (Feb to Dec, omitting Jan)

$Year =$ Year dummy variables (2009 to 2022, omitting 2008)

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[12] For participants from a specific program and year

[13] The daily bill costs were estimated using the same model specification, with a different dependent variable.

$$YearSince = \text{ Number of years since install dummy variables (1 to 13, omitting 0)}$$
$$COVID = \text{Dummy variable representing the period after March 15, 2020}$$
$$CDD = \text{Cooling degree days calculated from a baseline temperature of 65°F}$$
$$HDD = \text{Heating degree days calculated from a baseline temperature of 65°F}$$
$$Daylight = \text{Hours of daylight (between dawn and dusk) during time interval } t$$
$$Post = \text{Dummy variable } (0, 1) \text{ for the period after the solar was functional}$$
$$\beta_P, \beta_{CP}, \beta_{DP} = \text{ Average impact post install for each additional CDD and daylight hour}$$
$$\varepsilon = \text{ Random error assumed to be normally distributed}$$

The resulting model fit is presented in Table 12 and Table 13. These tables show the sample size, number of observations, and R-squared values of the final daily kWh and daily cost gross regression models by program and participation year.[14] The R-squared values of the daily models ranged from 0.29 to 0.43, which is in line with what we have seen for this type of program evaluation with diverse participants and a long study period. Despite the low R-squared values, nearly all coefficients and resulting estimates of the savings impacts were statistically significant. We estimated many variations of these models, and the R-squared values observed in these final model specifications were some of the highest that we observed. Removing daily outliers slightly improved the R-squared values but had no statistically significant impact on the coefficient estimates.

Table 12: Daily kWh Gross Regression Model Fit by Program and Year of Participation

	Sample Size				
Program - Year	Total	Treatment	Control	N Observations	R-sq
SASH 1.0 ('09-'18)	**2,811**	**2,811**	**0**	**11,262,182**	**0.364**
SASH 1.0 - 2010	39	39	0	206,705	0.310
SASH 1.0 - 2011	258	258	0	1,321,731	0.326
SASH 1.0 - 2012	492	492	0	2,302,679	0.354
SASH 1.0 - 2013	698	698	0	2,687,525	0.351
SASH 1.0 - 2014	603	603	0	2,202,920	0.417
SASH 1.0 - 2015	603	603	0	2,121,474	0.384
SASH 1.0 - 2016	112	112	0	396,612	0.419
SASH 2.0 ('15-'20)	**2,621**	**2,621**	**0**	**8,717,860**	**0.426**

[14] An R-squared value is a statistical measure of how close the data are to the fitted regression line. The R-squared value can range from 0 to 1, where the value of 1 means the model exactly matches the data feeding into the model.

Program - Year	Sample Size Total	Treatment	Control	N Observations	R-sq
SASH 2.0 - 2015	100	100	0	343,844	0.430
SASH 2.0 - 2016	499	499	0	1,706,073	0.445
SASH 2.0 - 2017	581	581	0	1,969,646	0.436
SASH 2.0 - 2018	779	779	0	2,545,064	0.437
SASH 2.0 - 2019	577	577	0	1,882,463	0.419
SASH 2.0 - 2020	85	85	0	270,770	0.306

Source: Evergreen analysis of energy consumption of program participants for program years 2010-2020

Table 13: Daily Costs Gross Regression Model Fit by Program and Year of Participation

Program - Year	Sample Size Total	Treatment	Control	N Observations	R-sq
SASH 1.0 (‘09-‘18)	**2,811**	**2,811**	**0**	**11,242,660**	**0.331**
SASH 1.0 - 2010	39	39	0	87,006	0.313
SASH 1.0 - 2011	258	258	0	1,220,255	0.367
SASH 1.0 - 2012	492	492	0	2,251,182	0.327
SASH 1.0 - 2013	698	698	0	2,601,807	0.249
SASH 1.0 - 2014	603	603	0	2,324,864	0.351
SASH 1.0 - 2015	603	603	0	2,244,770	0.379
SASH 1.0 - 2016	112	112	0	391,222	0.426
SASH 2.0 (’15-‘20)	**2,621**	**2,621**	**0**	**9,951,743**	**0.292**
SASH 2.0 - 2015	100	100	0	436,399	0.346
SASH 2.0 - 2016	499	499	0	1,944,543	0.313
SASH 2.0 - 2017	581	581	0	2,209,077	0.290
SASH 2.0 - 2018	779	779	0	2,998,706	0.318
SASH 2.0 - 2019	577	577	0	2,093,526	0.280
SASH 2.0 - 2020	85	85	0	69,492	0.222

Source: Evergreen analysis of electricity costs of program participants for program years 2010-2020

The estimated regression coefficients from this model, combined with average weather conditions from the year of participation and number of daylight hours, produce estimates for electricity savings (kWh) that result from installing solar panels, as shown in Equation 6.

Equation 6: Estimated Gross Savings

$$Savings_{ITT} = \hat{\beta}_{Post} * Days_{Year} + \hat{\beta}_{CDD*Post} \sum CDD_{Year} + \hat{\beta}_{Daylight*Post} \sum Daylight_{Year}$$

Where:

$$\hat{\beta} = \text{ Coefficients estimated in the regression model}$$
$$Days_{Year} = \text{ Count of days in the year}$$
$$\sum CDD_{Year} = \text{Sum of cooling degree days during the year post participation}$$
$$\sum Daylight_{Year} = \text{Sum of daylight hours during the year post participation}$$

Hourly Regression Model

The hourly model uses an ordinary least squares (OLS) regression with time-of-week indicators, heating degree-hours (HDH) and cooling degree-hours (CDH) to explain the variability in energy usage in terms of the day-of-week, time-of-day, and outdoor air temperature, as shown in Equation 7.[15] We tested additional interaction terms, and then dropped any that were not statistically significant and did not improve the model fit.

Equation 7: Hourly Regression Model

$$kWh_t = \sum_{TOW=1}^{47} \beta_{TOW} TOW_t + \sum_{S=1}^{3} \beta_S Season_t + \sum_{Year=1}^{14} \beta_Y Year_t + \sum_{Year=1}^{13} \beta_I YearSince_t + \beta_C CDH_t + \beta_H HDH_t + \beta_D Daylight_t + \beta_P Post_t + \beta_{CP} CDH * Post_t + \beta_{DP} Daylight * Post_t + \varepsilon_{i,t}$$

Where:

$$kWh_t = \text{ Energy consuption during time interval } t$$
$$TOW = \text{Indicator variables representing the time} - \text{of} - \text{week, 24 hours for two day types (weekdays vs. weekends)}$$
$$Season = \text{Season variable (spring, summer, and winter, omitting fall)}$$
$$Year = \text{Year dummy variables (2009 to 2022, omitting 2008)}$$
$$YearSince = \text{ Number of years since install dummy variables (1to 13, omitting 0)}$$

[15] Degree-day terms estimate a linear increase in energy usage for each additional degree below or above the baseline temperature (65 degrees Fahrenheit), when heating or cooling is likely required.

$$
\begin{aligned}
COVID &= \text{Dummy variable representing the period after March 15, 2020} \\
CDH &= \text{Cooling degree hours calculated from a baseline temperature of 65°F} \\
HDH &= \text{Heating degree hours calculated from a baseline temperature of 65°F} \\
Daylight &= \text{Dummy variable for daylight during time interval } t \\
Post &= \text{Dummy variable } (0,1) \text{ for the period after the solar was functional} \\
\beta_P, \beta_{CP}, \beta_{DP} &= \text{Average impact post install for each additional CDD and daylight hour} \\
\varepsilon &= \text{Random error assumed to be normally distributed}
\end{aligned}
$$

The estimated regression coefficients from this model, combined with average weather conditions from 2022, produce estimates for hourly gross electricity savings (kWh) for the year 2022, as shown in Equation 8.

Equation 8: Estimated Gross Hourly Savings in First Year

$$
\begin{aligned}
Savings_{ITT} = {} & \hat{\beta}_{Post} * Hours_{2022} + \hat{\beta}_{YearSince\_1} * Hours_{2022} + \hat{\beta}_{C*Post} \sum CDH_{2021} \\
& + \hat{\beta}_{D*Post} \sum Daylight_{2022}
\end{aligned}
$$

Where:

$$
\begin{aligned}
\hat{\beta} &= \text{Coefficients estimated in the regression model}^{16} \\
Hours_{2022} &= \text{Count of days in 2022} \\
\sum CDH_{2022} &= \text{Sum of cooling degree days in 2022} \\
\sum Daylight_{2022} &= \text{Sum of daylight hours in 2022}
\end{aligned}
$$

1.5.3 PV Impacts

To assess PV impacts, the evaluation had a two-part goal: 1) verify total PV installed capacity achieved through the programs, and 2) understand how this installed capacity performed compared to expectations and what factors may be most impactful on system performance.

To determine PV system impacts and avoided GHG emissions, the Evergreen team conducted 56 desk reviews including review of program data, EPBB tool outputs, and field inspection reports, analyzed PV generation data for 48 systems, and observed 8 systems in person. This analysis laid the groundwork for the population-level analyses for energy generation, demand reduction, and greenhouse gas (GHG) reductions.

[16]For participants from a specific program and year.

Desk Review

We conducted fifty-six desk reviews to determine how projects perform compared to program expectations. As part of the reviews, we collected program data from the sources below:

- GRID's program tracking data
- Publicly available data from CalDGStats
- Expected Performance Based Buydown (EPBB) tool files stored by GRID
- Field Inspection Reports stored by GRID
- PV monitoring systems (Enphase & SolarEdge) generation data

We requested energy generation data from program-installed solar PV monitoring systems from GRID for the sampled projects. GRID granted the Evaluation Team direct access to the Enphase-Enlighten (Enphase) portal, which allowed the us to review all available generation data for the Enphase systems in the sample. GRID also provided an extract of 13 months of generation data from a specific date range (June 2021 through June 2022) for projects with SolarEdge monitoring systems. Eight sampled Enphase projects had no available energy generation data so these samples were dropped from the analysis, resulting in sample distribution by program, IOU, and California Climate Zone as described in Table 14 and Table 15. Sampled project locations are shown in Figure 7.

Table 14: Summary of Sampled Projects, by Program

Program	Dropped	Enphase	SolarEdge	Total Sample
SASH 1.0	5	25	0	25
SASH 2.0	3	10	13	23
TOTAL	**8**	**35**	**13**	**48**

Table 15: Summary of Sampled Projects by Climate Zone and IOU

IOU	California Climate Zone																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
PG&E	2	2	7	1							1	1					14
SCE						1		4		4			12	2		2	24
SDG&E							8			1							9
TOTAL	**2**	**2**	**7**	**1**	**0**	**1**	**8**	**4**	**0**	**5**	**1**	**1**	**12**	**2**	**0**	**2**	**48**

Figure 7: Sampled Project Locations by Program

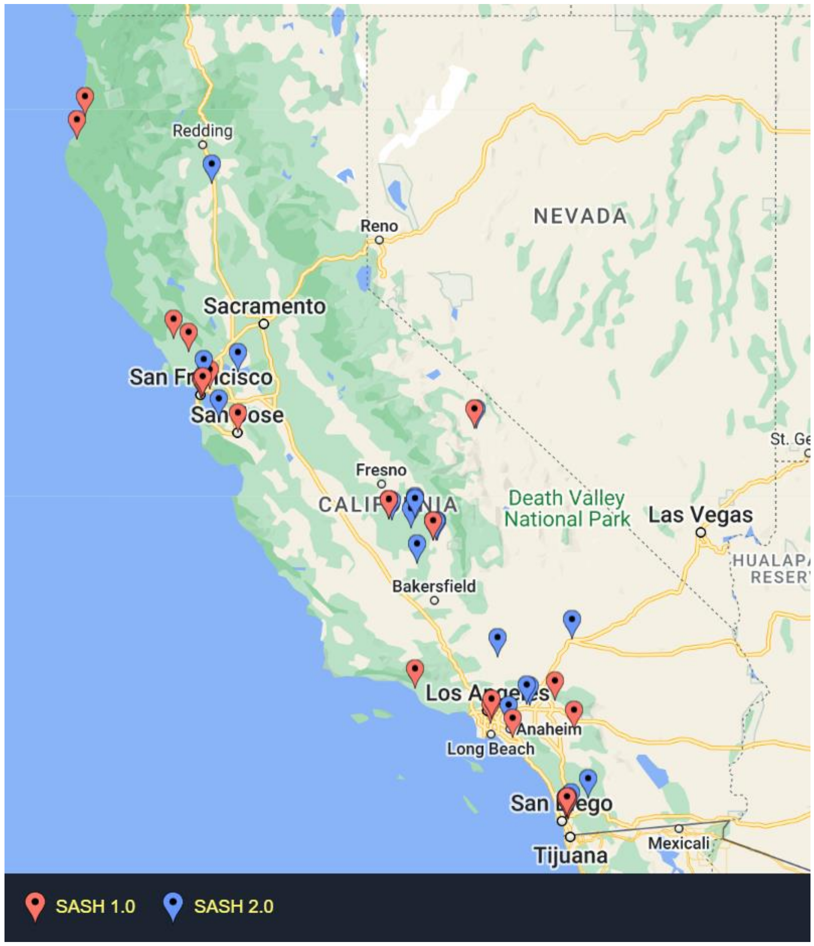


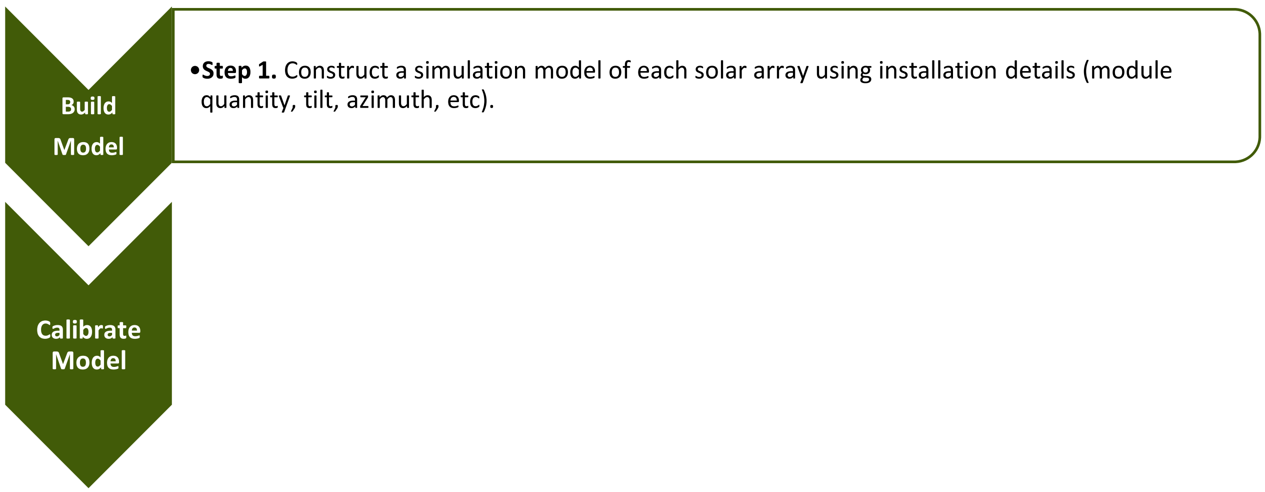
Table 16 describes the distribution of installed system kW-ratings by IOU within the population and sample. The last column indicates the percent of the population that was sampled for each IOU.

Table 16: Sample and Population Characteristics

IOU	Population: Installed Capacity (kW)	Population: Distribution Percent	Sample: Installed Capacity (kW)	Sample: Distribution Percent	Sample Percent kW-Rating
PG&E	15,449	45%	44	24%	0.29%
SCE	15,176	44%	113	61%	0.74%
SDG&E	3,582	10%	28	15%	0.78%

Sample Analysis

We analyzed and evaluated each sampled PV system through the following phased process to determine the normalized hourly and annual generation. Subsequent sections describe each step of the process in more detail.



Step 1. System Modelling

We conducted the system modelling in the National Renewable Energy Laboratory's (NREL's) System Advisor Model (SAM) tool, using the Detailed Photovoltaic Model option.[17] The CPUC's EPBB tool calculation incorporates an earlier version of this model to estimate anticipated energy generation. We modeled each sampled project in SAM based on the PV system parameters within its respective EPBB file(s) and Field Investigation report(s).

We selected the PV panel model and the inverter model from the California Energy Commission (CEC) database in SAM. If either model were not listed in the CEC database, we manually entered specifications from the equipment datasheet into SAM.

[17] SAM Version 2021.12.02, available from https://sam.nrel.gov/

Step 2. Calibration Period

We selected the most recent consecutive 12 months of metered generation data for the calibration period for each project. For projects with a complete data set, we used generation data from July 1, 2021 through June 30, 2022 as the calibration period. For projects missing data in that timeframe, we selected based on available data. Data availability issues are described in more detail in the next sections. For projects installed after July 1, 2021, we analyzed using all available generation data.

Step 3. Weather Files

We used California Measurement Advisory Council's (CALMAC) weather files for both calibration and normalization. [18] These weather files include historical single year observations beginning in 2014 as well as typical year files (CZ2022) for California weather stations. The analysis used geographic coordinates of each project to select the nearest CALMAC weather file location and collected observed weather data for the calibration period for each project.

Steps 4 -6. Calibration and Normalized Production Results.

SAM models were calibrated to align with the annual metered energy generation with 0 percent difference. Calibration of individual SAM models was performed by adjusting system loss parameters including but not limited to Constant AC Losses, Nameplate, Module mismatch, and Direct Current (DC) wiring.

Figure 8 illustrates the calibration process for an example array. The figure compares program reported energy generation (based on the CPUC's EPBB calculation tool, using equipment specifications and geographic details) to metered generation. We developed the calibrated model to align with metered generation. In this example, the energy generation reported by the program was significantly less than the metered generation, so upwards adjustments were made to calibrate the SAM model for this system.[19]

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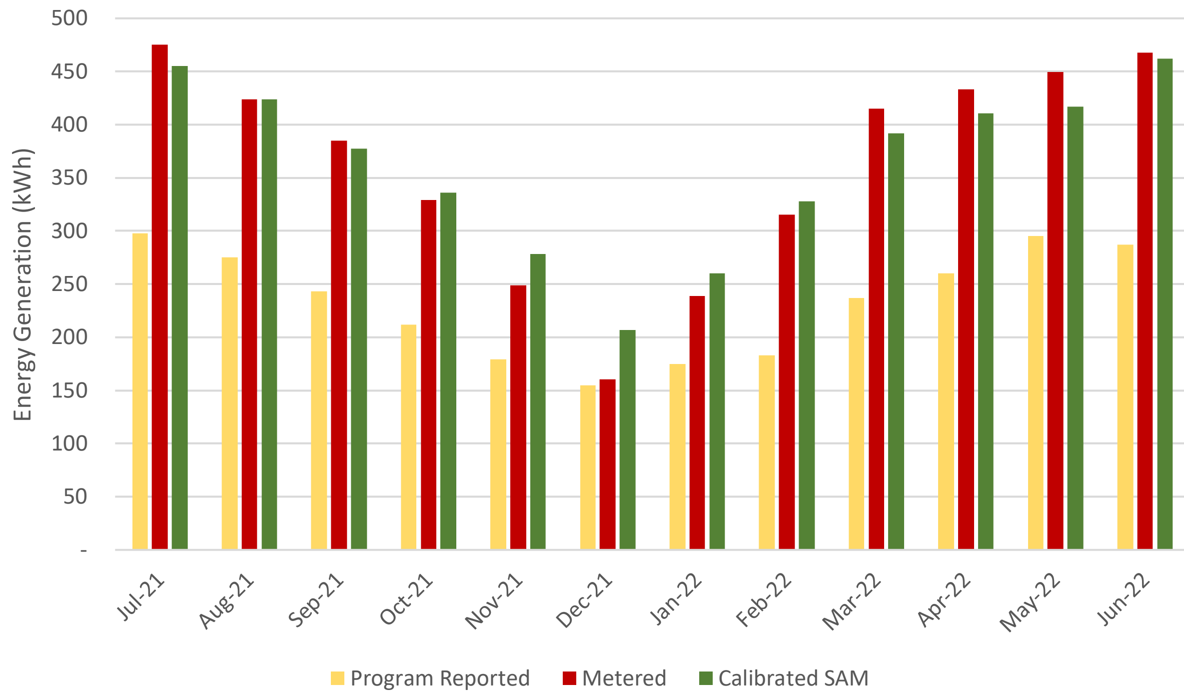
[18] California Measurement Advisory Council - California Weather Files (https://www.calmac.org/weather.asp)

[19] This is an extreme example to clearly show the calibration process. Most sites did not require such a large calibration.

Figure 8: Example Calibration Process



Step 6a. On-Site Assessments

The evaluation team conducted on-site assessments to verify and confirm installation conditions for a subset of eight projects, which we selected based on the results of the initial desk review and availability of data. We selected projects for on-site assessment based on completeness of installation documentation and monitoring data (as data is necessary to make a comparison), and an initial realization rate less than 90 percent or more than 110 percent compared to the reported generation.

Customers selected for on-site assessment were informed of the inspection prior to the field verification date and compensated for their time with $50 electronic gift cards.

The Evergreen team used a pre-defined data collection protocol to ensure consistency and quality across visits. We designed the procedure to verify parameters submitted in the most recent EPBB file. We observed all parameters included in the EPBB tool, including tilt angle, azimuth angle, and shading factors. The on-site assessment template has been included in Appendix G.

Environmental Benefits

The Evergreen team used emissions data and emissions factors to quantify the avoided GHG emissions and criteria pollutants such as methane (CH_4) and nitrous oxides (NO_x) to estimate benefits associated with the energy generated by installed systems during a typical year (i.e., baseline emissions avoided). Hourly marginal emissions data published by WattTime were used to estimate avoided GHG emissions.[20]

1.6 Cost Effectiveness

As part of the evaluation, we conducted a cost-benefit assessment for the programs (including both SASH 1.0 (2009-2015) and SASH 2.0 (2016-2021)) to understand the costs and benefits to the ratepayer and IOU as required by Assembly Bill 217.[21] In this section, we introduce the methodology of the various cost-benefit tests, then report on the calculated inputs of avoided costs, bill savings, non-energy benefits, incentives, administrative costs, equipment and installation costs, and other inputs such as discount rates, electricity rates, and Consumer Price Index (CPI) adjustments.

The cost-benefit assessment replicated the format and general content requirements of the 2001 CPUC California Standard Practice Manual for performing Economic Analysis of Demand-Side Programs and Projects across three tests outlined in that manual:

- Total Resource Cost (TRC) test,
- Societal Cost Test (SCT), and
- Ratepayer Impact Measure (RIM) test.

In addition, Evergreen gathered and assessed projected versus actual program costs for both SASH 1.0 and SASH 2.0.

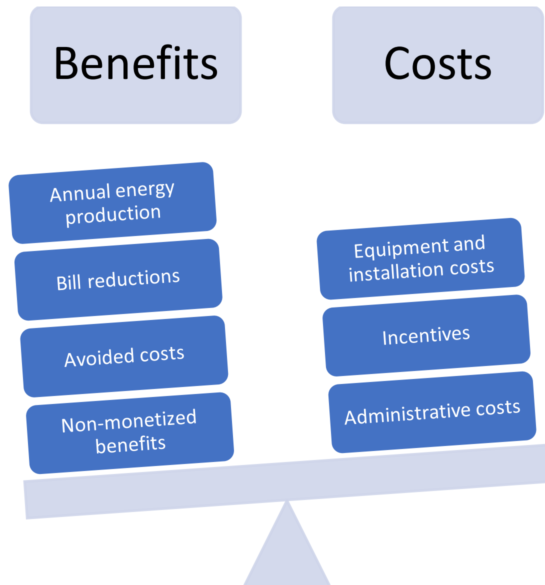
As seen in Figure 9, Evergreen included costs such as equipment and installation costs (TRC, SCT), administrative costs (TRC, SCT, RIM), and incentives (RIM), and benefits such as annual energy production (TRC, SCT, RIM), bill reductions (TRC, SCT, RIM), avoided costs (TRC, SCT, RIM), and Non-Energy Benefits (SCT). [22] Additional inputs included discount rates (societal and IOU-specific), distribution loss factors, and residential electric rates. Together, we used these inputs to calculate cost-benefit ratios for the program by IOU for SASH 1.0 and 2.0.

[20] Accessed via https://www.watttime.org/

[21] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB217

[22] Defined as the various benefits produced by energy efficiency in addition to energy and demand savings. The monetary benefit of Carbon reduced was considered as the sole Non-Energy Benefit in our assessment.

Figure 9: Costs and Benefits for SASH



The 2001 California Standard Practice Manual for Economic Analysis of Demand-Side Programs and Projects defines the three cost-benefit tests as follows: [23]

- **Total Resource Cost (TRC) Test:** measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's cost.
- **Societal Cost Test (SCT):** a variant on the TRC test; it differs from the TRC test in that it includes the effects of externalities (e.g., environmental, national security), excludes tax benefits, and uses a different (societal) discount rate.
- **Ratepayer Impact Measure (RIM) Test:** measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program.

To run these tests, Evergreen used a combination of data provided by GRID, outputs from E3's Avoided Cost Calculator, and outputs from Evergreen's billing analysis, shown in Table 17 below. The first column contains a general description of the input, the second column details the source of the data, and the final three columns list whether the input was treated as a cost or benefit. For example, non-energy benefits were only an input for the SCT and were considered as a benefit.

[23] https://www.raponline.org/wp-content/uploads/2016/05/cpuc-standardpractice-manual-2001-10.pdf

Table 17: Cost-Benefit Test Inputs and Sources

Input	Source	TRC	SCT	RIM
Avoided Costs	E3 Avoided Cost Calculator	Benefit	Benefit	Benefit
Bill Savings	Evergreen's billing analysis	Benefit	Benefit	Cost/ Benefit
Non-Energy Benefits	GRID data, IWG/Biden Administration SCC estimates[24]	N/A	Benefit	N/A
Incentives	GRID data	N/A	N/A	Cost
Administrative Costs	GRID data	Cost	Cost	Cost
Equipment and Installation Costs	GRID data	Cost	Cost	N/A

In the next sections, we present each of the inputs in more detail.

1.6.1 Avoided Costs

Evergreen defines the avoided cost of energy as the incremental cost of producing energy that is not incurred by the IOU due to the consumer generating their own electricity. The average avoided cost of energy was obtained for all three cost-benefit tests using E3's Avoided Cost Calculator (ACC) for Distributed Energy Resources (DER).[25] Multiple versions of the calculator were used to obtain the average avoided cost of energy for each year in the 20-year measure life for SASH 1.0 (2009-2028) and SASH 2.0 (2016-2035). Values for all years considered are shown in Table 18. As a general rule, avoided costs for a given year were pulled using the latest version of the calculator that had data available for that year. The avoided cost values were converted to $/kWh for all cost-benefit tests.

[24] https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf
[25] https://www.ethree.com/public_proceedings/energy-efficiency-calculator/

Table 18: Average Avoided Cost of Energy for SASH Program Measure Life by IOU

	Average Avoided Cost of Energy ($/MWh)		
Year	SDG&E	PG&E	SCE
2009	$55.10	$55.10	$55.10
2010	$35.01	$35.01	$35.01
2011	$36.45	$36.45	$36.45
2012	$42.78	$42.78	$42.78
2013	$46.76	$46.76	$46.76
2014	$49.49	$49.49	$49.49
2015	$51.18	$51.18	$51.18
2016	$52.87	$52.87	$52.87
2017	$54.56	$54.56	$54.56
2018	$56.18	$56.18	$56.18
2019	$37.06	$36.75	$36.57
2020	$51.21	$43.64	$58.42
2021	$41.78	$43.63	$41.78
2022	$36.61	$36.49	$36.61
2023	$36.12	$35.95	$36.12
2024	$36.28	$36.25	$36.28
2025	$36.31	$36.28	$36.31
2026	$38.54	$38.51	$38.54
2027	$39.58	$39.56	$39.58
2028	$37.09	$37.07	$37.09
2029	$38.48	$38.47	$38.48
2030	$36.44	$36.44	$36.44
2031	$38.13	$38.10	$38.13
2032	$38.77	$38.78	$38.77
2033	$39.08	$39.12	$39.08
2034	$39.44	$39.51	$39.44
2035	$39.80	$39.91	$39.80

1.6.2 Bill Savings

Evergreen's billing analysis provided inputs for bill savings. We used these inputs in all three tests, as a benefit for the TRC and SCT, and as a cost (consumer savings) and benefit (IOU savings) for the RIM test. Findings from Evergreen's billing analysis provided values for daily energy savings to the consumer (kWh/day) for SASH 1.0 and 2.0, by IOU. These values are presented in Table 19. Evergreen used these values to find the annual cost savings ($/year) for both the consumer and IOU, through the following calculations:

$$\boldsymbol{Consumer's\ annual\ energy\ savings}\ \left(\frac{\boldsymbol{kWh}}{\boldsymbol{year}}\right) = Daily\ energy\ savings\ to\ consumer\ \left(\frac{kWh}{day}\right) * 365\ days/year$$

$$\boldsymbol{IOU's\ annual\ energy\ savings}\ \left(\frac{\boldsymbol{kWh}}{\boldsymbol{year}}\right) = Consumer'sannual\ energy\ savings\ \left(\frac{kWh}{year}\right) * (1 - distribution\ loss\ factor)$$

$$\boldsymbol{Annual\ cost\ savings\ for\ the\ consumer}\ \left(\frac{\$}{\boldsymbol{year}}\right) = Consumer's\ annual\ energy\ savings\ \left(\frac{kWh}{year}\right) * residential\ electric\ rate\ (\frac{\$}{kWh})$$

$$\boldsymbol{Annual\ cost\ savings\ for\ the\ IOU}\ \left(\frac{\$}{\boldsymbol{year}}\right) = IOU's\ annual\ energy\ savings\ \left(\frac{kWh}{year}\right) * average\ avoided\ cost\ of\ energy\ (\frac{\$}{kWh})$$

Table 19: Daily Consumer Energy Savings by IOU and SASH 1.0 & 2.0

Program	IOU	Daily Energy Savings to Consumer (kWh/day)
SASH 1.0	SDG&E	9.7
	PG&E	14.1
	SCE	12.1
SASH 2.0	SDG&E	12.9
	PG&E	12.6
	SCE	13.4

1.6.3 Non-Energy Benefits

For the SCT, Evergreen considered the monetary value of Carbon reduced per PV system as a benefit. GRID provided a "Carbon Reduced Over System Life (Tons)" metric, which we aggregated by utility and program year. We then divided the value for each year by the total installations to find the carbon reduced per PV system. Next, we used the central estimates from the Biden

Administration's 2020 to 2040 Social Cost of Carbon projections (3% discount rate) to backcast values for pre-2020 years and determine yearly values through 2021.[26] These values are presented in Table 20 below. For each program year, Evergreen multiplied the Carbon reduced per PV system value by that year's Social Cost of Carbon, and then took an average across program years for SASH 1.0 and SASH 2.0 for each IOU. This value was added to other benefits for the SCT to determine total benefits.

Table 20: Social Cost of Carbon (in 2020 dollars per metric ton of Carbon)

Emissions Year	Social Cost of Carbon, 3% Discount Rate ($)
2009	39
2010	40
2011	41
2012	42
2013	43
2014	44
2015	45
2016	46
2017	48
2018	49
2019	50
2020	51
2021	52

1.6.4 Incentives

The RIM test includes incentives as a cost to the IOU. GRID provided the sum of incentives and the sum of PV installations by IOU and program year. For each year, Evergreen divided the incentive value by the number of installations to find the incentive amount per installation. Evergreen took

[26] See Table ES-1, https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

an average across program years for SASH 1.0 and SASH 2.0 (separately) to find the average incentive amount per installation for each program iteration, shown in Table 21.

Table 21: Average Incentive Amount by IOU and SASH 1.0 & 2.0

Program	IOU	Average Incentive Amount
SASH 1.0	SDG&E	$15,182
	PG&E	$16,279
	SCE	$16,934
SASH 2.0	SDG&E	$9,681
	PG&E	$9,797
	SCE	$11,052

1.6.5 Administrative Costs

All three tests include administrative costs as a cost to the IOU. Quarterly administrative cost data were provided by GRID, and Evergreen calculated total administrative costs by IOU for SASH 1.0 and SASH 2.0 based on budget allocations (43.70% for PG&E, 46% for SCE, and 10.30% for SDG&E).[27] Administrative costs include costs for application review and program compliance verification, coordination with IOUs, program tracking and reporting, database maintenance, workforce development, and other administrative tasks.[28]

Evergreen divided total administrative costs by total PV installations to find the administrative cost per installation, as shown in Table 22 below. This unitary cost was used as part of the incremental cost for each test.

[27] As outlined in the SASH semi-annual progress report here: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/csi-progress-reports/q3q4-2021-sash-semiannual-report--212022-final.pdf

[28] These tasks were provided for DAC-SASH only, but Evergreen assumes there is overlap in the administrative tasks for SASH 1.0, 2.0, and DAC-SASH.

Table 22: Administrative Cost per PV Installation by IOU and SASH 1.0 & 2.0

Program	IOU	Administrative Cost per PV Installation
SASH 1.0	SDG&E	$1,718
	PG&E	$1,853
	SCE	$2,080
SASH 2.0	SDG&E	$1,365
	PG&E	$1,299
	SCE	$1,476

1.6.6 Equipment and Installation Costs

Evergreen used equipment and installation costs as an input for the TRC test and SCT. GRID provided equipment and installation cost data by IOU for each program year. Using these data and total installation values, Evergreen found the average equipment and installation cost per PV installation, by IOU and program. This unitary cost is shown in Table 23, and was added to the unitary administrative cost to determine the total incremental cost for the TRC test and SCT.

Table 23: Average Equipment and Installation Cost per Installation by IOU and Program

Program	IOU	Average Equipment and Installation Cost per Installation
SASH 1.0	SDG&E	$17,267
	PG&E	$17,506
	SCE	$18,202
SASH 2.0	SDG&E	$16,721
	PG&E	$15,542
	SCE	$17,229

1.6.7 Other Inputs

In addition to the key inputs mentioned above, the following inputs were used for each cost-benefit test:

PV system degradation rate: Evergreen accounted for PV system degradation by applying a 1.25 percent per year[29] degradation rate to the consumer and IOU annual energy savings values. As a result, an increasingly lower savings value for each year in the PV system's 20-year lifetime was multiplied by the residential electric rate (consumer cost savings) or average avoided cost of energy (IOU cost savings).

Distribution loss factor: This input accounts for the losses from the secondary meter to the distribution facilities and was used to calculate IOU savings from the consumer savings. Distribution loss factors for the three utilities were obtained from the 2022 E3 ACC documentation and are presented in Table 24 below.[30] The loss factor for PG&E was calculated as the average across the county/section-level loss factors provided.

Table 24: Distribution Loss Factors for IOUs

IOU	Distribution Loss Factor
SDG&E	1.04%
PG&E	1.02%
SCE	1.02%

Residential electric rate: For both SASH 1.0 and SASH 2.0, the post-installation residential electric rate for each IOU was obtained through Evergreen's billing analysis. We used a regression model to estimate first year kWh savings post-installation for program participants, and another regression to estimate the first-year post-installation participant cost savings. The resulting ratio is the effective residential electric rate for participants in the year after participation, shown in Table 25 below.

[29] A 1.25 percent per year degradation rate was also used by Navigant in their 2011-2013 assessment, https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/9323-navigant-csi-sash-mash-impact-and-cost-benefit-analysis-2011-2013.pdf

[30] 2022 ACC Documentation v1b updated.pdf, located at: https://e3.sharefile.com/share/view/s3fdd4ff8b9db4e95904726427ae54e81/fo1ed759-f5d6-4904-8047-9aa67a677f9a

Table 25: Post-Installation Residential Electric Rates for SASH Participants

IOU	Cost per kWh, SASH 1.0	Cost per kWh, SASH 2.0
SDG&E	$0.17	$0.22
PG&E	$0.13	$0.18
SCE	$0.24	$0.22

Lifetime: As is standard in cost-benefit tests, the present value of the benefits was calculated across the lifetime of the technology. A lifetime value of 20 years was used, which is consistent with the value used by Guidehouse (formerly Navigant) in their 2011-2013 impact and cost-benefit analysis of the SASH program.[31]

Discount rates: Several discount rates were used across utilities and cost-benefit tests. For the TRC and RIM tests for SASH 1.0, the discount rates were taken from Navigant's 2011-2013 analysis, and reflect the IOUs' weighted average cost of capital. For the TRC and RIM tests for SASH 2.0, discount rates were based on updated 2020 values for the IOUs' weighted average cost of capital, as listed in CPUC decision 19-12-056.[32] For the SCT for SASH 1.0 and 2.0, a societal discount rate of 3 percent was used across all utilities.[33] Discount rates are presented in Table 26.

Table 26: Discount Rates used in CE Tests

Program	IOU	TRC and RIM	SCT
SASH 1.0	SDG&E	6.80%	3%
	PG&E	6.93%	3%
	SCE	6.87%	3%
SASH 2.0	SDG&E	7.55%	3%
	PG&E	7.81%	3%
	SCE	7.68%	3%

[31] https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/9323-navigant-csi-sash-mash-impact-and-cost-benefit-analysis-2011-2013.pdf

[32] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M322/K633/322633896.PDF

[33] This is based on CPUC decision 19-05-019 in the Integrated Distributed Energy Resources (IDER) proceeding, which mandated the use of a "social discount rate" of 3 percent. This was noted in E3's SCT Impact Evaluation, https://www.ethree.com/wp-content/uploads/2022/01/CPUC-SCT-Report-FINAL.pdf

Consumer Price Index (CPI) Calculator adjustment: To compare cost-benefit ratios across SASH 1.0 and 2.0, the present value of the benefits for SASH 1.0 was adjusted to 2020 dollars. This is because a 2012 discount rate was applied to the benefits calculation for SASH 1.0, whereas a 2020 discount rate was applied to the benefits calculation for SASH 2.0. The Bureau of Labor Statistics' CPI Inflation Calculator[34] was used to determine the appropriate inflation rate to apply to the sum of benefits in all SASH 1.0 cost-benefit tests.

1.7 Cost Analysis

As part of the evaluation, Evergreen conducted a cost analysis for the SASH program for the program years 2019 – 2021. We gathered, summarized, and reported on program costs by category (e.g., program administration, marketing, and outreach), compared forecasted versus actual spending, and assessed any underutilization of program funding.

Evergreen used GRID-provided data, an export from the California Distributed Generation Statistics (CaliforniaDGStats) website, and budget allocations from the Program Handbook to consider projected budget versus actual spending for the SASH program.[35] To determine yearly budget projections by utility and program function (administration, ME&O, evaluation, and incentives), we divided the allotted annual budget of $10M by the budget allocations from the handbook, as shown in Table 27 and Table 28 below.

Table 27: SASH Budget Allocation by IOU

IOU	Budget %
SDG&E	10.3%
PG&E	43.7%
SCE	46.0%

Table 28: SASH Budget Allocation by Program Function

Program Function	Budget %
Administration	10%
ME&O	4%
Evaluation	1%
Incentives	85%

[34] https://www.bls.gov/data/inflation_calculator.htm

[35] https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/csi-progress-reports/q3q4-2021-sash-semiannual-report--212022-final.pdf

We then used several datasets to obtain values for actual spending. GRID provided administrative and ME&O cost data aggregated across IOUs, so Evergreen calculated actuals by IOU based on budget allocations. GRID provided an additional "Direct Expense" field alongside administrative and ME&O costs, and this was also divided by utility budget allocation and included in the sum of total spending. Incentive values by IOU were obtained from the CaliforniaDGStats website, where GRID is required to report on a weekly basis. Filters were applied to pull incentive values for PV systems installed for SASH through 2021.[36] For evaluation costs, which make up 1 percent of the overall budget, Evergreen assumed that costs were equal to budget projections because cost data are not yet available.

[36] The "First Completed Date" field was filtered to exclude 2022 but include blanks. The "Current Application Status" field was left unfiltered and thus included "Completed," "Confirmed Reservation," "Incentive Claim Request Review," and "Reservation Request Review" statuses.

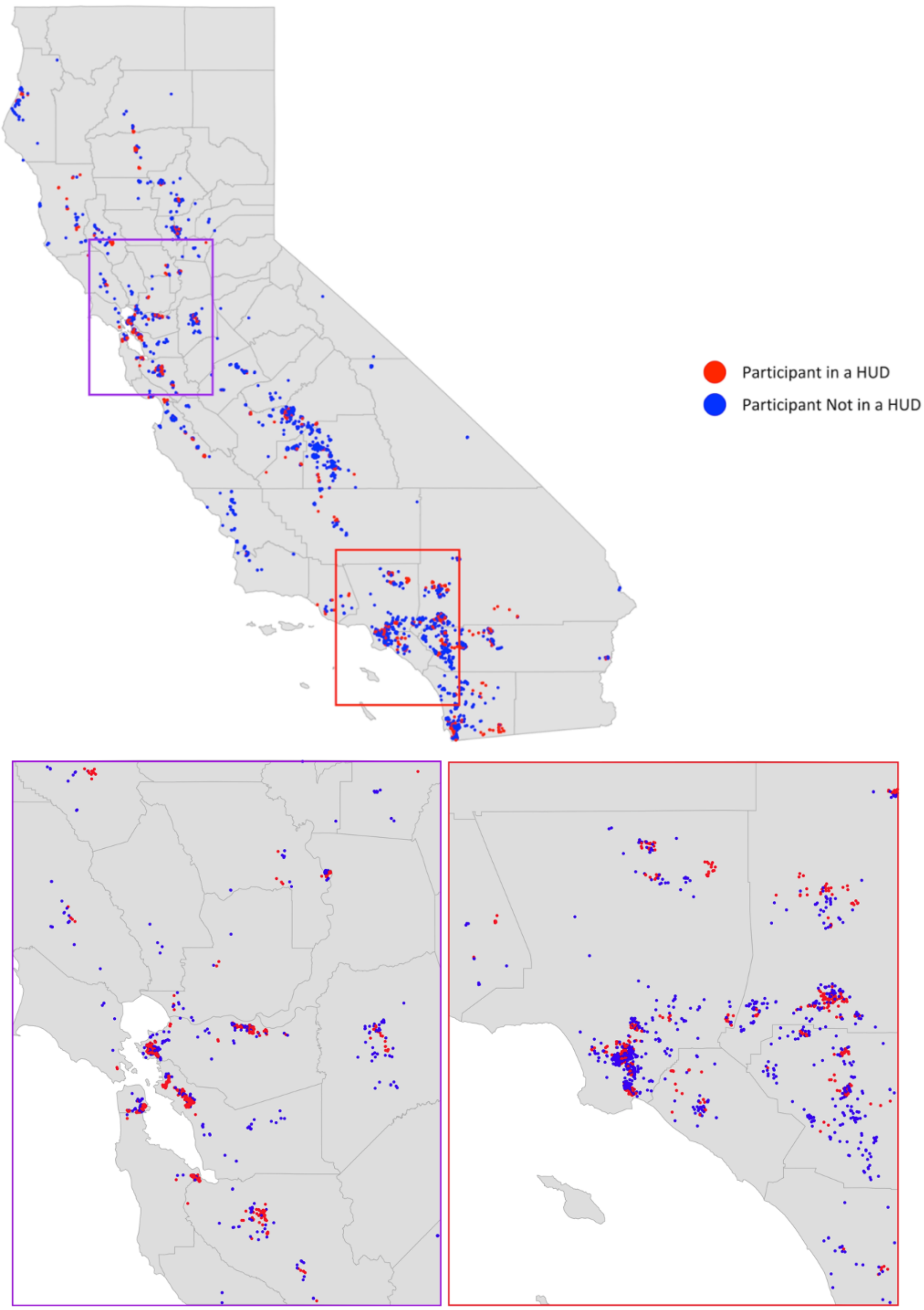
Appendix B: Study Findings by Metric

Category	Metric	Section in Report
Program Marketing	Percent of customers aware of various marketing channels	4.4
	Customer opinions on clarity of marketing materials	4.4
Customer Participation	The program's geographic coverage across the state	4.5
	Number and location of eligible customers and enrolled customers	4.3, 4.5
	Number of eligible non-participants that the PA reached out to but did not recruit	4.5
	Total population estimates of eligible customers by different metrics	4.3
	Number and location of eligible customers not served	4.3
	Number of eligible non-participants that already have solar	4.3
	Number of installations completed and pending	4.1
	Overall participation levels in relation to customer segment size	4.3
	Number of eligible customers who have successfully enrolled in CARE/FERA in the process of signing up for the program	4.5
	Other clean energy programs that customers have participated in along with enrolling in the program	4.5
	Customers satisfaction with the program	4.5
	PA performance from perspective of participants	4.5
	Effectiveness of each program in addressing specific barriers to solar adoption facing low-income customers	4.5
	Perceptions of non-participants/exploration of program participation barriers among qualified customers	4.5
PV System Performance	PV system performance, degradation - expected v metered performance	4.7
	Average system costs by equipment, installation, and other customer acquisition costs	4.2

Category	Metric	Section in Report
Customer Bill Impacts	Monthly bill reduction outcomes from program participants	4.8
	Changes in post-participation energy use patterns	4.8
Environmental Benefits	Program PV installation GHG and other emission impacts	4.10
	Participating and non-participating customer understanding and perception of the program's environmental and social benefits	4.10
Workforce Development and Job Training	Number of leveraged job training programs	4.11
	Number of local hires linked to the program	4.11
	Number of trainees and job outcomes	4.11

Appendix C: Participant Map

Figure 10: All SASH Participants



Appendix D: In-Depth Interview Guides

This appendix contains all in-depth interview guides used for this evaluation. Guides were approved by the CPUC prior to fielding. Most interviews occurred via online video call, but some were in person. Note that these interview guides were used for both the SASH and DAC-SASH evaluations and may include questions directly towards DAC-SASH. This report only covers findings from SASH, however.

Guides included below are:

- GRID Alternatives Staff
- IOU Staff
- ME&O Staff
- TPO Staff
- Tribal Liaison

1.1 GRID In-Depth Interview Guides

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
Intro/Context	1	Can you tell me a bit about yourself and your role at GRID?	Can you tell me a bit about yourself and your role at GRID?
Intro/Context	1.1	*Probe* on how long they have been at GRID.	*Probe* on how long they have been at GRID.
Intro/Context	2	How have you been involved in both the SASH and DAC-SASH programs thus far?	How have you been involved in both the SASH and DAC-SASH programs thus far?
Intro/Context	2.1	*Probe as needed* on how that might have changed over the lifetime of the SASH program.	*Probe as needed* on how that might have changed over the lifetime of the SASH program.
Program Admin	4	*I would like to get a snapshot of the current progress of the DAC-SASH program.*	*I would like to get a snapshot of the current progress of the DAC-SASH program for your specific field office.*
Program Admin	4.1	Looking at your most recent semi-annual report, it looks like	Can you tell me a bit about DAC-SASH pending commitments,

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
		you have roughly 1,100 projects installed and 270 applications in process. How does this line up with your internal expectations for applications and installations?	reservations, and expected demand over the next year?
Program Admin	4.2	*Probe:* is this slower than you would prefer? Faster? As expected?	*Probe:* is this slower than you would prefer? Faster? As expected?
Program Admin	4.3	*Probe:* how does this compare to the progress of the SASH program early on in its lifecycle?	*Probe:* how does this compare to the progress of the SASH program early on in its lifecycle?
Program Admin	5	For SASH specifically, the program implementation plan we reviewed was from back in 2010. At a high level, can you describe how GRID's approach to program administration evolved from that point to now?	If contact also worked on SASH: Can you describe how the DAC-SASH program differs from the work you did on SASH?
Program Admin	5.1	*Probe* on learnings from SASH that influenced DAC-SASH program implementation.	*Probe* on learnings from SASH that influenced DAC-SASH program implementation.
Program Admin	6	How does the customer's experience change if they have a third-party owned system, if at all?	How does the customer's experience change if they have a third-party owned system, if at all?
Program Admin	6.1	*Follow up:* Do you notice one works better for certain customers than others?	*Follow up:* Do you notice one works better for certain customers than others?
			How much GRID admin time is spent on identifying and facilitating the relationship with TPOs? [looking for a monthly figure of dollars and hours]

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
Program Admin	7	I'm wondering how the program differs for certain populations such as new construction vs. retrofit, or for projects on federally recognized tribal lands.	I'm wondering how the programs differs for certain populations such as new construction vs. retrofit, or for projects on federally recognized tribal lands.
Program Admin	8	Has GRID done any forecasting of how you expect demand for DAC-SASH projects to projects over the coming years?	Has GRID done any forecasting of how you expect demand for DAC-SASH projects to projects over the coming years in this region?
Program Admin	8.1	*Follow up [if forecast]:* What trends does your team anticipate in program demand?	*Follow up [if forecast]:* What trends does your team anticipate in program demand?
Program Admin	8.2	*Probe as needed:* Do you anticipate any challenges in meeting program demand?	*Probe as needed:* Do you anticipate any challenges in meeting program demand?
Program Admin	9	Does GRID have targets for installations by geographies/specific DACs?	What specific targets has GRID set for DAC-SASH in this region? On what timeline?
Program Admin	10	What is the typical timeline from application to installation?	What is the typical timeline from application to installation?
Program Admin	10.1	*Probe* on how often project timelines exceed one year from application, what causes those delays, and how often projects are not completed because they exceed the maximum timeline.	*Probe* on how often project timelines exceed one year from application, what causes those delays, and how often projects are not completed because they exceed the maximum timeline.
Program Admin	11	Can you walk me through the process that occurs between when an application is approved and the installation of the project? What steps occur during the reservation stage? What are GRID's responsibilities at that	Can you walk me through the process that occurs between when an application is approved and the installation of the project? What steps occur during the reservation stage? What are GRID's responsibilities at that time, and

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
		time, and what are the expectations of the customer?	what are the expectations of the customer?
Program Admin	12	*Now I would like to think a bit through budgetary considerations.*	*Now I would like to think a bit through budgetary considerations.*
Program Admin	12.1	Are you in charge of/have a good sense of budgeting and spending for the SASH and DAC-SASH programs? Is this done at the statewide level or at the regional office level?	If budgets are handled regionally: Are you in charge of/have a good sense of budgeting and spending for the SASH and DAC-SASH programs?
Program Admin	13	Do you see areas of program administration where there is more budget is allocated than spent?	If budgets are handled regionally: Do you see areas of program administration where there is more budget is allocated than spent?
Program Admin	13.1	*If yes:* What areas are those? Do you anticipate that trend to continue?	*If yes:* What areas are those? Do you anticipate that trend to continue?
Program Admin	13.2	*If yes:* What do you think accounts for the gap between funding and spending?	*If yes:* What do you think accounts for the gap between funding and spending?
Program Admin	13.3	*Probe as needed:* Are there areas of program administration where you think that more budget is needed?	*Probe as needed:* Are there areas of program administration where you think that more budget is needed?
			How much administrator time is going towards identifying sources to fill incentive gaps needed to either cover the cost of installations or to cover the cost of repairs needed before installation? [Ideally we get in monthy hours or dollars- could be per project]

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
Program Marketing	14	*Next I have a few questions about the marketing for the SASH and DAC-SASH programs.*	*Next I have a few questions about the marketing for the SASH and DAC-SASH programs.*
Program Marketing	15	Thinking about the data you receive, how is it processed and prepared for outreach and marketing?	Do you do anything to process, filter or prioritize the data you receive for leads?
Program Marketing	16	Would you say the data sources you have are accurately identifying eligible households? If not, what would help? What is needed to better identify eligible households	Would you say the data sources you have are accurately identifying eligible households? If not, what would help? What is needed to better identify eligible households
Program Marketing	17	How often are contact lists updated or refreshed?	How often are contact lists updated or refreshed?
Program Marketing	18	How is the data we just discussed then used for marketing and outreach?	How is the data we just discussed then used for marketing and outreach?
Program Marketing	19	Based on the materials you provided to us, it looks like mail marketing and local events are major outreach strategies. Can you give me a sense of which outreach strategies are most effective in enrolling customers?	Based on the materials you provided to us, it looks like mail marketing and local events are major outreach strategies. Can you give me a sense of which outreach strategies are most effective in enrolling customers in your region?
Program Marketing	19.1	*Probe:* does this differ by program (SASH v DAC-SASH)? Or by customer profile?	*Probe:* does this differ by program (SASH v DAC-SASH)? Or by customer profile?
Program Marketing	20	How has the leveraging of local community events evolved over the course of the pandemic?	How has the leveraging of local community events evolved over the course of the pandemic?
Program Marketing	22	We talked earlier about third-party ownership. Can you talk me through how leasing	We talked earlier about third-party ownership. Can you talk me through how leasing arrangements

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
		arrangements with Sunrun are promoted to customers?	with Sunrun are promoted to customers?
Customer Participation	23	*Now I have a few questions about customer participation and experience.*	*Now I have a few questions about customer participation and experience.*
Customer Participation	23.1	Do you find that certain customer segments are more or less likely to participate relative to the full population of eligible customers? [probe on differences between programs]	Do you find that certain customer segments are more or less likely to participate relative to the full population of eligible customers? [probe on differences between programs]
Customer Participation	23.2	*If yes, probe:* which segments are those? Why do you think they are more/less likely to participate?	*If yes, probe:* which segments are those? Why do you think they are more/less likely to participate?
Customer Participation	23.3	*Probe* on geographic differences, demographics and what they based these observations on (anecdotes v. reviewing outreach data by demog data)	*Probe* on geographic differences, demographics and what they based these observations on (anecdotes v. reviewing outreach data by demog data)
Customer Participation	24	Do you find that there are segments of customers who are harder to reach and engage? If so, why?	Do you find that there are segments of customers who are harder to reach and engage? If so, why?
Customer Participation	25	For qualified customers who are harder to reach or convert, what barriers stand in the way of their participating?	For qualified customers who are harder to reach or convert, what barriers stand in the way of their participating?
Customer Participation	25.1	*Probe on* steps GRID takes to overcome those barriers, or resources needed to address them.	*Probe on* steps GRID takes to overcome those barriers, or resources needed to address them.
Customer Participation	26	Where customers were interested but ultimately ended	Where customers were interested but ultimately ended up being

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
		up being unable to participate, what barriers did they face to participating?	unable to participate, what barriers did they face to participating?
Customer Participation	26.5	Can you differentiate between what barriers you find out early on, when getting leads, and which barriers you run in to later in the process? We're curious which reasons are discovered on site, or before visiting, or at first outreach? At first glance for DAC-SASH it looks like most of the times things are identified at the "approve-outreach stage" but there are a few that are sometimes realized during the construction phase (not owner occupied, rented, HOA issues, zoning issues, code issues). Do you know why these sometimes aren't identified earlier? Are there any common hold ups that you think different data could help you screen for before doing outreach?	Can you differentiate between what barriers you find out early on, when getting leads, and which barriers you run in to later in the process? We're curious which reasons are discovered on site, or before visiting, or at first outreach? At first glance for DAC-SASH it looks like most of the times things are identified at the "approve-outreach stage" but there are a few that are sometimes realized during the construction phase (not owner occupied, rented, HOA issues, zoning issues, code issues). Do you know why these sometimes aren't identified earlier? Are there any common hold ups that you think different data could help you screen for before doing outreach?
			do you use a checklist or some other questionnaire when verifying eligibiltiy before going on site?
Customer Participation	26.1	A lot of different barriers were listed for people who were still active. Which ones are their workarounds for and which mean the project can't move forward? (if needed pull up list from Teams of different barriers)	A lot of different barriers were listed for people who were still active. Which ones are their workarounds for and which mean the project can't move forward? (if needed pull up list from Teams of different barriers) Probe on steps

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
		Probe on steps GRID takes to overcome those barriers, or resources needed to address them.	GRID takes to overcome those barriers, or resources needed to address them.
Customer Participation	27	For customers who decide not to participate, why do you think they are not interested in the program? We saw that for DAC-SASH, 40% of active customers became uninterested during the construction visit and not before. Why do you think that is?	For customers who decide not to participate, why do you think they are not interested in the program? We saw that for DAC-SASH, 40% of active customers became uninterested during the construction visit and not before. Why do you think that is?
			It sounds like you're using an electronic application now. How much time do you think you're saving per site by using an electronic application? Do you have any examples of that? How much time do you think the customers save? [Probe to get examples to substantiate]
Customer Participation	28	Can you give me a snapshot of how many customers typically enrolled in CARE, FERA, or ESA during the application process for SASH and DAC-SASH? At what point does this come up with customers?	Can you give me a snapshot of how many customers typically enrolled in CARE, FERA, or ESA during the application process for SASH and DAC-SASH? At what point does this come up with customers?
Customer Participation	29	What about other program enrollments? Do you have any insights into, say, medical baseline customers or SJV DAC pilot participants who are engaging with SASH or DAC-SASH as well?	What about other program enrollments? Do you have any insights into, say, medical baseline customers or SJV DAC pilot participants who are engaging with SASH or DAC-SASH as well?

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
Customer Participation	30	We have gotten some information about how you collect customer feedback and complaints. Can you talk about some common feedback, positive or negative, you receive from customers?	We have gotten some information about how you collect customer feedback and complaints. Can you talk about some common feedback, positive or negative, you receive from customers?
Customer Participation	31	Though complaints seem rare, are there common complaints you receive from customers? How do you work to address those?	Though complaints seem rare, are there common complaints you receive from customers? How do you work to address those?
Customer Participation	32	*If always an isolated case:* can you briefly walk me through those specific complaints you received?	*If always an isolated case:* can you briefly walk me through those specific complaints you received?
Customer Participation	33	I'm aware that GRID provides participants education about solar and energy efficiency training. Can you walk me through what this usually looks like?	I'm aware that GRID provides participants education about solar and energy efficiency training. Can you walk me through what this usually looks like?
Customer Participation	34	On a scale of 1 to 3 (1= not, 2= somewhat, 3=very), how satisfied do you think enrolled customers are with the program? Why? What positive feedback do you hear from customers about the program?	On a scale of 1 to 3 (1= not, 2= somewhat, 3=very), how satisfied do you think enrolled customers are with the program? Why? What positive feedback do you hear from customers about the program?
PV System Performance	35	*Moving on, I'd like to ask some questions regarding solar system performance.*	*Moving on, I'd like to ask some questions regarding solar system performance.*
PV System Performance	35.1	I am aware that DAC-SASH projects can range from capacities of 1-5 kW and meet	I am aware that DAC-SASH projects can range from capacities of 1-5 kW and meet certain performance

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
		certain performance standards. Can you talk me through what those standards are, and how often they are not met?	standards. Can you talk me through what those standards are, and how often they are not met?
PV System Performance	35.2	*Probe on* how this is similar to or different from SASH	*Probe on* how this is similar to or different from SASH
PV System Performance	36	What is the process for determining solar system performance?	What is the process for determining solar system performance?
PV System Performance	36.05	What happens if a customer system stops working performing as expected after installation?	What happens if a customer system stops working performing as expected after installation?
PV System Performance	36.1	*Follow up:* I am aware that inspections occur for one in twelve installations. How often do inspectors find issues with solar systems? What kinds of issues do they encounter? How are these reported? Is this done evenly across the different geographic offices?	*Follow up:* I am aware that inspections occur for one in twelve installations. How often do inspectors find issues with solar systems? What kinds of issues do they encounter? How are these reported?
PV System Performance	36.2	Beyond what you mentioned when we discussed inspections, have you had any challenges ensuring the quality of PV systems?	Beyond what you mentioned when we discussed inspections, have you had any challenges ensuring the quality of PV systems?
PV System Performance	37	How often, if ever, do customers add on to their solar system with onsite storage?	How often, if ever, do customers add on to their solar system with onsite storage?
PV System Performance	37.1	*Probe on* whether GRID ever pitches onsite storage to customers	*Probe on* whether GRID ever pitches onsite storage to customers
		How is equipment selected for a customers? How does cost play	How is equipment selected for a customers? How does cost play in

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
		in to that? *(looking to understand price setting and total project costs, areas for program improvement)*	to that? *(looking to understand price setting and total project costs, areas for program improvement)*
		Are costs usually consistent across projects? If not, what would make a project more or less expensive?	Are costs usually consistent across projects? If not, what would make a project more or less expensive?
		What happens if a roof needs repair? Is there other work that comes up that needs to be done? How are those costs covered?	What happens if a roof needs repair? Is there other work that comes up that needs to be done? How are those costs covered?
PV System Performance	38	What typical funding sources does GRID provide in cases where the cost exceeds the incentive? How often is this extra gap funding needed? Are there specific types of customers that need this more than others?	What typical funding sources does GRID provide in cases where the cost exceeds the incentive? How often is this extra gap funding needed? Are there specific types of customers that need this more than others?
Environmental Benefits	40	How important do you think the environmental benefits of renewables are to the customers who enroll? How do you think that compares to the broader population of eligible customers?	How important do you think the environmental benefits of renewables are to the customers who enroll? How do you think that compares to the broader population of eligible customers?
Environmental Benefits	41	Does GRID educate customers on environmental benefits at any point in the process? What do you share with customers?	Does GRID educate customers on environmental benefits at any point in the process? What do you share with customers?
Environmental Benefits	42	Do customers typically have an understanding of what kinds of environmental or social benefits come out of renewable energy? If so, what is that understanding?	Do customers typically have an understanding of what kinds of environmental or social benefits come out of renewable energy? If so, what is that understanding?

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
Workforce Development and Job Training	43	*I just have a few questions about workforce development and job training.*	*I just have a few questions about workforce development and job training.*
Workforce Development and Job Training	44	How do you design your workforce development and job training process? Do you leverage any other programs? What data do you use to determine how to design these programs?	How do you design your workforce development and job training process? Do you leverage any other programs? What data do you use to determine how to design these programs?
Workforce Development and Job Training	45	And as far as workforce development, how do you typically market your training programs? What marketing and outreach strategies have been most effective?	And as far as workforce development, how do you typically market your training programs? What marketing and outreach strategies have been most effective?
Workforce Development and Job Training	46	Can you talk me through the differences between the major job programs GRID offers (Solar corps, IBT, team leaders, etc.)? Is the same curriculum used for each? Is that curriculum the basics training?	Can you talk me through the differences between the major job programs GRID offers (Solar corps, IBT, team leaders, etc.)? Is the same curriculum used for each? Is that curriculum the basics training?
Workforce Development and Job Training	46.1	*If different curriculum:* how does the content of the training courses differ?	*If different curriculum:* how does the content of the training courses differ?
Workforce Development and Job Training	47	I'm interested in hearing more about the sub-contractor program. Do the trainees for that program participate in any GRID curricula? Or are they separate from GRID except for working on a GRID project?	I'm interested in hearing more about the sub-contractor program. Do the trainees for that program participate in any GRID curricula? Or are they separate from GRID except for working on a GRID project?

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
Workforce Development and Job Training	48	Does the workforce development/job training efforts roughly align for SASH and DAC-SASH? If not, how do they differ?	Does the workforce development/job training efforts roughly align for SASH and DAC-SASH? If not, how do they differ?
Workforce Development and Job Training	48.1	*Probe on* how workforce dev evolved for SASH.	*Probe on* how workforce dev evolved for SASH.
Workforce Development and Job Training	49	How well do students generally perform in GRID's training courses? (i.e., assessments and learning outcomes) What data do you collect that tracks training performance?	How well do students generally perform in GRID's training courses? (i.e., assessments and learning outcomes) What data do you collect that tracks training performance?
Workforce Development and Job Training	50	Do you solicit feedback on your courses? What kind of feedback, positive or negative, does GRID commonly receive?	Do you solicit feedback on your courses? What kind of feedback, positive or negative, does GRID commonly receive?
Workforce Development and Job Training	51	Do job trainees work both on DAC-SASH and SASH projects? Or only one v. another?	Do job trainees work both on DAC-SASH and SASH projects? Or only one v. another?
Workforce Development and Job Training	52	How would you characterize the current range of approaches that GRID uses for solar project installation as far as which parties complete the installation work (such as the subcontractor partner program)? How do these approaches differ from an "open contractor" model?	How would you characterize the current range of approaches that GRID uses for solar project installation as far as which parties complete the installation work (such as the subcontractor partner program)? How do these approaches differ from an "open contractor" model?
Closing	53	*Wrapping up I want to take a step back and think more about the programs overall.*	*Wrapping up I want to take a step back and think more about the programs overall.*

Category	Order	Question for Main GRID Contact	Question for Regional GRID Contact
Closing	53.1	Taking a broader view, the goal of the DAC-SASH program is to reduce barriers to renewable energy for DAC residents. In your view, how well is the program as designed meeting this goal? Where do you see room for growth or missed opportunities?	Taking a broader view, the goal of the DAC-SASH program is to reduce barriers to renewable energy for DAC residents. In your view, how well is the program as designed meeting this goal? Where do you see room for growth or missed opportunities?
Closing	54	Do you have any other program feedback you would like to share for either DAC-SASH or SASH?	Do you have any other program feedback you would like to share for either DAC-SASH or SASH?

1.2 IOU In-Depth Interview Guide

#	Question (note to interviewer to ask about DAC SASH and SASH)
1	Can you introduce yourself(f/ves) and your role(s) at [IOU]?
2	At a high level, can you give me a sense about what role(s) [IOU] plays in the administration of the SASH and DAC-SASH programs? I have questions about enrollment, customer feedback, interconnection, and incentives.
3	Did we miss any other ways in which [IOU] is involved with SASH and DAC-SASH?
4	What type of coordination do you do with GRID specifically on DAC-SASH or SASH and what you do independently of GRID?
	I want to talk first about data sharing with GRID.
5	We understand that the CPUC directed the IOUs to provide eligible customer data to GRID. Can you share some detail about how you determined which customers' data to share with GRID and what information was shared?
	Probe on if they were able to provide the data and what limitations their were. Were they able to identify who owned and who was in SF, if not what sources did they use? Are there any learnings from other programs like ESA for finding eligible customers (low income, owners, etc.)?
6	What was the process by which that data was delivered to GRID?

#	Question (note to interviewer to ask about DAC SASH and SASH)
7	Were there any challenges in getting data prepped and ready for GRID? How frequently will this happen in the future?
	We've heard that some utilities work to co-market the program. I'd like to discuss that next.
8	First can you tell me about any co-marketing you've done and how that's gone? How do you help GRID with marketing and then what programs do you get referrals from GRID for customers that they interact with?
9	Assuming you get enrollments for CARE/FERA from GRID's outreach to customers, can you give me a snapshot of how many customers typically enrolled in CARE or FERA during the application process for SASH and DAC-SASH? This may be available in submitted customer data so just an estimate will do.
10	What about ESA, SJV, or other energy programs? Can you tell me how many referrals you've seen from GRID? This may be available in submitted customer data so just an estimate will do.
	Probe: Have you come across any barriers in collecting and processing referral data? Do you track leads after they get handed off to other programs?
11	Do you find that certain customer segments are more or less likely to participate in SASH / DAC-SASH relative to the full population of eligible customers? This may be something GRID has more insight into but we wanted to check with you as well.
	If yes, probe: which segments are those? Why do you think they are more/less likely to participate?
	Probe on geographic differences, demographics
12	*If questions about budget are relevant to IOUs ask:* Are you involved at all in overseeing the program budgets? If not, who should we talk to? Do you have any thoughts on the current budget allocations for the SASH or DAC-SASH programs for the IOUs?
	Probe: How do allocations and expenditures compare. Do they seem to match the program accomplishments? [Evergreen to review budget and expenditures before interview]
13	Are you aware of any feedback that [IOU] has received from customers regarding their participation in the programs (SASH and DAC-SASH), whether positive or negative?
14	On a scale of 1 to 3 (1= not, 2= somewhat, 3=very), how satisfied do you think enrolled customers are with the program? Why?

#	Question (note to interviewer to ask about DAC SASH and SASH)
15	Taking a broader view, the goal of the DAC-SASH program is to reduce barriers to renewable energy for DAC residents. In your view, how well is the program as designed meeting this goal? What are the biggest barriers for this population (probe on incentive amount and participation drivers)? Where do you see room for growth or missed opportunities?
16	Do you think the program as designed is reaching all the customers it is intended to serve? Probe on barriers faced with M&O, identifying customers, and customer conversion.
	Finally, I would like to finish up with some questions about how you think the DAC-SASH program can improve moving forward.
17	Do you have any thoughts on potential changes to program design regarding system installation? For example, an open contractor model? What are the pros and cons of an open contractor model in your opinion?
	Do you think that there are additional ways that the IOUs can support and facilitate the interconnection process?
18	Do you have any other thoughts on program administration and room for process improvement either at GRID, the IOUs? What additional support do you think is needed from the IOUs, if any?
19	Do you have any other program feedback you would like to share for either DAC-SASH or SASH?

1.3 ME&O In-Depth Interview Guide

#	Question
1	Can you tell me a bit about yourself and your role at [org]?
	Probe on how long they have been at [org].
2	In what way does [org] support GRID's work for DAC-SASH? How do you and GRID work together to determine what each organizations roles, rules and processes will be? How do you both decide which marketing strategies to use?
3	How long have you been working with GRID on DAC-SASH? How did you get started on the program?

#	Question
4	In which areas or with what populations do you do marketing and outreach work for GRID? What type of marketing and outreach do you do?
	Now I have a few questions about the customers you are engaging with for the program
	When you talk about the program, do you call it "DAC-SASH" or "Energy for All." Do you mention GRID or the CPUC or a utility? What do customers recognize?
5	How do you identify customers to market the program to? Does GRID provide you referrals to eligible customers in your area?
	Probe: How useful is the data / info you are provided with? What is working about this process and what could be improved? (how hard is it to locate eligible homeowners) How much time do you spend correcting the data if any?
	Probe for DAC-SASH: How easy or hard is it to work with the geographic boundaries? Do you think as designed that DAC-SASH is meeting its intent to serve DAC customers? If not, how do you think it could be better met?
	Probe for DAC-SASH: How easy or hard is it to work with the tribal regions? Do you think as designed that DAC-SASH is meeting its intent to serve tribal customers? If not, how do you think it could be better met?
6	Do you find that particular groups of people tend to show more interest or are more likely to enroll in DAC-SASH??
	If yes: Which groups are more receptive? Why do you think they show more interest?
7	Do you find that groups of people show more hesitance or skepticism toward the program?
	Probe on differences by geography, demographics.
	Probe on reasons for skepticism/hesitance if present.
8	*[If people are hesitant]* How much of the time would you say you are able to help overcome that hesitance? What strategies, if any, work best to gain customer trust?
9	Do you assist with their application, or does GRID primarily do that work? Can you walk me through how the application process goes for the customer after you perform marketing and outreach?
10	*[If assist with application]* What are some common barriers and issues, if any, that customers experience during the application process? *[Probe on incentive amount, eligibility requirements]*

#	Question
10a	*[If barriers present]* What steps, if any, are you or GRID able to take to help alleviate these barriers?
10b	*[If assist with application]* Are there specific aspects of the application or application process that prove to be confusing for customers?
10c	*[If assist with application]* Do you assist in enrolling customers in other programs besides DAC-SASH?
10d	*If yes:* which programs are those? What share of customers do you enroll in each of those programs?
10e	*Probe on* SJV pilots, CARE, FERA, Medical Baseline, and NEM.
11	Do you hear from the people you reached out to about DAC-SASH as they progress through the program?
12	What type of feedback, if any, do you tend to get from customers as they go through the process to get solar installed?
13	On a scale of 1 to 3 (1= not at all, 2=somewhat, 3=very), how satisfied do you think people are who engage with DAC-SASH?
14	Do you assist at all in marketing GRID's workforce development and/or training programs?
14a	*If yes:* How do you provide support for those programs?
14b	*If yes:* How do you identify people to market the workforce programs to?
14c	*If yes:* What level of interest do you receive when you market these programs?
	I'd like to finish up by getting some feedback from you about the program.
15	Do you have any other feedback on the program you would like to share? What changes might help increase participation and make M&O easier? [Probe on relationship with GRID, M&O strategies used, data availability and usability, plication process, workforce programs]

1.4 TPO In-Depth Interview Guide

#	Question
	Note: Evergreen will review data before each TPO call to understand the flow of installs over time. We will also review the company's website and will look at the role and

#	Question
	experience of the interviewee. We are targeting employees that work directly with GRID on setting up the partnership.
1	Can you tell me a bit about yourself and your role at [TPO name]?
2	When did [TPO] start working with GRID? How have the number of projects you've done through SASH and DAC-SASH changed over the years? [Probe on impacts of federal tax incentive changes, if percent of projects that are TPO vs. not mirror their non SASH DAC-SASH business, if income/region is a factor]
3	Can you tell me a bit about when [TPO] gets involved, and how you work with GRID to complete projects? Probe on timeline, use of trainees, who does the installations. Ask about: -Contracting the ownership models (covering consumer protection) -Budget negotiations - are they covering any of the costs with outside funds? -System arranged and installed using volunteers from GRID and trainees
4	Over the years you've worked with GRID, how has your process for installing solar for these programs changed? When would you work with GRID HQ vs a regional office? How has your role changed as TPO has become leveraged more and more often compared to ownership models? Does this mirror the trend in your broader business as well?
	Do you know of any customers who have been unable to complete their projects? Yes/no
5	[If yes] Does [TPO] get involved when customers are unable to complete projects due to issues with their home such as roof or electrical upgrades? If so, how?
6	What are the pros and cons to customers for using a TPO agreement vs an ownership model? [Probe on from their perspective vs. customer perspective]
7	I'd like to get some information about average costs in terms of equipment, installation, or any other costs. If you could share how these differ based on TPO model. Do customers have to pay anything out of pocket? If not, who pays?
8	How many of the completed installations come from [TPO] outreach or leads vs. outreach from GRID? Does how you get leads differ in DACs vs. non-DACs? [Probe on quality of leads from GRID]
9	What are the barriers that customers face in participating with this program? What are the main drivers? Does this differ for DACs or other types of customer/home structure characteristics? [Probe on incentives, work that has to be done before installation]
10	Has the flow of projects been about the same, faster, or slower than you expected? Why do you think that is?

#	Question
11	When it comes time for installation - what options do you have for staffing your projects? Can you tell me a bit about contractor requirements from GRID and how working with you fits into the process of the trainee's training? [Who pays them, how much, do they like this model]
12	What has your experience been with workers that come through GRID's training or volunteering programs?
13	What do you or your staff tell customers about the program's environmental benefits, if anything? When do you do this and how is it received by customers? Is this different for customers you work with through GRID and this program vs. outside of this program?
14	Do you hear from customers after installation? What have you heard from customers regarding their satisfaction or dissatisfaction?
15	Do you have any other feedback on the program you would like to share? What changes might help increase participation and installation easier? [Probe on trainings, working with GRID, customer interactions, incentive structure]

1.5 Tribal Liaison In-Depth Interview Guide

#	Question
1	Can you tell me a bit about yourself and your role at the CPUC? Can you tell me a bit about your background before you started working with the CPUC?
2	Can you give me some context about your involvement in the SASH and DAC-SASH programs, from the proceedings stage to implementation?
3	It looks like there are almost 30 completed projects in tribal lands for DAC SASH in Campo and Bishop in addition to the 10 done for SASH. Does this sound right to you? Is this what you were expecting by now or did you think there would be more or less? Why is that?
4	Can you speak to how recruitment and participation of tribal members residing on reservation land is similar or different to that of tribal residents in DACs that are not on reservation lands? Should outreach be varied when approaching tribal communities?
	Are some tribal communities or locations more difficult to serve than others, and if so, why?
5	Do you know if tribal communities are hearing about other programs when they hear about this one (such as CARE, FERA, medical baseline, SJV DAC) when they learn about SASH or DAC SASH? Do you know if they're enrolling in these programs? [Probe to ask if there is already awareness of these programs]

#	Question
6	Are there certain tribal lands that benefit more or less from this program? Are there differences in levels of interest?
	Do you follow installations or have you heard about how installations have gone? If so, what are your impressions about how installations are going? How long does an installation typically take?
7	Do you have a sense about how satisfied tribal members who participated are with the program?
	Probe on potential causes for dissatisfaction (such as application process, etc.)
8	Are you aware of barriers or difficulties that prevent tribal members from completing applications, or signing up for the program in the first place? Do you think these barriers are unique to members of tribal communities? [Probe on barriers related to housing repairs or siting issues.]
9	Have you received any feedback from tribal community members about SASH or DAC-SASH? (probe on incentive amount, etc.)
10	Do you have any thoughts on how this program could better serve tribal communities? [Probe on what would need to be done to serve more or different tribal communities that aren't being reached, and on quality of outreach]
11	Have you heard from any tribal members who are interested in the program but are not federally recognized?
12	Do you have any other feedback you would like to share about SASH or DAC-SASH?

Appendix E: Survey Guides

This appendix contains all survey guides used for this evaluation. Guides were approved by the CPUC prior to fielding. Sections in blue are programming cues and are not shown to the respondent. Note that these survey guides were used for both the SASH and DAC-SASH evaluations and may include questions directly towards DAC-SASH. This report only covers findings from SASH, however, and respondents only saw questions about the program they participated in or were eligible for.

Guides included below are:

- Participant Survey
- Non-Participant Survey
- Trainee Survey

1.1 SASH Participant Survey

Introduction

Thank you for taking the survey on GRID's Energy For All (SASH) Solar Program. Your feedback is vital to us. This survey will take approximately 10-15 minutes to complete, and all information collected is confidential. As a thank you for completing this survey, we will email you a $25 Visa gift card within the next 3 to 4 weeks.

Marketing

1. Before we begin, can you confirm that you installed a solar system on your home's roof through the Energy for All (SASH) program?
    a. Yes
    b. No [Thank and terminate]

2. *First, we'd like to start with some questions about how you learned about the* Energy for All (SASH) program*.* Where have you received information about the Energy for All (SASH) program? Please select all that apply.
    a. From my utility
    b. From the city or county that I live in
    c. From a friend/neighbor and/or family member
    d. From a community organization
    e. From GRID Alternatives
3. Did you receive information in any of the following ways? Please select all that apply.
    a. I got something in the mail
    b. I looked up information online
    c. Someone talked to me about the program at an event
    d. Someone called me on the phone
    e. Someone came to my door to tell me about the program
    f. Through a discussion with a friend/neighbor and/or family member
    g. I heard about it through the TV
    h. Don't recall [exclusive answer] [skip to Q6]

Next, we would like to ask you some questions about how easy or difficult it was for you to understand the program based on the information you received.

4. [if 2=e] How clear would you say the information received from GRID about the program was?
    a. Very clear
    b. Somewhat clear
    c. Neither clear nor unclear
    d. Somewhat unclear
    e. Very unclear
5. [if 2=a] How clear would you say the information received from your utility about the program was?
    a. Very clear
    b. Somewhat clear
    c. Neither clear nor unclear
    d. Somewhat unclear
    e. Very unclear
6. Did you feel like you had the information you needed to make the decision to participate in the program?
    a. Yes
    b. No
    c. Don't know

7. What concerns (if any) did you have as you made the decision to participate in the program?
    a. I didn't have any concerns [if selected, no others can be selected]
    b. The offer seemed too good to be true
    c. I was worried it was a scam
    d. I didn't think I would be eligible
    e. I didn't think I would have time to participate
    f. Other: My concerns were… ____________________________________ [force response if selected]

Customer Participation – Application Process

Next, we'd like to ask you about your experience with the application process for the Energy for All (SASH) program.

8. Are there any topics GRID Alternatives discussed that you're still not sure you understood correctly, or any that you thought you understood, but have been surprised about since installing your solar system?
    a. Yes: _______________
    b. No
    c. Don't know
9. How did you fill out the full application for submission? If someone else filled out the application for you, how did they do it?
    a. Over the phone
    b. Via email and/or DocuSign
    c. Via a paper application by myself
    d. Via a paper application with help from GRID
    e. Don't know
10. [If 9 = a, b, or c] How easy or difficult would you say it was to complete your application for this solar project?
    a. Very easy
    b. Somewhat easy
    c. Neither easy nor difficult
    d. Somewhat difficult
    e. Very difficult
11. [If 10 10= d or e] Which of the following, if any, contributed to the application process being difficult? Please select all that apply.
    a. Providing tax documents for proof of income
    b. Providing proof of homeownership
    c. Providing a recent utility bill

   d. Understanding what the application was asking for
   e. Managing revisions that were needed for my application
   f. Other (please specify): ____________

12. Which energy programs were you already enrolled in ***before*** applying for the Energy for All (SASH) program? Please select all that apply.
   a. California Alternate Rates for Energy (CARE) - a bill discount based on income
   b. Family Electric Rate Assistance (FERA) – reduces electric bills for qualified households
   c. Energy Savings Assistance (ESA) - a program that does weatherization and includes faucet aerators and major appliances
   d. Medical Baseline Rate - a bill discount to help with necessary medical equipment
   e. San Joaquin Valley Energy Project - a program which swaps out propane and wood-burning appliances
   f. Self-Generation Incentive Program (SGIP) offers rebates for installing energy storage technology
   g. Other energy assistance program (please specify): ______________________
   h. None of the above
   i. I'm not sure

13. Which energy programs did you enroll ***in around the same time*** as applying for the Energy for All (SASH) program? Please select all that apply. *[Survey will not ask about answers selected in prior question]*
   a. California Alternate Rates for Energy (CARE) - a bill discount based on income
   b. Family Electric Rate Assistance (FERA)- reduces electric bills for qualified households
   c. Energy Savings Assistance (ESA) - a program that does weatherization and includes faucet aerators and major appliances
   d. Medical Baseline Rate - a bill discount to help with necessary medical equipment
   e. San Joaquin Valley Energy Project - a program which swaps out propane and wood-burning appliances
   f. Self-Generation Incentive Program (SGIP) offers rebates for installing energy storage technology
   g. Other energy assistance program (please specify): ______________________
   h. None of the above
   i. I'm not sure

14. When did you apply for the programs? [each answer from question above]

	Before enrolling in the Energy for All (SASH) program	*During enrollment in the Energy for All (SASH) program*	*After enrollment in the Energy for All (SASH) program*

Selected program #1	
Selected program #2	
Selected program #3	

Financing and Installation

Now, we'd like to learn more about the financing options and installation process for the project.

15. Are you the owner of the solar system, or are you leasing it?
    a. I own the system
    b. The system is leased (owned by a third party like Sunrun)
    c. Not sure
16. [If 15 15= a] Why did you select to own the system instead of lease?
    a. [free text]
17. Did your solar project require any additional things like roof repair, electrical upgrades, or tree trimming?
    a. Yes, there were additional things required
    b. No
    c. I'm not sure
18. [If 17 = a] Did GRID help connect you to funding needed for your project to pay for the additional things (roof repair, etc.)?
    a. Yes, GRID did help connect me to additional funding
    b. No
    c. Not sure
19. If 18= a] What type of additional funding help did GRID provide to make sure you could complete the installation?
    a. [free text]
20. [If 18 = a] How much additional funding did they provide?
    a. Amount in dollars: ____________
    b. Not sure
21. Did you have to pay anything yourself to get the system installed? This may have been on roof repairs, electrical upgrades, etc.
    a. Yes, I did have expenses
    b. No
    c. Don't know
22. [IF 21= a] Please tell us about what you had to pay yourself in order to get the system installed:
    a. How much did you have to pay (in dollars)? [required number]

b. What did you have to pay for? ____________

Next, we want to ask about your overall experience with installation and participation.

23. How important was it to you that the contractors were arranged by GRID (instead of you having to find contractors yourself)?
    a. Extremely important
    b. Very important
    c. Somewhat important
    d. A little important
    e. Not at all important
24. How easy or difficult was it to schedule the installation?
    a. Very easy
    b. A little easy
    c. Neither easy nor difficult
    d. Somewhat difficult
    e. Very difficult
25. Overall, how easy or difficult would you say the installation went for your project?
    a. Very easy
    b. A little easy
    c. Neither easy nor difficult
    d. Somewhat difficult
    e. Very difficult
26. How satisfied or dissatisfied were you with… [grid with scale from Extremely satisfied to Extremely dissatisfied, and Not sure]?
    a. How long it took to complete the solar installation
    b. The professionalism and courteousness of the installers
    c. The overall functioning of your equipment
    d. GRID Staff's ability to address my concerns
27. How did GRID Alternatives describe how the solar installation would affect your electric bill??
    a. GRID Alternatives said my bill would likely decrease.
    b. GRID Alternatives said they could not predict the effects on my bill.
    c. GRID Alternatives said my bill would likely increase.
    d. GRID Alternatives did not describe the effects on my bill.
28. Have you had any issues with the solar system since it was installed?
    a. Yes, there have been issues with the solar system
    b. No
29. [if 28 = a] Can you tell me a bit about the issue(s) you've had? If fixing the issues cost you money, please tell us how much.
    a. Cost of fixing the issue in dollars: [free text]

b. Description of the issues: [free text]

30. Have you done any maintenance for your solar panels?
    a. Yes, maintenance was needed for the solar panels
    b. No
31. [If 29 =a] Can you tell me about the maintenance you had to do and how much it cost if you did it yourself?
    a. Cost of maintenance in dollars: [free text]
    b. Description of the maintenance: [free text]

Customer Bill Impacts

32. Now, please tell us about your electric bills. Since the installation of solar on your rooftop, have your ***monthly electric bills*** gone up, gone down or stayed the same?
    a. Gone up
    b. Gone down
    c. Stayed the same
    d. I don't know
33. [if 32 = a] Have your electric bills gone **up** a little, somewhat, or a great deal?
    a. A little
    b. Somewhat
    c. A great deal
34. [if 32 = b] Have your electric bills gone **down** a little, somewhat, or a great deal?
    a. A little
    b. Somewhat
    c. A great deal
35. Since installing solar, is your household using more electricity, less electricity, or about the same as before?
    a. More energy use
    b. Less energy use
    c. About the same energy use as before
    d. Don't know
36. [If 35 = a] Can you tell me more about what you think caused your electricity usage to go up?
    a. [free text]
37. If 35 = b] Can you tell me more about what you think caused your electricity usage to go down?
    a. [free text]

38. Do you know if you have access to your solar generation data?
    a. Yes
    b. No

c. Don't know

39. [IF 38 = A] Have you ever accessed your solar generation data?
    a. Yes
    b. No
    c. Don't know

Environmental Benefits

Now we want to talk to you about different environmental benefits.

40. The first is greenhouse gas emissions. Greenhouse gases trap heat and make the planet warmer. Greenhouse gases come from burning fossil fuels for electricity, heat and transportation. Do you think the rooftop solar program helps to reduce greenhouse gas emissions?
    a. Yes, a lot
    b. Yes, somewhat
    c. No, not very much
    d. No, not at all
    e. I'm not sure
41. How important is it to you that your rooftop solar helps to reduce greenhouse gas emissions?
    a. Extremely important
    b. Very important
    c. Somewhat important
    d. Not very important
    e. Not at all important
    f. I'm not sure
42. Next is particulate matter. Particulate matter includes tiny bits of solid material that move around in the air and are produced by things like industrial processes, burning of diesel fuel, and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems. Do you think the rooftop solar program helps to reduce particulate matter?
    a. Yes, a lot
    b. Yes, somewhat
    c. No, not very much
    d. No, not at all
    e. I'm not sure
43. How important is it to you that your rooftop solar helps to reduce particulate matter?
    a. Extremely important
    b. Very important

c. Somewhat important
d. Not very important
e. Not at all important
f. I'm not sure

44. Finally, nitrogen oxides. Nitrogen oxides are a family of gasses that form when fuel is burned at high temperatures in power plants, automobiles and turbines. These in part contribute to smog. Do you think the rooftop solar program helps to reduce nitrous oxide emissions?
    a. Yes, a lot
    b. Yes, somewhat
    c. No, not very much
    d. No, not at all
    e. I'm not sure
45. How important is it to you that your rooftop solar helps to reduce nitrogen oxide emissions?
    a. Extremely important
    b. Very important
    c. Somewhat important
    d. Not very important
    e. Not at all important
    f. I'm not sure

Customer Satisfaction

Next, we'd like to hear your insights and feedback about how to spread awareness and increase participation in the program.

46. What do you think would get in the way of someone in your community participating in the program? Please select all that apply.
    a. Don't think they'll save money
    b. Don't have time to be around for installation
    c. Don't want to share the required information for the application
    d. Don't know how long they'll be in their home
    e. Would consider solar but don't want incentives from this program
    f. Would consider solar but don't want to use the installers from this program
    g. Worried about disconnection from power during installation
    h. Don't think their roof can support solar
    i. Their home has outdated electrical wiring
    j. Electric bill is already low
    k. Don't trust that the offer is real
    l. Don't want solar

m. Other: ____________
n. None of the above
o. I don't know

47. How can the program better get the word out to your community about this program? Please select all that apply.
    a. Door to door outreach
    b. Community event such as: ___________
    c. Mail
    d. Word of mouth
    e. Advertise in a magazine or newsletter: Which one(s)_______________
    f. Social media
    g. Other: ______________________
48. Do you have any other feedback about the program?
    a. [free text]

Customer Information

49. Finally, we just have a few questions about yourself and your household. How many people live in your household full-time (i.e., for more than half of the year) including yourself?
    a. Drop down from 1 to 10
50. How many children (aged 0 - 17) live in your household?
    a. Drop down from 0 to 10
51. How many elderly people (aged 65 or older) live in your household?
    a. Drop down from 0 to 10
52. How much longer do you expect that you'll live in this home?
    a. 0 to 5 years
    b. 6 to 10 years
    c. 11 to 20 years
    d. 21 years or more
    e. Don't know
53. Thank you very much for completing our survey! **Please fill out the information below so that we can email you a $25 online Visa card**. If you do not have an email address, please give us a call at 971-930-8686. [request response]
    a. Name: _______________________
    b. Email: _______________________

Environmental Benefits

Now we want to talk to you about different environmental benefits.

54. The first is greenhouse gas emissions. Greenhouse gases trap heat and make the planet warmer. Greenhouse gases come from burning fossil fuels for electricity, heat and transportation. Do you think the rooftop solar program helps to reduce greenhouse gas emissions?
    a. Yes, a lot
    b. Yes, somewhat
    c. No, not very much
    d. No, not at all
    e. I'm not sure

55. How important is it to you that your rooftop solar helps to reduce greenhouse gas emissions?
    a. Extremely important
    b. Very important
    c. Somewhat important
    d. Not very important
    e. Not at all important
    f. I'm not sure

56. Next is particulate matter. Particulate matter includes tiny bits of solid material that move around in the air and are produced by things like industrial processes, burning of diesel fuel, and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems. Do you think the rooftop solar program helps to reduce particulate matter?
    a. Yes, a lot
    b. Yes, somewhat
    c. No, not very much
    d. No, not at all
    e. I'm not sure

57. How important is it to you that your rooftop solar helps to reduce particulate matter?
    a. Extremely important
    b. Very important
    c. Somewhat important
    d. Not very important
    e. Not at all important
    f. I'm not sure

58. Finally, nitrogen oxides. Nitrogen oxides are a family of gasses that form when fuel is burned at high temperatures in power plants, automobiles and turbines. These in part contribute to smog. Do you think the rooftop solar program helps to reduce nitrous oxide emissions?
    a. Yes, a lot
    b. Yes, somewhat
    c. No, not very much
    d. No, not at all
    e. I'm not sure

59. How important is it to you that your rooftop solar helps to reduce nitrogen oxide emissions?
    a. Extremely important
    b. Very important
    c. Somewhat important
    d. Not very important
    e. Not at all important
    f. I'm not sure

Customer Satisfaction

Next, we'd like to hear your insights and feedback about how to spread awareness and increase participation in the program.

60. What do you think would get in the way of someone in your community participating in the program? Please select all that apply.
    a. Don't think they'll save money
    b. Don't have time to be around for installation
    c. Don't want to share the required information for the application
    d. Don't know how long they'll be in their home
    e. Would consider solar but don't want incentives from this program
    f. Would consider solar but don't want to use the installers from this program
    g. Worried about disconnection from power during installation
    h. Don't think their roof can support solar
    i. Their home has outdated electrical wiring
    j. Electric bill is already low
    k. Don't trust that the offer is real

l. Don't want solar
m. Other: ____________
n. None of the above
o. I don't know

61. How can the program better get the word out to your community about this program? Please select all that apply.
    a. Door to door outreach
    b. Community event such as: ___________
    c. Mail
    d. Word of mouth
    e. Advertise in a magazine or newsletter: Which one(s)_______________
    f. Social media
    g. Other: ______________________

62. Do you have any other feedback about the program?
    a. [free text]

Customer Information

63. Finally, we just have a few questions about yourself and your household. How many people live in your household full-time (i.e., for more than half of the year) including yourself?
    a. Drop down from 1 to 10

64. How many children (aged 0 - 17) live in your household?
    a. Drop down from 0 to 10

65. How many elderly people (aged 65 or older) live in your household?
    a. Drop down from 0 to 10

66. How much longer do you expect that you'll live in this home?
    a. 0 to 5 years
    b. 6 to 10 years
    c. 11 to 20 years
    d. 21 years or more
    e. Don't know

67. Thank you very much for completing our survey! **Please fill out the information below so that we can email you a $25 online Visa card**. If you do not have an email address, please give us a call at 971-930-8686. [request response]
    a. Name: ________________________
    b. Email: ________________________

1.2 SASH Non-Participant Survey

Aware Non-Participants

Below are the questions that we intend to include in the aware non-participant web survey. Skip logic, piped data, and conditions that end the survey are detailed in blue.

Introduction

Thank you for taking the survey on GRID's Energy For All (DAC-SASH and SASH) Solar Program. Your feedback is vital to us. This survey will take approximately 10-15 minutes to complete, and all information collected is confidential.

This will help an evaluation overseen by the California Public Utilities Commission (https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/customer-generation-evaluation).

Before we begin, we'd like to confirm you are eligible for this survey. If you are eligible and complete the survey, we will email you a $25 Visa gift card within the next 3 to 4 weeks as a thank you.

Screening

1. Do you currently live at [embedded]?
    a. Yes
    b. No [Termination message #1]

2. Do you own or rent your home?
    a. Own
    b. Rent [Termination message #2]

3. GRID Alternatives offers no-cost solar installations on rooftops of single-family homes that meet certain income and location qualifications. Before taking this survey, had you heard of this program Energy for All program, also known as [embedded: program name with acronym]?
    a. Yes
    b. No [SKIP to "unaware" survey]

Market Adoption

4. Since you moved into your home, have you installed solar panels on your roof?
    a. Yes
    b. No

5. [IF 4= A] Have you installed solar panels on your roof through the GRID Alternatives Energy for All Solar Program?
    a. Yes [Termination message #2]
    b. No
    c. Not sure

6. [IF 5 = B | C] Did you or someone in your household pay to have solar panels installed on your roof, or did a program or other organization help pay for the installation?
    a. I paid for the solar panel installation
    b. A program or other organization helped me pay for the solar panel installation
    c. Something else: _______________ [force response if selected]

7. [IF 4= A] Please choose the statement that best describes your solar system.
    a. I own the system
    a. I have a Power Purchase Agreement (PPA) where I pay a certain amount for each kWh used each month
    b. I pay a flat monthly rate to the solar company for the solar energy
    c. I have a different lease payment structure: ______________________ [force response if selected]
    d. I lease but am not sure how my lease payments are set up
    e. I am not sure

8. [IF 7 = B] What program or organization helped you pay for the solar panel installation?
    a. [Free text]

a. [IF 4 = A] How important were the following factors to your decision to install solar panels on your roof? [matrix with Extremely important, Very important, Somewhat important, A little important, and Not a factor]
b. Use less energy
c. Lower energy bills
d. Help the environment
e. Concern about power outages
f. Other: ____________ [force response if selected]

Marketing

9. How did you receive information about GRID Alternatives' Energy for All program that offers free solar panels for your home?
    a. From [embedded: utility]
    b. From the city or county that I live in
    c. From a friend/neighbor and/or family member
    d. From a community organization
    e. From GRID Alternatives
    f. Other: _____________ [force response if selected]

10. Do you remember receiving information about the Energy for All program in any of the following ways? Please select all that apply.
    a. I got something in the mail
    b. I looked up information online
    c. Someone talked to me about the program at an event
    d. Someone called me on the phone
    e. Someone came to my door to tell me about the program
    f. Through a discussion with a friend/neighbor and/or family member
    g. I heard about it through the TV
    h. I saw an ad on social media (like Facebook)
    i. I saw it in my utility bill
    j. Other: _____________ [force response if selected]
    k. Don't recall [exclusive answer]

11. How can GRID Alternatives better get the word out to your community about the Energy for All program? Please select all that apply.
    a. Door to door outreach
    b. Community event such as: ___________
    c. Mail
    d. Word of mouth

e. Advertise in a magazine or newsletter: Which one(s)_______________
f. Social media
g. Other: ______________________ [force response if selected]

Next, we would like to ask you some questions about how easy or difficult it was for you to understand the Energy for All program based on the information you received.

12. [if 9 = E] How clear was the information you received from GRID Alternatives about the program?
    a. Very clear
    b. Somewhat clear
    c. Neither clear nor unclear
    d. Somewhat unclear
    e. Very unclear

13. [if 9 = A] How clear was the information you received from [embedded: utility] about the program?
    a. Very clear
    b. Somewhat clear
    c. Neither clear nor unclear
    d. Somewhat unclear
    e. Very unclear

14. [if 12 = D, E |5 = D, E] What was unclear about the program information you received?
    a. [free text]

Barriers

15. How interested were you in participating in the Energy for All program when you first learned about it?
    a. Extremely interested
    b. Very interested
    c. Somewhat interested
    d. A little interested
    e. Not at all interested

16. [IF 15= A|B|C] How important were the following factors to your interest in installing solar panels on your roof? [matrix of Extremely important, Very important, Somewhat important, A little important, and Not a factor]

a. Use less energy
b. Lower energy bills
c. Help the environment
d. Concern about power outages
e. Other: ____________ [force response if selected]

17. Which statements below describe why you did not move forward with the Energy for All program to install free solar panels on your roof? Please select all that apply.
    a. I am still interested and waiting to move forward
    b. I was told I was not eligible
    c. I would have needed to pay to improve my roof
    d. I would have needed to pay to upgrade my electrical panel
    e. I would have needed to pay for tree trimming
    f. I would have needed to pay for some other service before they could install solar panels: _____________ [force response if selected]
    g. I did not want to get a permit
    h. I did not have time to participate
    i. [IF 4 = A] I did not want to wait for solar panels
    j. I was unsure of the benefits
    k. Some other reason: _____________ [force response if selected]

    l. What concerns, if any, did you have as you learned about the program?
    m. I didn't have any concerns [if selected, no others can be selected]
    n. The offer seemed too good to be true
    o. I was worried it was a scam
    p. I didn't think I would be eligible
    q. I didn't think I would have time to participate
    r. Other: My concerns were… ____________________________________ [force response if selected]

18. [IF 17 = A] When was the last time you talked to GRID Alternatives about participating in the program?
    a. Within the last month
    b. Within the last three months
    c. Within the last year
    d. I have not spoken with GRID in over a year
    e. I have never spoken with someone from GRID

19. [IF 17 = A] Can you tell me more about what you are waiting on to move forward with installing solar?
    a. [free text]

20. [IF 17 = B] Can you tell me more about why you were not eligible? Please select all that apply.
    a. I do not know why I am not eligible [exclusive answer]
    b. I was not able to provide all necessary documents
    c. I did not qualify because of income
    d. I did not qualify because of where my house is located
    e. I did not qualify because I do not own my home
    f. I did not qualify because of neighborhood restrictions
    g. I did not qualify because of my electricity usage
    h. I did not qualify for a different reason: ___________ [force response if selected]

21. [IF 15 = C | D | E] Can you tell me how important each of the following factors were in why you were not interested in the program? [Matrix with scale Extremely important, Very important, Somewhat important, A little important, Not a factor]
    a. I did not have time to participate
    b. I did not trust the program
    c. I did not like solar panels
    d. My electricity bills were already low
    e. Some other reason: _______ [force response if selected]

22. [IF 17 = C|D|E|F] Did GRID Alternatives try to connect you to any organizations to try to help you find funding for…

Service	Yes	No	Don't know
[IF 17 = C] Roof Repair			
[IF 17 = D] Electrical Panel			
[IF 17 = E] Tree Trimming			
[IF 17 = F] Other Service			

23. [IF 22= YES for any] Was GRID successful in connecting you to any organizations to help you finding funding for the following?

Service	Yes	No	Don't know
[IF 17 = C & 22 = YES] Roof Repair			
[IF 17 = D & 22 = YES] Electrical Panel			
[IF 17 = E & 22 = YES] Tree Trimming			
[IF 17 = F & 22 = YES] Other Service			

24. [IF 23 = YES for any] Was the funding offered enough to move forward with installing solar?

Service	Yes	No	Don't know
[IF 17 = C & 23 = YES] Roof Repair			
[IF 17 = D & 23 = YES] Electrical Panel			
[IF 17 = E & 23 = YES] Tree Trimming			
[IF 17 = F & 23 = YES] Other Service			

25. [IF 17 = C|D|E|F] About how much would it have cost to upgrade your home to be ready for solar? An estimate is fine.

Service	**Estimated Cost to Repair**
[IF 17 = C] Roof Repair	
[IF 17 = D] Electrical Panel	

[IF 17 = E] Tree Trimming
[IF 17 = F] Other Service

26. Overall, how satisfied were you with your experience with GRID Alternatives?
    a. Extremely satisfied
    b. Somewhat satisfied
    c. Neither satisfied nor dissatisfied
    d. Somewhat dissatisfied
    e. Extremely dissatisfied

27. Can you tell me why you answered that you were [ANSWER from 26] with GRID Alternatives?
    a. [free text]

Application Process

28. Did you ever submit an application for the Energy for All Program to install free solar panels?
    a. Yes
    b. No
    c. Don't know

29. [IF 28 = A] How did you fill out the full application for submission? If someone else filled out the application for you, how did they do it?
    a. Over the phone
    b. Via email and/or DocuSign
    c. Via a paper application by myself
    d. Via a paper application with help from GRID
    e. Don't know

30. [IF 29 != E] How easy or difficult would you say it was to complete your application for this solar project?
    a. Very easy to apply
    b. Somewhat easy to apply
    c. Neither easy nor difficult to apply
    d. Somewhat difficult to apply

e. Very difficult to apply

31. [IF 10 = D | E] Which of the following, if any, contributed to the application process being difficult? Please select all that apply.
    a. Providing tax documents for proof of income
    b. Providing proof of homeownership
    c. Providing a recent utility bill
    d. Understanding what the application was asking for
    e. Making changes to my application
    f. Other (please specify): ____________ [force response if selected]

32. [IF 28 = A] Which energy programs were you already enrolled in ***before*** applying for the Energy for All program? Please select all that apply.
    a. California Alternate Rates for Energy (CARE) - a bill discount based on income
    b. Family Electric Rate Assistance (FERA) – reduces electric bills for qualified households
    c. Energy Savings Assistance (ESA) - a program that does weatherization and includes faucet aerators and major appliances
    d. Medical Baseline Rate - a bill discount to help with necessary medical equipment
    e. [IF embedded = SJV] San Joaquin Valley Energy Project - a program that swaps out propane and wood-burning appliances
    f. Self-Generation Incentive Program (SGIP) – a program that offers rebates for installing energy storage technology like batteries
    g. Other energy program (please specify): _____________________ [force response if selected]
    h. None of the above
    i. I'm not sure

33. [IF 28 = A] Which energy programs did you enroll ***in around the same time*** as applying for the Energy for All program? Please select all that apply. *[Survey will not ask about answers selected in prior question]*
    j. California Alternate Rates for Energy (CARE) - a bill discount based on income
    k. Family Electric Rate Assistance (FERA)- reduces electric bills for qualified households
    l. Energy Savings Assistance (ESA) - a program that does weatherization and includes faucet aerators and major appliances
    m. Medical Baseline Rate - a bill discount to help with necessary medical equipment
    n. [IF embedded = SJV] San Joaquin Valley Energy Project - a program that swaps out propane and wood-burning appliances

o. Self-Generation Incentive Program (SGIP) – a program that offers rebates for installing energy storage technology like batteries
p. Other energy program (please specify): ____________________ [force response if selected]
q. None of the above
r. I'm not sure

34. [IF 28 = A] When did you apply for the programs? [each answer from question above]

	Before applying for the Energy for All program	*While I applied for the Energy for All program*	*After applying for the Energy for All program*
Selected program #1			
Selected program #2			
Selected program #3			

35. [IF 28 = B|C] Which energy programs are you currently enrolled in? Please select all that apply.
a. California Alternate Rates for Energy (CARE) - a bill discount based on income
b. Family Electric Rate Assistance (FERA) – reduces electric bills for qualified households
c. Energy Savings Assistance (ESA) - a program that does weatherization and includes faucet aerators and major appliances
d. Medical Baseline Rate - a bill discount to help with necessary medical equipment
e. [IF embedded = SJV] San Joaquin Valley Energy Project - a program that swaps out propane and wood-burning appliances
f. Self-Generation Incentive Program (SGIP) – a program that offers rebates for installing energy storage technology
g. Other energy program (please specify): ____________________[force response if selected]
h. None of the above
i. I'm not sure

Environmental Benefits

Lastly we want to ask you about potential environmental benefits to using solar panels.

36. The first is greenhouse gas emissions. Greenhouse gases trap heat and make the planet warmer. Greenhouse gases come from burning fossil fuels for electricity, heat, and transportation. How much, if at all, do you think the rooftop solar program we've been asking about would help to reduce greenhouse gas emissions?
    a. A lot
    b. some
    c. Not very much
    d. Not at all
    e. I'm not sure

37. How important is reducing greenhouse gas emissions to you?
    a. Extremely important
    b. Very important
    c. Somewhat important
    d. Not very important
    e. Not at all important

38. Next is particulate matter. Particulate matter includes tiny bits of solid material that move around in the air and are produced by things like industrial processes, burning of diesel fuel, and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems. Do you think the rooftop solar program we've been asking about would help to reduce particulate matter?
    a. Yes, a lot
    b. Yes, somewhat
    c. No, not very much
    d. No, not at all
    e. I'm not sure

39. How important is it to you that your rooftop solar helps to reduce particulate matter?
    a. Extremely important
    b. Very important
    c. Somewhat important
    d. Not very important
    e. Not at all important
    f. I'm not sure

40. Finally, nitrogen oxides. Nitrogen oxides are a family of gasses that form when fuel is burned at high temperatures in power plants, automobiles, and turbines. These in part contribute to smog. Do you think the rooftop solar program we've been asking about would help to reduce nitrous oxide emissions?
    a. Yes, a lot
    b. Yes, somewhat
    c. No, not very much
    d. No, not at all
    e. I'm not sure

41. How important is it to you that your rooftop solar helps to reduce nitrogen oxide emissions?
    a. Extremely important
    b. Very important
    c. Somewhat important
    d. Not very important
    e. Not at all important
    f. I'm not sure

Customer Information

42. Finally, we just have a few questions about yourself and your household. How many total people live in your household full-time (i.e., for more than half of the year) including yourself?
    b. Drop down from 1 to 10

43. How many of these people are children aged 0 - 17?
    b. Drop down from 0 to 10

44. How many of these people are age 65 and older?
    b. Drop down from 0 to 10

45. If you had to guess, how much longer do you think you will live in this home?
    f. 0 to 5 years
    g. 6 to 10 years
    h. 11 to 20 years

i. 21 years or more
j. Don't know

a. Thank you very much for completing our survey! **Please fill out the information below so that we can email you your $25 online Visa card**. If you do not have an email address, please give us a call at 971-930-8686. [request response]
b. Name: ________________________
c. Email: ________________________

Termination Messages

1. Thank you for your interest in this survey. Unfortunately, we were trying to reach someone else. If you believe you received this message in error, please contact us at kirksey@evergreenecon.com or call (971) 930-8686.
2. Thank you for your interest in this survey. Unfortunately, you are not eligible for this survey.

Unaware Non-Participant Survey Instrument

Below are the questions that we intend to include in the aware non-participant web survey. Skip logic, piped data, and conditions that end the survey are detailed in blue. Embedded data will include address information to determine whether the address is located in a HUD Qualified Tract or not, and what 80 percent AMI income should be used to determine eligibility based on their county.

Screening & Eligibility

Thank you for taking the survey on solar panel and energy usage in your community. Your feedback is vital to us. This survey will take approximately 10-15 minutes to complete, and all information collected is confidential. As a thank you, we will email you a $25 Visa gift card if you are eligible and complete the survey.

Before we get started, we would like to confirm that you are eligible for this study. All of your information will be kept confidential.

[Programming note, questions 1 – 8 will force a response]

1. Do you currently live at [embedded: address]?
    a. Yes
    b. No [Termination Message #1]

2. Which best describes your home?
    a. A single-family home
    b. A multi-family home with less than 4 units in the building [Termination Message #2]
    c. A multi-family home with more than 4 units in the building [Termination Message #2]
    d. Something else [Termination Message #2]

3. Do you own or rent your home?
    a. Own
    b. Rent [Termination Message #2]
    c. Not sure [Termination Message #2]

4. Including yourself, how many people live in your home at least half of the time?
    a. [drop down menu with 1 – 8+]

5. [IF DAC = TRUE] Is your annual household income above or below [Calculated 200% FPL based on 4]?
    a. Above [Calculated 200% FPL based on 4]
    b. Below [Calculated 200% FPL based on 4]
    c. Not sure [Termination Message #2]

6. [IF (5 = A | DAC = FALSE) & (HUD = FALSE & 5 != B)] Does your home fall into any of the following categories? (Affordable housing, deed-restricted, purchased through a first-time homebuyer loan, etc.)
    a. Yes
    b. No [Termination Message #2]
    c. Not sure

7. [IF HUD = TRUE | 6 = A] Is your annual household income above or below [embedded AMI amount]?
    a. Above [embedded AMI amount] [Termination Message #2]
    b. Below [embedded AMI amount]
    c. Not sure [Termination Message #2]

8. GRID Alternatives offers no-cost solar installations on rooftops of single-family homes that meet certain income and location qualifications. Before taking this survey, had you heard of this program Energy for All, also known as the Single-family Affordable Solar Homes Solar Program (SASH)?
    a. Yes [SKIP to "aware" survey]
    b. No
    c. Not sure

Thank you for completing the screening questions! You are eligible for this survey and will receive a $25 visa gift card after you complete the following questions. Please click the next arrow to continue.

Existing Solar for Eligible Non-Parts

9. Do you have solar panels on your roof?
    a. Yes, they were already installed when I purchased the home
    b. Yes, I had them installed after I moved in
    c. No

10. [IF 9 = A | B] Please choose the statement that best describes your solar system.
    a. I own the system
    b. I have a Power Purchase Agreement (PPA) where I pay a certain amount for each kWh used each month
    c. I pay a flat monthly rate to the solar company for the solar energy
    d. I have a different lease payment structure: ______________________ [force response if selected]
    e. I lease but I am not sure how my lease payments are set up
    f. I am not sure

11. [IF 9 = B] Next we would like to know if you received any assistance to help pay for the installation or cost of the solar panels.
    a. Did you receive a tax credit? YES NO
    b. Did you receive help from a program or organization? YES NO
    c. Did you receive any other sort of assistance, such as a grant? YES NO

12. [IF 11b = YES] What program or organization helped you pay for the solar panel installation?
    a. [Free text]

13. [IF 11c= YES] What assistance did you receive that helped you pay for the solar panel installation?

a. [Free text]

14. [IF 9 = B] How important were the following factors to your decision to install solar panels on your roof? [matrix with Extremely important, Very important, Somewhat important, A little important, and Not a factor]
    a. Use less energy
    b. Lower energy bills
    c. Help the environment
    d. Concern about power outages
    e. Other: ____________ [force response if selected]

Marketing

15. Have you ever been enrolled in any of the following energy programs? Please select all that apply.
    a. California Alternate Rates for Energy (CARE) - a bill discount based on income
    b. Family Electric Rate Assistance (FERA) – reduces electric bills for qualified households
    c. Energy Savings Assistance (ESA) - a program that does weatherization and includes faucet aerators and major appliances
    d. Medical Baseline Rate - a bill discount to help with necessary medical equipment
    e. [IF embedded = SJV] San Joaquin Valley Energy Project - a program that swaps out propane and wood-burning appliances
    f. Self-Generation Incentive Program (SGIP) – a program that offers rebates for installing energy storage technology like batteries
    g. Other energy program (please specify): _____________________ [force response if selected]
    h. None of the above
    i. I'm not sure

16. Are you **currently enrolled** in any of the following energy programs? Please select all that apply. [only display for those selected above]
    a. California Alternate Rates for Energy (CARE) - a bill discount based on income
    b. Family Electric Rate Assistance (FERA) – reduces electric bills for qualified households
    c. Energy Savings Assistance (ESA) - a program that does weatherization and includes faucet aerators and major appliances
    d. Medical Baseline Rate - a bill discount to help with necessary medical equipment
    e. [IF embedded = SJV] San Joaquin Valley Energy Project - a program that swaps out propane and wood-burning appliances

f. Self-Generation Incentive Program (SGIP) – a program that offers rebates for installing energy storage technology like batteries
g. Other energy program (please specify): ______________________ [force response if selected]
h. None of the above
i. I'm not sure

17. How do you typically receive information about energy programs for your home? Select all that apply.
    a. From [embedded: utility]
    b. From the city or county that I live in
    c. From a friend/neighbor and/or family member
    d. From a community organization
    e. Other: ______________ [force response if selected]
    f. I have not received any information about energy programs

18. [IF 17 != F] Have you received information about energy programs in any of the following ways? Please select all that apply.
    a. I got something in the mail
    b. I looked up information online
    c. Someone talked to me about the program at an event
    d. Someone called me on the phone
    e. Someone came to my door to tell me about the program
    f. Through a discussion with a friend/neighbor and/or family member
    g. I heard about it through the TV
    h. An ad on social media (like Facebook)
    i. On a utility bill
    j. Other: ______________ [force response if selected]
    k. Don't recall [exclusive answer]

19. How can energy companies better get the word out to your community about energy programs? Please select all that apply.
    a. Door to door outreach
    b. Community event such as: ____________
    c. Mail
    d. Word of mouth
    e. Advertise in a magazine or newsletter: Which one(s)________________
    f. Social media
    g. Other: ________________________ [force response if selected]

Barriers

20. [IF 9 = C] Overall, how interested are you in having solar panels installed on your roof at no cost to you?
    a. Extremely interested
    b. Somewhat interested
    c. Neither interested nor disinterested
    d. Somewhat disinterested
    e. Extremely disinterested

21. [IF 9 = C] Can you tell me more about why you answered that you are [response from 20] in installing free solar panels on your roof?
    a. [Free text]

22. If there were a program that helped with installing free solar panels on communities like yours, how likely would you be to be interested in participating?
    a. Extremely interested
    b. Somewhat interested
    c. Neither interested nor disinterested
    d. Somewhat disinterested
    e. Extremely disinterested

23. Can you tell me why you would be [insert answer from above]?
    a. [Free text]

Customer Information

24. Finally, we just have a few questions about yourself and your household. How many of the people in your household are children aged 0 - 17?
    a. Drop down from 0 to 10

25. How many of the people in your household are aged 65 or older?
    a. Drop down from 0 to 10

26. If you had to guess, how much longer do you think that you will live in this home?
    a. 0 to 5 years
    b. 6 to 10 years

c. 11 to 20 years
d. 21 years or more
e. Don't know

27. Thank you very much for completing our survey! **Please fill out the information below so that we can email you your $25 online Visa card**. If you do not have an email address, please give us a call at 971-930-8686. [request response]
    d. Name: ________________________
    e. Email: ________________________

Termination Messages

1. Thank you for your interest in this survey. Unfortunately, we were trying to reach someone else. If you believe you received this message in error, please contact us at kirksey@evergreenecon.com or call (971) 930-8686.
2. Thank you for your interest in this survey. Unfortunately, you are not eligible for this survey.

1.3 Trainee Survey

Thank you for taking our survey on volunteer and training opportunities with GRID. We will be asking about both solar installations and classroom trainings GRID Alternatives' Install Basic Training Course (IBT). Your feedback is vital to us. This survey will take approximately 15 minutes to complete, and all information collected is confidential.

As a thank you for taking our survey, we will send you a $25 VISA gift card.

Q1. First, can you confirm what GRID activities you've participated in? [Select all that apply]
  a. I took the GRID installations basic training course [COURSE=1]
  b. I helped (volunteered or trained) at one of GRID's rooftop solar installations **without taking GRID's broader training course [COURSE=2]**
  c. None of the above [thank and terminate]

Q2. Where do you remember first learning about [GRID's training course/the opportunity to help with a solar installation]?
  a. Word of mouth
  b. Community events/meetings
  c. Job training organizations
  d. Social media
  e. Radio/TV advertisement
  f. Local paper/Community Newsletter

g. Flyers
h. Community College
i. Local utility
j. GRID marketing materials or direct outreach
k. Other (please specify) __________

Q3. Where did you attend [GRID's training course/the opportunity to help with a solar installation]? Select all that apply.
a. Bay area
b. Central Valley
c. North Coast
d. Los Angeles
e. Inland Empire
f. North Valley
g. North Valley
h. San Diego

Q4. On average, approximately how far did you need to travel roundtrip to attend the [GRID's training course/the opportunity to help with a solar installation]?
a. 0-5 miles
b. 6-10 miles
c. 11-15 miles
d. 16-20 miles
e. More than 20 miles

Q5. [if COURSE=1] On average, approximately how far did you need to travel roundtrip to attend the solar installation part of the training?
a. 0-5 miles
b. 6-10 miles
c. 11-15 miles
d. 16-20 miles
e. More than 20 miles

Q6. [if COURSE=1] How many weeks did you attend the GRID training course?
a. Drop down of 0 – 50+

Q7. About how many days did you go on-site to a solar installation?
a. Drop down of 0 – 50+

Q8. What made you interested in participating in [GRID's training course/the opportunity to help with a solar installation]? Select all that apply.
  a. Looking for a new career path
  b. Looking for an introduction to the solar industry
  c. Start a career in solar
  d. Wanted to expand my knowledge of the solar industry
  e. Other (please specify) __________

Q9. [If COURSE=1] What are were hoping to get out of the trainings in terms of your career? **[programmer note: program Q as optional]**
  a. Free Response __________

Q10. [If COURSE=2] What are were hoping to get out of the installation on-site visit(s) in terms of your career? **[programmer note: program Q as optional]**
  a. Free Response __________

Q11. What best describes your employment status BEFORE participating in [GRID's training course/the opportunity to help with a solar installation]?
  a. Full-time (40 hours a week or more)
  b. Part-time (less than 40 hours a week)
  c. Unemployed/retired/not working
  d. Other (please specify) __________

Q12. [IF Q11 = Part-time] Was your **part-time** employment BEFORE participating in [GRID's training course/the on-site solar installation]a short-term contract, long-term contract, or was it not contract work?
  a. Yes, short-term contract (less than 6 months)
  b. Yes, long-term contract (6 months or longer)
  c. No, it was not a contract job
  d. Don't know

Q13. What best describes your employment status AFTER participating in the [GRID's training course/the on-site solar installation]?
  a. Same as before
  b. Full-time (40 hours a week or more)
  c. Part-time (less than 40 hours a week)
  d. Unemployed/retired/not working
  e. Other (please specify) __________

Q14. [IF Q13 = Part-time] Was your **part-time** employment AFTER participating in [GRID's training course/the on-site solar installation]a short-term contract, long-term contract or was it not contract work?

a. Yes, short-term contract (less than 6 months)
b. Yes, long-term contract (6 months or longer)
c. No, it was not a contract job
d. Don't know

Q15. Before participating in [GRID's training course/the on-site solar installation], were you ever employed in the solar industry?

a. Yes
b. No

Q16. [IF Q15 = No AND Q11 =/= Unemployed] What best describes your work experience BEFORE participating in [GRID's training course/the on-site solar installation]?

a. Construction
b. Finance
c. Agriculture
d. Entertainment
e. Education
f. Health Care
g. Food services
h. Hotel services
i. Legal services
j. Military
k. Other (please specify) ___________

Q17. Are you currently employed in the solar industry?

a. Yes
b. Not yet, I am looking for a job in the solar industry
c. No, but I was for some time after the training course
d. No, I haven't worked in solar since the training course

Q18. [IF Q17 = a OR c] After attending the [GRID's training course/the on-site solar installation] how long did it take for you to obtain employment in the solar industry?

a. _____ Years _____ Months

Q19. [IF Q17 = a OR c] What best describes your [current/previous] role(s) in the solar industry? Select all that apply.

a. Solar sales representative

b. Solar PV installer
c. Maintenance technician
d. Solar fleet manager
e. Solar service technician
f. Solar site assessor
g. Quality assurance specialist
h. Other (please specify) __________

Q20. [IF Q17 = a OR b] About how long [have you/did you] [been working/work] for your [current/previous] employer?

a. _____ Years _____ Months

Q21. [IF Q15 = Yes AND Q17 = No] Can you tell us why you no longer work in the solar industry?

a. Free response __________

Q22. [If COURSE=1] Did you obtain any professional certifications as part of the GRID training course?

a. Yes
b. No

Q23. [If COURSE=1 and IF Q22 = Yes] What professional certifications did you receive as part of the GRID training course?

a. Free response __________

Q24. [IF Q22 = No] Do you currently plan to pursue any professional certifications in the solar industry?

a. Yes
b. No
c. Don't know

Q25. [If COURSE=1 and IF Q22 = Yes] Outside of what you received as part of the GRID training course, do you plan to pursue (or have you pursued) any other professional certifications in the solar industry?

a. Yes
b. No
c. Don't know

Q26. [If COURSE=1] Now going back to the on-site installation part of the class, was being in the field for on-site installations different from what you've learned in the class?

a. Text box __________

Q27. While on-site, were you ever able to interact with any of the residents of the homes that were getting the solar installed?

a. Yes
b. No

Q28. [IF Q27 = Yes] Did the residents have any questions about the installation or process?

a. Yes
b. No
c. Don't know

Q29. [IF Q28 = Yes] Did you feel that you had the knowledge necessary to answer the residents' questions?

a. Yes, I was able to answer all of their questions
b. Sort of, I was able to answer most of their questions
c. No, I wasn't able to answer any of their questions

Q30. Do you believe your on-site installation time with the GRID project(s) improved your career opportunities in the solar industry?

a. Yes
b. No
c. Don't know

Q31. [IF Q30 = Yes] Please describe in a couple sentences how you believe your on-site training created additional opportunities for you in the solar industry. **[programmer note: program Q as optional]**

a. Text box __________

Q32. [If COURSE=1] Do you feel that the on-site training you received through the GRID training course provided you with the knowledge and skills to be successful in the solar industry?

a. The training prepared me well enough to get a job in the solar industry
b. The training prepared me fine, but I still needed some additional training to get a job in the solar industry
c. The training did not prepare me to get a job in the solar industry

Q33. [If COURSE=1] Do you believe the training you received in the classroom provided you with the knowledge and skills to be successful in the solar industry?

a. The training prepared me well enough to get a job in the solar industry
b. The training prepared me fine, but I still needed some additional training to get a job in the solar industry
c. The training did not prepare me well enough to get a job in the solar industry

Q34. [If COURSE=1 and IF Q32 OR Q33 = b OR c] Can you please describe what else you feel you needed to know to be successfully employed in the solar industry?
a. Text box __________

Q35. [If COURSE=1] What networking and employment opportunities were provided to you as part of the GRID training course? Select all that apply.
a. On-site networking opportunities with other participants and corporate sponsors
b. Referrals to companies who are hiring for installation and other positions in the solar field
c. Access to the GRID Alternative Resume Bank
d. Referrals through GRID's Sub-contractor Partnership Program (SPP) for paid short-term work as a SPP Job Trainee
e. Other (please specify) __________
f. None that I can think of

Q36. [If COURSE=1] Overall, how well did the GRID training course do with providing you the opportunities and resources (training, job search assistance) you needed to obtain a job in the solar industry?
a. Extremely well
b. Very well
c. Somewhat well
d. Not too well
e. Not at all well

Q37. [IF Q36 = c, d, e] What else do you think the GRID training course could have provided you that would help obtain employment in the solar industry?
a. Free response __________

Q38. [If COURSE=1] If you were to have not participated in the GRID training course, do you think you would have known how to seek the skills necessary for employment in the solar industry?
a. Yes
b. No
c. Don't know

Q39. How much of a barrier are each of the following to getting hands-on experience in the solar industry? *Note to programmer – program as a matrix table with a scale of not at all a barrier, somewhat of a barrier, moderate barrier, extreme barrier.*

a. Lack of financial resources
b. Lack of transportation
c. Distrust in the program
d. Lack of information (don't know how)
e. Lack of information (don't even know the option exists)
f. Time needed to get training
g. Training facility is too far away
h. Other (please specify) __________

Q40. [IF COURSE=1 AND Q39 does not equal "not at all a barrier" for all response options] Do you have any suggestions for how programs might be developed to help overcome any of those barriers?

a. Yes, please specify __________
b. No
c. Don't know

We have just a few more questions.

Q41. [If COURSE=1] Were you paid in some way for participating in the GRID training course?

a. Yes
b. No

Q42. Have you moved since you participated in [GRID's training course/the on-site solar installation]?

a. Yes
b. No

Q43. What is your age?

___ Years old.

Q44. What is the highest degree or level of school you have completed?

a. No schooling completed
b. Nursery school to 8th grade
c. Some high school, no diploma
d. High school graduate, diploma or the equivalent (for example: GED)
e. Some college credit, no degree
f. Trade/technical/vocational training

g. Associate degree
h. Bachelor's degree
i. Master's degree
j. Professional degree
k. Doctorate degree

Q45. Which of these describes your personal income before taxes last year?

a. $0
b. $1 to $9,999
c. $10,000 to $24,999
d. $25,000 to $49,999
e. $50,000 to $74,999
f. $75,000 to $99,999
g. $100,000 to $149,999
h. $150,000 or greater
i. Prefer not to say

Q46. Lastly, as mentioned we would like to provide you with a $25 VISA gift card as a thank you for taking our survey. What is the best address to send the gift card to? Please note that we will not use your address for anything other than sending you the gift card.

a. First Name __________
b. Last Name __________
c. Address ____________
d. City _______________
e. State ______________
f. Zip Code ___________

Appendix F: Survey Recruitment Postcards

This section presents the postcards used in customer recruitment for both participants and non-participant survey recruitment. Each postcard had a unique tiny.url that directed them to the specific respondents' survey.

Postcard – Participants

Postcard – Aware Non-Participants

Evergreen Economics is a research firm working with your utility and GRID Alternatives to evaluate the **Energy for All Program** (SASH and DAC-SASH).

We are asking for your help to improve this program. **We want to know about your experience. Our online survey will only take 10 minutes and <u>we are offering $25 as our thanks</u> for your feedback.**

* La encuesta también está disponible en español.

We want to know your thoughts!

We'll be emailing you with a link to the survey soon. Or you can type the link below into your browser to take it now!

[tiny.url]

If you have questions about this study, or would like to take the survey over the phone, please contact Kayla Kirksey at Evergreen Economics kirksey@evergreenecon.com (971) 930- 8686

Postcard – Unaware Non-Participants

Evergreen Economics is a research firm working with your utility to evaluate solar programs in California. **We want to hear your opinions about solar and energy usage in your community.**

We are asking for your help! **Our online survey will only take 10 minutes and <u>we are offering $25 as our thanks</u> for your feedback.**

* La encuesta también está disponible en español.

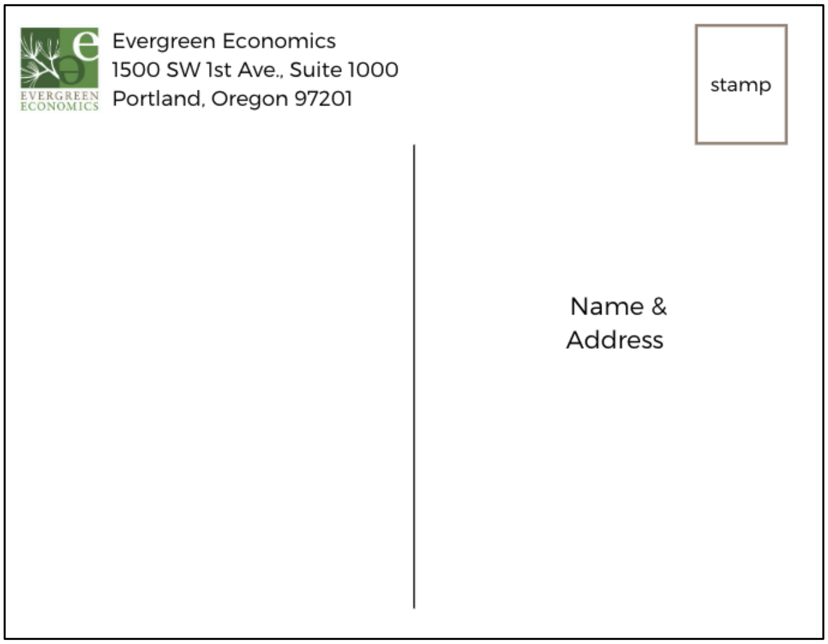
We want to know your thoughts!

We'll be emailing you with a link to the survey soon. Or you can type the link below into your browser to take it now!

[tiny.url]

If you have questions about this study, or would like to take the survey over the phone, please contact Kayla Kirksey at Evergreen Economics kirksey@evergreenecon.com (971) 930-8686

Postcard – Backside of all options



Appendix G: Field Verification Visit Protocols

This appendix contains recruitment materials and forms used during the onsite field verification visits conducted to inform the PV impacts analyses. All highlighted fields were piped in during distribution to personalize the letter and email recruitment.

1.1 Authentication Letter

Dear <Program Name> Participant,

Thank you for participating in the <Program Name> program with GRID, and for completing a customer survey about the program recently.

I am contacting you to share that we are getting ready to begin conducting site visits with a small group of program participations. These will help us better understand the overall impact of the <Program Name> program.

This letter authenticates the request for a technical specialist to perform a visual verification of the solar array at your property. **These specialists will be from either Evergreen Economics or BrightLine Group**. This representative will not be requesting any personal information from you, but they may need access to part of your property, such as your back yard, to view your solar panels. They will **not** need access to the inside of your home, or on your roof, and you do not need to be home at the time of the visit.

If you have any questions or concerns, please use the contact information listed below to reach us directly. For verification of this evaluation, please follow this link.

Thank you for helping to make California a leader in solar energy generation, and for your participation in this follow-up evaluation.

Sincerely,

Zoey Burrows
Program Manager, DAC-SASH/SASH
1171 Ocean Ave | Oakland, CA 94608
O: 510-646-8205
zburrows@gridalternatives.org

The <Program Name> program is funded through the California Public Utilities Commission (CPUC) and the CPUC has commissioned an evaluation to be conducted by Evergreen Economics and the BrightLine Group. If you have any questions for the CPUC about this study, please contact Sarah Lerhaupt, sarah.lerhaupt@cpuc.ca.gov.

1.2 Recruitment Email

Subject: <Program Name> Site Visit Scheduling

Dear <Customer Name>,

My company BrightLine Group is working with GRID to research how solar arrays installed through the <Program Name> are performing. **We will be sending a field specialist to your area on <Date> and would like your permission to visit your property. To thank you for your time, we will email you a $50 gift card after the visit.** The specialist will visually observe your solar array and may take measurements or photos but will **not** need access to the inside of your home and you will not need to be home at the time of the visit. If your solar array is not visible from the street, the specialist will need to access the area behind your home. Only one visit ranging from 45 to 60 minutes is requested, and we are grateful for your participation.

Please reply to this email and tell us these two things:

- Is it ok for our specialist to come look at your solar arrays on **<Date>**?
- Any access issues that the specialist should be aware of? If the solar array is only accessible from an area that can't be seen from the front of your home, please note things like locked gates, backyard pets, etc. that the field specialist should be aware of. Note that we do not plan to go on your roof.

If you have any questions about the specialist's visit to look at your solar arrays or about this program, please feel free to contact us at <BL contact> or GRID Alternatives with any questions at <GRID Contact>. If you would like to verify this study, please see the attached letter and/or follow this link to the California Public Utilities Commission website.

Thank you!

<BrightLine Contact>

<Contact email>

BrightLine Group

The <Program Name> program is funded through the California Public Utilities Commission (CPUC) and the CPUC has commissioned an evaluation to be conducted by Evergreen Economics and the BrightLine Group. If you have any questions for the CPUC about this study, please contact Sarah Lerhaupt, sarah.lerhaupt@cpuc.ca.gov.

Learn more at: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/customer-generation-evaluation

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1.3 Field Collection Form

SASH/DAC-SASH Data Collection Form		
Project ID		Field Engineer
Customer Name		
Street Address		
City		Zip Code
Phone Number		
Inspection Date & Time		
	Reported Values	*Evaluation Values*
Solar Panel Modules		
Module Quantity		
Manufacturer		
Model No.		
Mounting Method		
Tilt Angle		
Azimuth Angle		
Soiling Level		
Physical Condition		
Inverter(s)		
Quantity		
Manufacturer		
Model No.		
Distance Meter [ft, in]		
Vertical Distance (Tall)		Vertical Distance (Short)
Horizontal Distance (Between Short & Tall)		
Estimated Solar Panel Tilt Angle [DEG]		0
Pitch Gauge App		
Measurement	Estimated Solar Panel Tilt Angle [DEG]	0
Shading Factors		
JAN		
FEB		
MAR		
APR		
MAY		
JUN		
JUL		
AUG		
SEP		
OCT		
NOV		
DEC		
Photograph Checklist		
System Array(s)	Module Nameplate	Inverter Nameplate
Shading	Physical Damage	Soiling Level(s)
Additional Notes		

Appendix H: Additional Methods Detail

Table 29 on the next page illustrates how our study research (shown in the columns) aligns with the initial set of metrics identified by the RFP's scope of work (shown in the rows), which we have placed into eight research issue categories. In the table, a "P" indicates the research component intended to be the primary way that we address the corresponding metric category. An "S" indicates the research component will be secondary. As shown, we plan to often use multiple data sources to fulfill each study area of inquiry.

Table 29: Evaluation Metrics and Data Sources
(P=Primary, S= Secondary Source)

Initial metrics (from RFP SOW)	Secondary Data			Primary Data						Other Data Sources
	Program Background and Imple-mentation Documents	PA Program Tracking Data	IOU CIS and Billing Data	Participating Customer Surveys	Non-Participating Customer Surveys	In-Person Field Visits / Ride Alongs	On-Site Verification Visits	Trainee web survey	PA/ Stakeholder Interviews	
Program Administration										
Costs by program; further broken out by:		P								
Forecasted vs. actual		P								
Expenditures and uncommitted balances		P								
Type/category:		P								
Program Admin Costs		P								
Program Management		P								
IT		P								
Regulatory Compliance		P								

Initial metrics (from RFP SOW)	Secondary Data			Primary Data						Other Data Sources
	Program Background and Imple-mentation Documents	PA Program Tracking Data	IOU CIS and Billing Data	Participating Customer Surveys	Non-Participating Customer Surveys	In-Person Field Visits / Ride Alongs	On-Site Verification Visits	Trainee web survey	PA/ Stakeholder Interviews	
Direct implementation / installation costs		P								
Marketing, Education and Outreach		P		S	S					
Other TBD categories		P								
Summary of admin costs by program tasks and key milestones		P								
Identification of misallocated / overallotments of admin costs or other addressable cost drivers		P								
Program Marketing										

Initial metrics (from RFP SOW)	Secondary Data			Primary Data						Other Data Sources
	Program Background and Imple-mentation Documents	PA Program Tracking Data	IOU CIS and Billing Data	Participating Customer Surveys	Non-Participating Customer Surveys	In-Person Field Visits / Ride Alongs	On-Site Verification Visits	Trainee web survey	PA/ Stakeholder Interviews	
Enrollment % of eligible population over time		P								Estimates of market adoptions and eligible population (based on IOU data and Census/ RASS)
Effective use of IOU customer data on eligible population		S							P	
Customer Participation										
The programs' geographic coverage across the state,		P								Geographic data

Initial metrics (from RFP SOW)	Secondary Data			Primary Data						Other Data Sources
	Program Background and Imple-mentation Documents	PA Program Tracking Data	IOU CIS and Billing Data	Participating Customer Surveys	Non-Participating Customer Surveys	In-Person Field Visits / Ride Alongs	On-Site Verification Visits	Trainee web survey	PA/ Stakeholder Interviews	
including Disadvantaged Communities										
Number and location of eligible customers (SAIDs) and enrolled customers		P								Geographic data
Number and location of eligible customers not served		P	S							Geographic data
Market adoptions of rooftop solar among eligible households			P							
Size of the eligible customer market			S							Census, RASS
Number of installations completed and pending		P					S			

Initial metrics (from RFP SOW)	Secondary Data			Primary Data						Other Data Sources
	Program Background and Imple-mentation Documents	PA Program Tracking Data	IOU CIS and Billing Data	Participating Customer Surveys	Non-Participating Customer Surveys	In-Person Field Visits / Ride Alongs	On-Site Verification Visits	Trainee web survey	PA/ Stakeholder Interviews	
Overall participation levels in relation to eligible population overall and by segment		P	S							Geographic data
Number of customers who have successfully enrolled in CARE and FERA in the process of signing up for the program			P							
Other clean energy programs that customers (such as those in SJV pilot communities) have participated in along with enrolling in the program	S	P		S					S	Other program tracking data
Customer satisfaction with the program				P	S	S			S	

Initial metrics (from RFP SOW)	Secondary Data			Primary Data						Other Data Sources
	Program Background and Imple-mentation Documents	PA Program Tracking Data	IOU CIS and Billing Data	Participating Customer Surveys	Non-Participating Customer Surveys	In-Person Field Visits / Ride Alongs	On-Site Verification Visits	Trainee web survey	PA/ Stakeholder Interviews	
PA performance from perspective of participants				P		S	S			
The effectiveness of each program in addressing specific barriers to solar adoption facing low-income customers	S			P	s	S	S		S	
Perception of non-participants / exploration of program participation barriers among qualified customers	S				P	S			S	
PV System Performance										
PV System Performance Degradation - Expected v. Metered Performance							P			Optional PV system

Initial metrics (from RFP SOW)	Secondary Data			Primary Data						Other Data Sources
	Program Background and Imple-mentation Documents	PA Program Tracking Data	IOU CIS and Billing Data	Participating Customer Surveys	Non-Participating Customer Surveys	In-Person Field Visits / Ride Alongs	On-Site Verification Visits	Trainee web survey	PA/ Stakeholder Interviews	
										metered data
Cost-Benefit assessment (TRC, RIM, SCT) **(SASH only)**		P								Secondary data for C/B model inputs
Average system costs by equipment, installation, and/or other customer acquisition costs		P								
Customer Bill Impacts										
Monthly bill reduction outcomes for program participants			P	S						

Initial metrics (from RFP SOW)	Secondary Data			Primary Data						Other Data Sources
	Program Background and Imple-mentation Documents	PA Program Tracking Data	IOU CIS and Billing Data	Participating Customer Surveys	Non-Participating Customer Surveys	In-Person Field Visits / Ride Alongs	On-Site Verification Visits	Trainee web survey	PA/ Stakeholder Interviews	
Changes in post-participation customer energy usage patterns			P	S						
Environmental Benefits										
Environmental benefits - program PV installation GHG and other emission impacts (PM-10, NOx)	P	P		P					P	Secondary data on benefits
Participating and non-participating customer understanding and perception of each program's environmental or social benefits	S	S		P	P	S			S	Secondary data on benefits
Workforce Development and Job Training										

Initial metrics (from RFP SOW)	Secondary Data			Primary Data						Other Data Sources
	Program Background and Imple-mentation Documents	PA Program Tracking Data	IOU CIS and Billing Data	Participating Customer Surveys	Non-Participating Customer Surveys	In-Person Field Visits / Ride Alongs	On-Site Verification Visits	Trainee web survey	PA/ Stakeholder Interviews	
The number of leveraged job training programs	S	P								
The number of local job hires linked to the program	S	P								
The number of trainees and job outcomes	S	P				S		S	S	

Appendix I: Public Comment and Response

Table 30 on the next page includes all public comments from the public webinar on April 4, 2023. The righthand column includes the evaluation response and whether any changes were made to the report.

Table 30: Public Comment and Response

Comment #	Commenter	Item #	Page #	Comment/Feedback/Change Requested	Evaluator Response
1	SCE		2	Bullet point on pg. 2 says "Most surveyed customers (81%) reported seeing lower bills after participating in SASH" indicates some customers experienced higher bills. This should clarified to note that the higher bills are not a result of the program but due to other factors, including customer's change to energy usage patterns after solar installation, as stated on pg. 60 "while most participants exhibited substantial reductions in their electricity bills during the year after the solar installation, we confirmed that a small group of participants exhibited increases in their annual electricity bills after the solar installation."	Added footnote to main section: "Energy usage increases may be due to a variety of factors including a change in the number of people in the home, or a change in equipment."
2	PG&E		p. 12-13	The metrics are inconsistent between incentive and administrative costs. Can the administrative costs be broken down by $/W installed? This may be helpful for future budget planning purposes should a similar program be implemented.	Added values to this section of the report.
3	PG&E		p. 75-76	Are the lifecylce GHG impacts available? GHGs from panel construction and/or demolition may outweigh the benefits.	We did not do embodied carbon analysis for this evaluation.
4	GRID		6	Evergreen: "Future programs should consider implementing a fund for additional services that may be required to allow customers that are not solar-ready to participate." GRID Comment: GRID agrees and believes this should be implemented for the DAC-SASH program as soon as possible. It would be helpful to get more input from the evaluator or CPUC on where this funding can come from.	May be useful to set aside a portion of existing DAC-SASH program funds to help ensure the program can serve targeted households. Could be worth looking into newly allocated federal funding to see if there is anything to leverage.

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5	GRID		4	Evergreen: "Future programs should leverage GRID's model of administering SASH, utilizing local sources of grant funding to help cover full costs of installation so the program is no-cost to LI households. Continuing to leverage grant funding will ensure that the program funds can be used to serve more households." GRID Comment: We are pleased that the value of this model for single family PV projects is so clear.	This comment is noted but does not warrant any changes to the report.
6	GRID		6	Evergreen: "Future programs should follow GRID's model and leverage partnerships with trusted organizations and municipalities, as well as customer referrals, to build up credibility within communities they are aiming to serve." GRID Comment: We have brought this model fully into the DAC-SASH program and although it was more challenging to collaborate with partners during COVID-19, we are doubling down on this model now as we begin stack more services for these single family homes, in adittion to solar PV.	This comment is noted but does not warrant any changes to the report.

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7	GRID		59	Evergreen: "Figure 25 shows that most of the respondents (81%) reported that their bills have gone down. Only a few respondents shared that they believe their bills increased after installation (10%)." GRID Comment: As Evergreen reports, usage does increase for some customers once households go solar. This may be for a variety of reasons, including the customers swapping gas applicances for electric ones or using appliances such as air conditioners that they previously did not turn on. This points to a need for future programs to have flexiblity in sizing the system to account for customers potential load growth when appropriate. Continued education about energy conservation and efficiency programs from utility partners and GRID will further help to ensure homeowners continue to receive an economic benefit from their solar energy system.	See added footnote from SCE comment #2
8	GRID		117	Evergreen: "Respondents reported that GRID's training course provided them with the opportunities and resources needed to obtain a job in the solar industry extremely well or very well (81%)." GRID comment: Workforce development has always been a big part of GRID's mission. Although very challenging during COVID-19, our training programs are expanding in California as their value has been demonstrated, such as the IBT program expanding to the Bay Area in 2023 for example.	This comment is noted but does not warrant any changes to the report.