DAC-SASH 2022-2024 EVALUATION REPORT

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LIST OF ACRONYMS

AB	Assembly bill
AC	Alternating current
ACC	California Avoided Costs Calculator
AMI	Advanced metering infrastructure
AMP	Arrearage Management Program
CAISO	California Independent System Operator
CARB	California Air Resources Board
CARE	California Alternate Rate for Energy
CBO	Community-based organization
CCA	Community choice aggregator
CEC	California Energy Commission
CO_2	Carbon dioxide
CPUC	California Public Utilities Commission
CSI	California Solar Initiative
D.	Decision
DAC	Disadvantaged community
DAC-SASH	Disadvantaged Communities Single-family Solar Homes (program)
DC	Direct current
DER	Distributed energy resource
DER-CAT	Distributed energy resource cost-effectiveness analysis tool (Verdant's tool)
DHI	Diffuse horizontal irradiance
DNI	Direct normal irradiance
DR	Demand response (program)
EPBB	Expected performance-based buydown (calculator)
ESA	Energy Saving Assistance (program)
FERA	Family Electric Rate Assistance (program)
GHG	Greenhouse gas emissions
GHI	Global horizontal irradiance
GRID	GRID Alternatives
HCO	Host customer owned

HVAC	Heating, ventilation, and air conditioning
IBT	Installation Basics Training (program)
IDI	In-depth interview
IEPEC	International Energy Program Evaluation Conference
IOU	Investor-owned utility
ITC	Federal Investment Tax Credit
kW	Kilowatt
KWh	Kilowatt hour
LIWP	Low-income weatherization program
MASH	Multifamily Affordable Solar Housing (program)
ME&O	Marketing, education, and outreach
MW	Megawatt
MWh	Megawatt hour
NBT	Net billing tariff
NEM	Net energy metering
NPV	Net present value
NREL	National Renewable Energy Laboratory
NSRDB	National Solar Radiation Database
OASIS	Open Access Same-time Informational System
PA	Program administrators
PG&E	Pacific Gas & Electric
PSM	Physical solar model
PTO	Permission to operate
PV	Photovoltaic
QC	Quality control
RIM	Ratepayer impact measure (test)
RSSE	Residential Solar and Storage Equity (program option)
SASH	Single-family Affordable Solar Homes (program)
SCE	Southern California Edison
SCT	Societal cost test
SDG&E	San Diego Gas & Electric
SGIP	Self-Generation Incentive Program
SPM	Standard practice manual (test)

SPP	Subcontractor Partnership Program
TMY	Typical meteorological year
TOU	Time-of-use (rate)
TPO	Third party owned
TRC	Total resource cost (test)
WACC	Weighted average cost of capital

1 EXECUTIVE SUMMARY

This report represents the second evaluation of the Disadvantaged Communities Single-family Solar Homes (DAC-SASH) program. This report provides an update on the DAC-SASH program's performance over the program evaluation period (2022 to 2024) and presents estimates of the program's impacts (energy, environmental, and economic) and cost-effectiveness, an assessment of participating and non-participating customer experiences, and the progress made by the DAC-SASH PA to implement recommendations from the first DAC-SASH evaluation. It also identifies areas where further program improvements are needed based on a review of program tracking data, program administrator and subcontractor feedback, and participant and eligible customer feedback. These findings can be used to help increase program participation and satisfaction.

1.1 INTRODUCTION

In 2018, the California Public Utilities Commission (CPUC), as directed by California Assembly Bill (AB) 327 (Perea, 2013)[1] and Decision (D.) 18-06-027, created the DAC-SASH program.[2] The DAC-SASH program, modeled after the Single-family Affordable Solar Homes (SASH) Program, provides assistance in the form of financial incentives towards the installation of solar generating systems on the homes of low-income homeowners in disadvantaged communities (DACs). DAC-SASH program incentives are meant to assist low-income customers in overcoming barriers to the installation of solar energy, such as a lack of up-front capital or credit needed to finance solar installation. The DAC-SASH program incorporates job training objectives to promote green-collar jobs in low-income communities and to develop a trained workforce that will foster a sustainable solar industry in California. GRID Alternatives (GRID) serves as the program administrator (PA) for the DAC-SASH program.

Table 1-1 presents the primary research objectives for the second evaluation of DAC-SASH Program along with an overview of the research activities that will be conducted to assess these objectives. A comprehensive overview of the study's evaluation methods is provided in Section 3 of this report.

1 California Assembly Bill No. 327 (Perea, 2013). http://www.leginfo.ca.gov/pub/13-14/bill/asm/ab_0301-0350/ab_327_bill_20131007_chaptered.htm

2 CPUC D.18-06-027. Alternate Decision Adopting Alternatives to Promote Solar Distributed Generation in Disadvantaged Communities. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M216/K789/216789285.PDF

TABLE 1-1: RESEARCH FOCUS AND EVALUATION APPROACH

Research Activities*	Research Objectives
Project application data review	Summarize geographic distribution of DAC-SASH participants. Identify which projects are leveraging the storage attachment rate and completed vs. pending installations.
DAC-SASH Participant surveys	Assess customer satisfaction with the program and effectiveness of ME&O activities.
In-depth interviews with GRID, subcontractor partnership program (SPP) participants, and tracking data review of DAC-SASH applications with cancelled projects	Understand factors in application cancellation, the program's effectiveness in addressing barriers, and the effectiveness of the SPP program.
Solar and storage impact assessment	Estimate the program's energy and environmental impacts.
Utility data analytics	Determine the number and location of eligible customers not served, the number of participants enrolled in CARE/FERA/SGIP/ESA or other clean energy programs, the monthly bill reductions, and the changes in consumption post-installation of solar/solar and storage.
Program cost-benefit analysis	Quantify the program's cost effectiveness using the three SPM tests (RIM, TRC, and SCT) and provide incentive level-setting support.
Vendor assessment, program documentation review	Conduct a comparison of forecasted vs. actual expenses, PA costs, program management costs, information technology costs, regulatory compliance, implementation costs, and ME&O costs.

* The evaluation research plan also called for web surveys with job trainees to assess the skills and knowledge gained through DAC-SASH job training and determine how the training has supported trainees' careers. This research activity was not conducted as the job trainee data collected by the program implementer was insufficient to facilitate this research. Further details are provided in the Data Limitations section in Section 3.1.1.

1.2 KEY EVALUATION FINDINGS AND RECOMMENDATIONS

Key evaluation findings and recommendations are presented below.

Participant and Process Findings and Recommendations

Current Program Status

- **The DAC-SASH program had its most successful two years in terms of applications submitted in 2023 and 2024,** but internal completion goals were not achieved during the evaluation period
- **The DAC-SASH PA responded to NBT changes by offering paired or add-on storage through other complementary programs, such as SGIP**
- **DAC-SASH participation continues to vary across IOU service territories**
- **PV-only projects were completed faster in 2024 than 2022,** but still took longer than market rate
- **32% of in-scope projects were cancelled.** Construction issues (old roofs) were the main cause
- **Cancellation rate and days to cancel vary by GRID office** --> Review administrative practices from offices with lowest days to cancel projects to identify best practices
- **Cancellation rates increased from last evaluation, mostly due to construction issues** --> Add questions about roof age, roof type, or having solar to pre-screening tools
- **Ineligible projects or disinterested participants stay in the program for ~4 months before cancelling** --> create more stringent pre-screening processes for eligibility and interest
- **PV-only projects get completed at higher rates than storage paired projects, but cancellation rates aren't different** --> identify ways to accelerate storage paired projects

Key Characteristics of DAC-SASH Participants and Projects

- **DAC-SASH effectively serves all income levels that fall under the eligibility criteria**
- **32% of participants with completed projects were in arrears before the program**, but only 23% were in arrears one year post installation
- **Subcontracted projects made up 9% of all projects during the evaluation period** and had a 94% customer satisfaction rate
- **6% of all DAC-SASH projects were Tribal and had a significantly lower cancellation rate**

Program Administration

- **There were multiple data limitations that impacted the evaluation** --> review details on tracking data issues and IOU data limitations to rectify for next evaluation
- **Battery storage data is missing from tracking data** --> include key data for evaluation
- **Job trainee data can't be used to assess workforce development** --> collect additional data
- **Cost data is not collected at a granular fashion consistently** --> add additional fields
- **Cost data is likely underreporting project cost** --> track all costs for each project
- **SCE eligible customer lists were incorrect** and impacted outreach and evaluation --> SCE should update their lists, GRID should report if and when received, processes should be developed to catch and resolve issues like this in the future
- **Invoice process is confusing** --> include summary sheets to assist with review
- **Current incentive only covers ~63% of solar installation** --> increase incentive to $4.75/W
- **Subcontractor projects cost more than GRID installed projects** --> explore why install-only projects have a higher equipment cost than GRID projects
- **2022-2024 evaluation period had almost 1,000 more completed projects than last evaluation**

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Participant and Process Findings and Recommendations

Program Administration (Continued)

- **The SGIP impacted storage paired project completion rates** --> provide feedback in quarterly meetings
- **CalEnviroScreen difficult to use to identify eligible homes** --> use shapefiles to automate IDs
- **Eight subcontractors** participated in DAC-SASH during evaluation period
- **Subcontractor application can be lengthy and expensive because of insurance** --> allow subcontractors to acquire necessary insurance after application has been approved
- **Subcontractors carry a greater financial risk with the full design and install model as compared to install only** -----> Allow subcontractors to invoice more frequently to lessen financial burden

Program Marketing Activities

- **Marketing partners like IOUs and CBOs helped generate new leads** --> Expand partnerships across GRID offices, attend more community events (including townhalls, school, fairs), educate marketing partners more to help with outreach, share eligibility tools
- **19% of non-participants were aware of the DAC-SASH program** with 90% of those aware able to identify what the program offered
- **Lower electric bills and free installation were the biggest participant drivers** with word of mouth being largest source of awareness --> use solar installations as marketing events to educate neighbors; include 'Free Solar!' signs in yards
- **Direct communication and GRID's website build program trust** (i.e., not a scam) --> Gather user feedback to improve the website for accessibility, key information, and build trust.
- **GRID has many strategies to support Tribal outreach** --> add or increase working with Tribal environmental programs, hiring Tribal staff, creating materials that reflect Tribal values
- **51 DAC-SASH participants shared that they felt GRID marketing could be improved** ---> Review participant outreach ideas
- **The biggest challenges to marketing the DAC-SASH program include lack of trust, lack of interest in solar, and finding eligible customers to market to**

Customer Participation

- **90% of participants surveyed are satisfied with their solar and 87% satisfied with program overall but only 64% with billing education** --> revist how billing and true ups is explained, provide examples, share tools to help, find partners to help with billing questions
- **71% of participants surveyed report a decrease in stress around energy costs** --> consider using this information in program marketing
- **55% of participants surveyed report no challenges participating in DAC-SASH**; most common challenge is long project timelines --> next evaluation should review
- **Tribal projects have unique challenges** --> simplify the income verification process, revisit eligibility income amounts for Tribal participants, share Tribal resources across GRID offices
- **ESA participation post DAC-SASH is low for SCE (24%) and SDG&E (11%) compared to PG&E (62%)**
- **60% of participants surveyed said they made an energy saving change post DAC-SASH**
- **Participants surveyed report decreases in summer (92%) and winter (79%) energy bills**
- **72% of participants surveyed wanted battery storage but didn't get it**

Impact and Cost-Effectiveness Findings and Recommendations

PV Production and Energy Impacts Findings

- **Observed PV Production:** 1,555 MWh in 2022, 5,676 MWh in 2023, and 10,954 MWh in 2024. The observed capacity factors (DC) were 16.8% in 2022 and 2023 and 16.6% in 2024. The forecast full-year realization rate is 103%
- **Forecasted PV Production:** 12,752 MWh annually from completed in-scope projects. Forecasted capacity factor (DC) of 16.6%. The forecasted realization rate is 103%

Customer Electricity Consumption Findings

- Participants tend to increase energy consumption following PV installation

Demand Impacts Findings

- **CAISO Gross Peak** (PV only): coincident generation of 648 kW in 2022, 888 kW in 2023, and 1,658 kW in 2024. Estimated capacity factor of 40.4% in 2022, 20.8% in 2023 and 20.4% in 2024
- **CAISO Net Peak** (PV only): coincident generation of 13 kW in 2022, 83 kW in 2024, and 532 kW in 2024. Estimated capacity factor of 0.8% in 2022, 1.9% in 2023, and 6.5% in 2024
- **IOU Peak** (PV only): coincident generation ranged from a low of 19 kW in SDG&E to a high of 433 kW in PG&E in 2022. Coincident generation ranged from 9 kW in SDG&E to 599 kW in SCE in 2023. Coincident generation ranged from 19 kW in SDG&E to 599 kW in PG&E in 2024

Environmental Impact Findings

- **Observed Emissions Reductions:** 463 metric tons of CO2 in 2021, 1,333 in 2023, and 2,558 in 2024
- **Forecasted Emissions Reductions:** 3,015 metric tons of CO2 per year from completed projects. The forecasted monetary value of emissions reductions is $85,000 per year from completed projects

Economic Impacts Findings

- **PG&E Customer Bill Impacts:** $163 per month, or 68% saved on average monthly bill in 2024
- **SCE Customer Bill Impacts:** $110 per month, or 57% saved on average monthly bill in 2024
- **SDG&E Customer Bill Impacts:** $108 per month, or 81% saved on average monthly bill in 2024
- **Overall Customer Bill Impacts:** $140 per month, or 64% saved on average monthly bill in 2024

Cost Effectiveness Findings

- **Total Resource Cost Test:** NPV Total Benefits of $19M, NPV Total Costs of $42.4M, Benefit-Cost Ratio of 0.45
- **Societal Cost Test:** NPV Total Benefits of $23M, NPV Total Costs of $42.4M, Benefit-Cost Ratio of 0.55
- **Ratepayer Impact Measure Test:** NPV Total Benefits of $7.7M, NPV Total Costs of $26.4M, Benefit-Cost Ratio of 0.29

Impact and Cost Effectiveness Recommendations

- Collect and provide battery telemetry data for future evaluations
- Consider additional system maintenance and education assistance
- Research changing incentive calculations away from EPBB calculator

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2 INTRODUCTION

Verdant Associates (Verdant) was contracted by San Diego Gas and Electric (SDG&E) on behalf of the California Public Utilities Commission (CPUC) to conduct the second evaluation of the Disadvantaged Communities Single-family Solar (DAC-SASH) program, as directed by CPUC Decision (D.) 18-06-027. This report provides an update on the DAC-SASH program's performance from 2022 to 2024 and presents estimates of the program's energy, environmental, and economic impacts, program cost-effectiveness, an assessment of participating and non-participating customer experiences, and the progress made by the DAC-SASH program administrator (PA) to implement recommendations from the first DAC-SASH evaluation. It also identifies areas where further program improvements are needed to help increase program participation.

2.1 BACKGROUND

California Assembly Bill (AB) 327 (Perea, 2013) directed the CPUC to develop a standard contract or tariff applicable to customer-generators with renewable electrical generation, as a successor to then-existing Net Energy Metering (NEM) tariffs, and, as a part of this mandate, required the CPUC to develop specific alternatives designed to increase adoption of renewable generation in disadvantaged communities (DACs).[3] As directed by AB 327, CPUC D. 18-06-027 created the DAC-SASH program.[4] The DAC-SASH program, modeled after the Single-family Affordable Solar Homes (SASH) program, provides assistance in the form of financial incentives towards the installation of solar photovoltaic (PV) energy systems on the homes of low-income homeowners who reside in DACs. The incentives aim to assist low-income customers overcome a key barrier faced to installing solar PV – a lack of up-front capital or credit needed to finance the solar PV installation. The DAC-SASH program incorporates job training objectives to promote green-collar jobs in low-income communities and to develop a trained workforce that will foster a sustainable solar industry in California. The DAC-SASH program is administered statewide by GRID Alternatives (GRID). D.18-06-027 ordered that every three years, beginning in 2021, the CPUC Energy Division shall select an independent evaluator to assess the effectiveness and efficiency of both the PA and the DAC-SASH program overall. This report represents the second triennial evaluation of the DAC-SASH program.

3 California Assembly Bill No. 327 (Perea, 2013). http://www.leginfo.ca.gov/pub/13-14/bill/asm/ab_0301-0350/ab_327_bill_20131007_chaptered.htm

4 CPUC D.18-06-027. Alternate Decision Adopting Alternatives to Promote Solar Distributed Generation in Disadvantaged Communities. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M216/K789/216789285.PDF

2.2 PRIMARY ASSESSMENT AREAS

Table 2-1 below documents the primary areas of research focus, our evaluation approach, and where this information can be found in the report.

TABLE 2-1: RESEARCH ACTIVITIES AND OBJECTIVES

Research Activities	Research Objectives	Report sections
Project application data review	Summarize geographic distribution of DAC-SASH participants.	Section 4.1
	Identify which projects are leveraging storage.	Section 4.1
	Identify completed vs. pending installations.	Section 4.1
	Analyze DAC-SASH applications with cancelled projects to understand factors in application cancellation	Section 4.1.2
DAC-SASH Participant surveys	Assess customer satisfaction with the program and effectiveness of ME&O activities.	Section 5.2 Section 5.3
In-depth interviews with GRID and subcontractor partnership program (SPP) participants	Understand the program's effectiveness in addressing barriers and the effectiveness of the SPP.	Section 5.1
Solar and storage impact assessment	Estimate the program's energy and environmental impacts.	Section 6.1 Section 6.4
Utility data analytics	Determine the number and location of eligible customers not served.	Section 4.1 Section 5.2.1
	Determine the number of participants enrolled in CARE/FERA/SGIP/ESA or other clean energy programs.	Section 4.2.2 Section 5.3.3
	Determine the monthly bill reductions.	Section 6.5
	Determine the changes in consumption post-installation of solar/solar and storage.	Section 6.2
Program cost-benefit analysis	Quantify the program's cost effectiveness using the three Standard Practice Manual (SPM) tests (RIM, TRC, and SCT) and provide incentive level-setting support.	Section 7
Vendor assessment, program documentation review	Conduct a comparison of forecasted vs. actual expenses, PA costs, program management costs, information technology costs, regulatory compliance, implementation costs, and ME&O costs.	Section 5.1.1

2.3 REPORT ORGANIZATION

The remaining sections of this report are organized as follows:

- **Section 3: Evaluation Data Sources and Methods.** This section provides an overview of the evaluation methods used to answer the primary research questions. It includes a summary of the data collection activities, sample sizes, and quantitative analyses completed.

- **Section 4: Participation Assessment.** This section provides a summary and assessment of DAC-SASH participation to date.
- **Section 5: Process Assessment.** This section presents the results of the DAC-SASH process assessment activities.
- **Section 6: Impact Assessment.** This section presents the results of the DAC-SASH impact assessment. It includes estimated energy, environmental, and economic impacts of DAC-SASH projects.
- **Section 7: Cost-Effectiveness Assessment**. This section provides the results of the DAC-SASH cost-effectiveness assessment.
- **Section 8**: **Progress on Prior Recommendations.** This section provides an update on prior recommendations.
- **Section 9: Findings and Recommendations.** This section presents a summary of the findings and recommendations from the participation, process, impact, and cost-effectiveness assessments of the DAC-SASH program. It also includes recommendations for future research.
- **Appendix A: Data Collection Activities, Interview Guides, and Survey Instruments.** This section summarizes the data collection activities conducted for this evaluation. It also includes interview guides for the DAC-SASH PA, subcontractors, IOUs, marketing partners, and GRID Tribal manager, and survey instruments for DAC-SASH participants and non-participants.
- **Appendix B: Customer Electricity Consumption Regression Methodology.** This section includes further details describing the methodology used for the customer electricity consumption change analysis.
- **Appendix C: California Air Resources Board Greenhouse Gas Savings.** This section includes the estimated lifetime greenhouse gas emissions reductions attributable to proceeds per the California Air Resources Board requirements.
- **Appendix D: Cost Data Collection Recommendation.** This section provides recommendations on what cost data should be collected to facilitate understanding both the total and disaggregated cost of installing solar through the DAC-SASH program.
- **Appendix E: Participant Survey Recommended ME&O Activities.** This section documents the marketing and outreach ideas shared by survey participants.
- **Appendix F: Solar Readiness Issues by GRID Office.** This section provides an overview on what solar readiness issues afflict each GRID office most.

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3 EVALUATION DATA SOURCES AND METHODS

In this section we provide an overview of the data sources, tools, and methodologies used to evaluate the DAC-SASH program. For more detailed information (such as survey instruments or modeling specifications) see the appendices.

3.1 DATA SOURCES AND TOOLS

The primary data sources used in this evaluation included a mix of pre-existing data sources and data collected during evaluation research activities.

Pre-existing data sources

- **DAC-SASH Program Tracking Database** (as of December 31, 2024). This dataset includes DAC-SASH program tracking data, including data on completed, active, and inactive/cancelled projects. This data was used to assess program participation from 1/1/2022 through 12/31/2024 and to develop the sample frame for the participant web surveys.

- **GRID Cold Lead Database.** This database contains recent contact information for eligible customers that GRID has engaged with, but who chose not to participate in the DAC-SASH program (program non-participants). This contact data was used to develop the sample frame for the non-participant web surveys.

- **IOU Eligible Customer Leads.** These are yearly datasets of potentially eligible customers that the IOUs provide to GRID as mandated by D.20-12-003. The datasets are created by identifying Energy Saving Assistance (ESA) program customers located in DACs.

- **National Solar Radiation Database (NSRDB) weather data**.[5] This weather data includes both typical (most representative of a span of years) and historical (single year) weather data files sites in a 4x4 km grid across the United States.

- **Investor-owned utility (IOU) and California Independent System Operator (CAISO) hourly load** from 2022 through 2024 from the CAISO Open Access Same-time Information System (OASIS) website.[6]

- **Marginal greenhouse gas (GHG) emissions** data developed by WattTime.[7] The real-time marginal carbon dioxide (CO_2) emissions signal was developed for the Self-Generation Incentive Program (SGIP) and is considered a reliable approximation of actual conditions during a particular year.

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5 https://nsrdb.nrel.gov/data-sets/us-data

6 http://oasis.caiso.com

7 http://sgipsignal.com

- **The 2024 CPUC Avoided Cost Calculator v1b**[8] which includes hourly utility avoided costs by climate zone.

- **Sunrun PV generation data.** Metered PV interval generation data from 2022 through 2024 (or the permission to operate (PTO) date through 2024) for completed DAC-SASH projects was requested from Sunrun for all completed DAC-SASH projects owned by Sunrun. 91% (1,756/1,922) completed in-scope projects are owned by Sunrun.

- **Utility advanced metering infrastructure (AMI) hourly interval usage and billing data** for DAC-SASH participants. This data was collected from utilities for completed DAC-SASH projects starting on the system's PTO date. Additional billing information was collected, including rate selections over time and CARE participation status.

- **Utility CARE/FERA/other program data** for DAC-SASH participants. This data was collected from utilities for completed projects from 2022 to 2024.

- **Utility arrearage data** for DAC-SASH participants. This data was collected for completed projects for one year prior to the evaluation period (1/1/2021) to the completion of the evaluation period (12/31/24).

In-depth Interviews (IDIs) and web surveys with program administrators, marketing partners, and participants

- **1 IDI** with the DAC-SASH program administrator,

- **2 IDIs** with participating DAC-SASH subcontractors,

- **3 IDIs** with partnering IOUs,

- **2 IDIs** with marketing partners,

- **1 IDI** with GRID's Tribal manager, and

- **297 web surveys** with DAC-SASH participants (n = 146) and non-participants (n = 151).

Additional tools

- **Verdant's Distributed Energy Resource Cost-effectiveness Analysis Tool (DER-CAT)**. Verdant maintains a model to evaluate the cost-effectiveness of distributed energy resources (DERs) using CPUC Standard Practice Manual (SPM) tests. The model also includes a bill savings module that calculates customers' total bill payments under various NEM 2.0 or Net Billing Tariff (NBT) scenarios.

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8 A copy of the 2024 Avoided Cost Calculator and documentation can be found here: https://www.cpuc.ca.gov/dercosteffectiveness

- **PVLIB Python Package.** This package is an open-source software, initially developed by Sandia National Laboratories.[9] *Pvlib-python* uses different simulation models to estimate electricity production of grid-connected PV systems. We chose to use the PVWatts simulation model because it is a transparent and widely accepted PV generation model. Additionally, PVWatts (though, an earlier version of it) is the basis of the expected performance-based buydown (EPBB) calculator used to calculate DAC-SASH incentives.

3.1.1 Data Limitations

The following section details limitations the evaluation team encountered with different data streams required for the DAC-SASH program evaluation. These issues include limitations around incomplete and inconsistent data.

Tracking Data Limitations

The DAC-SASH program tracking database includes detailed project-level information (e.g., customer contact, application status, system sizing). Below we note some limitations we identified with the battery storage, job trainee, and cost data included within this database.

Battery Storage Data

The evaluation team originally planned to collect the capacity of storage projects and simulate battery dispatch as part of our impacts assessment. However, as battery storage is not a part of the DAC-SASH program, the data necessary to conduct this analysis was often missing (e.g., recording a completed storage project as having zero kWh capacity). This prevents us from reporting metrics on battery storage adoption and modeling likely storage dispatch. Because of this data limitation, we have removed this analysis from the report.[10]

Only 2% (41/1,922) of DAC-SASH projects in the scope of this evaluation are classified as paired with storage or storage add-on projects, and 71% of those 41 projects had PTO dates in 2024. As such, these projects have minor influence on the overall DAC-SASH program impacts covered by this evaluation. If understanding the impact of battery storage projects becomes important for the DAC-SASH program

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9 William F. Holmgren, Clifford W. Hansen, and Mark A. Mikofski. "pvlib python: a python package for modeling solar energy systems." Journal of Open Source Software, 3(29), 884, (2018). https://doi.org/10.21105/joss.00884

10 The inclusion of a few dozen projects paired with storage with limited operations during the evaluation period would provide anecdotal evidence at best. Notably, this evaluation does assess the process-related questions for systems paired with storage. The SGIP Annual Impact Evaluations provide an in-depth assessment of the energy, environmental, and bill impacts of PV systems paired with storage.

moving forward, we recommend ensuring all key information (e.g., battery size, capacity, cost) is collected consistently for all storage paired and add-on projects.

Job Trainee Data

The original evaluation plan was to use GRID's job trainee data to submit surveys that could enable us to assess trainees' experiences working on DAC-SASH projects, both in terms of skills or knowledge gained and ease of participation, and whether the DAC-SASH job training helped them secure longer-term employment within a clean energy field. Specifically, Verdant was hoping to quantify metrics such as:

- The number of leveraged job training programs
- The number of local job hires linked to the program
- The number of trainees and job outcomes from the program

Currently, the job trainee data GRID collects is insufficient to accomplish any of these research goals. GRID's tracking data cannot reliably differentiate between job trainees, interns, and volunteers. The focus of our surveys and analyses would need to exclusively be job trainees as the mission of workforce development doesn't apply to volunteers. GRID states in their Q3-Q4 Progress Report that a volunteer could be, '…community volunteers seeking experience, corporate volunteers participating in team-building events, or attendees of community-based events hosted by GRID.', so surveying them and analyzing their data as part of a workforce development initiative would not be appropriate for this analysis. The previous evaluation conducted their surveys on a mix of SASH and DAC-SASH 'trainees', asking them to self-report as either a job trainee or volunteer. Half of all respondents asserted they were volunteers. Given that Verdant has a much smaller pool to work with compared to the previous evaluation (n = 336 participants) as we are only evaluating the DAC-SASH program, and operating under the assumption that volunteer rates would be similar to the last evaluation, we concluded that we would likely not reach a sufficient number of job trainees to survey to provide statistically robust results.

It's important to note that GRID does work to survey participants in their programs, so some data for DAC-SASH trainees, interns, and volunteers does exist. However, the data is not DAC-SASH specific and so can't be used to evaluate the impact of DAC-SASH workforce development (i.e., data represent GRID job training programs – like GRID's Installation Basics Training (IBT) program - not DAC-SASH). We believe GRID has a strong framework that could be modified and expanded to collect the information needed to robustly evaluate workforce development – a core component of the program since its inception. Table 3-1 below documents where data is currently incomplete, missing, and what could be done to address the data limitation for future evaluations.

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TABLE 3-1: JOB TRAINING DATA LIMITATIONS AND RECOMMENDATIONS

Data Limitation	Recommendation
No way to accurately differentiate between trainee, intern, and volunteer	Include a variable in the system as well as a standardized and required protocol to report out the status of the worker (trainee, intern, volunteer) for all DAC-SASH job training opportunities
No way to determine role on project and skills gained (can’t differentiate between job training program and DAC-SASH work experience with current tracking data)	Collect information on what role each job trainee fulfilled on each DAC-SASH project and have a specific survey just to evaluate DAC-SASH training opportunities (could be as simple as a few questions they fill out post-installation that are tied to workforce development metrics and goals for the program)
Can’t determine local hiring[11] - 20% of job trainee addresses missing - 52% of job trainees missing work outcome information - Only 41% of job trainees had a viable address and job outcome data - Address and job training outcome not provided for most Solar Corps fellows	Ensure basic contact information (including address) is collected for each job trainee. Consider collecting additional hiring data such as, 1) the field the job was in (solar, adjacent, etc.), 2) if the job was a full time position, 3) if the job was a short term or long-term hire, 4) location of the hiring company (in a DAC?), 5) if the trainee moved out of a DAC for work.
Can’t determine job outcomes and wages	Schedule regular follow ups for DAC-SASH job trainees to ask: 1) did you get a job and when, 2) where and what role, 3) how much do you get paid. Also record the wages job trainees earn working with subcontractors.

Cost Data

Project cost data (installation and equipment) does not lend itself to disentangling different component costs. For example, the current tracking data system does not allow for the accurate determination of what aspects of solar installation would be covered by the program vs. what would not be (i.e., actual solar installation vs. solar readiness). The distribution of labor costs (e.g., GRID vs. subcontractors or installation vs. customer education) is also unclear. Finally, for cost components that are broken out, it’s not possible to use GRID’s individual reported component costs to re-calculate the final cost they report out for the project. This makes calculating and analyzing program costs difficult, and we acknowledge that what we report out here may be an under-representation of the true costs of these projects because of these tracking data limitations.

Verdant recommends including additional fields in the tracking data that separate equipment, labor, solar readiness, storage, and subcontracted service components to allow for more transparent roll-ups and program-level evaluation. We’ve provided an example of the level of detail we recommend for this

[11] GRID works to collect contact information for job trainees and reports on trainees in DACs in their Semi-Annual reports.

initiative in Appendix D. Note that GRID is already collecting some information at this level; it's just not being consistently employed across all projects.

IOU Data Limitations

Rate Data

The rates analysis used utility billing data to identify customer rate schedules before and after their PTO date. However, SCE's billing data showed only the most recent rate schedule per customer throughout the entire observation period, failing to capture temporal changes in rates. This limitation does not reflect actual customer behavior, as customers typically transition between rate programs over time, particularly following solar PV system installation. While this limitation can be resolved with an improved query, there were too many data delays which meant it was impossible to go back to SCE to resolve this issue while meeting study timelines.

To address this limitation, the analysis used SCE program tracking data when determining pre- and post-PV rate schedules for SCE customers. This alternative data source provides more accurate rate transition information, though it should be noted that program tracking data and billing data are not always perfectly aligned.

Eligible Customer Data

Verdant used eligible customer data from IOU lists delivered to GRID as part of D.20-12-003. These lists are created using utility information on customers that qualify for CARE/FERA, reside in a DAC, and have participated in ESA. However, since 2021, SCE's lists were inaccurate; using outdated filtering methods that included using ESA treated dates from 2003-2006 (which are not viable) that made the lists unusable. As such, SCE is excluded from this evaluation's eligible customer analysis.

GRID reported that SCE had staff turnover in 2021 which contributed to the eligible customer data issues, noted above. GRID began working with SCE's new staff in early 2025 but had still not received a corrected eligible list as of September 2025. D.20-12-003 mandates the IOUs to provide eligible customer data to GRID. The lack of key outreach data for four (or more) years from one of the IOUs is a significant challenge for DAC-SASH implementation. We recommend the CPUC require GRID to report if and when they have received the mandated SCE data for this year. The CPUC and GRID should ensure a process is in place where GRID can track and report on issues like this to the CPUC.

3.2 EVALUATION METHODOLOGY

Below we present the primary study methods utilized in each of the four evaluation assessment areas.

3.2.1 Participant Assessment

Current Program Status

Project Breakdown

We constrained projects to be analyzed in this evaluation using the following criteria: 1) the project had to have an application date within the evaluation period (1/1/2022-12/31/2024), 2) be active (i.e., not reported as inactive or completed) during the evaluation period, 3) be cancelled during the evaluation period, or 4) be completed during the evaluation period. Essentially, if a project was completed prior to 1/1/2022 or applied on or after 1/1/2025 they were excluded from our analysis.

There were three types of projects recorded in the tracking data that we analyzed.

- PV-only: The applicant only has a PV system installed as part of their DAC-SASH participation
- PV + Storage Add-on: a DAC-SASH PV system is retrofitted with a battery
- PV + Storage Paired: a DAC-SASH PV system and battery storage are designed and installed at the same time

To determine participating project locations (those in the tracking data provided by GRID during our evaluation period, as noted above) as compared to eligible customers, we used utility data provided to GRID from SDG&E and PG&E that identified ESA participants who were in DACs. Participant projects were mapped using latitude and longitude coordinates from the program tracking data, with six entries removed due to coordinates falling outside California or missing location data. Non-participant eligible households were mapped using 2023 IOU provided leads data containing street addresses from PG&E and SDG&E. SCE eligible customer data was excluded from this analysis because their list of eligible addresses was derived using an incorrect methodology (See Data Limitations Section 3.1.1). Street addresses were geocoded into latitude and longitude coordinates using a combined approach with the U.S. Census Geocoding Application Programming Interface (API) and the Google Geocoding API. GRID office locations were mapped using coordinates derived from addresses listed on their website.[12] IOU service territories were mapped using electric service area boundaries only, excluding gas service territories.[13]

DACs were mapped using shapefiles encompassing both CalEnviroScreen-designated DACs and Tribal regions.[14] Each DAC polygon was assigned to the IOU territory with which it had the greatest spatial

12 GRID office locations found here: Contact Us | GRID Alternatives

13 IOU shape files from here: Electric Load Serving Entities (IOU & POU) - Dataset - California Open Data

14 DAC and tribal spatial data from here: https://gis.carb.arb.ca.gov/portal/apps/experiencebuilder/experience/?id=5dc1218631fa46bc8d340b8e82548a6a&page=Priority-Populations-4_0

overlap, then color-coded accordingly. Participant and eligible non-participant households were overlaid on these territories. Tribal participant projects, identified through program tracking data, are shown in orange. The evaluation team used CalEnviroScreen version 4.0 and Tribal regions based on CalEPA's identification of lands under the control of federally recognized Tribes. Based on our analysis, GRID served households in DACs or Tribal territories.

Project Completion Times

To analyze project completion times of DAC-SASH projects we constrained our analysis to only those projects that were submitted in 2022, 2023, and 2024. We then compared their incentive paid date (the variable confirmed by GRID to mark a project's completion) to their application submission date to determine the length of time it took to complete a project.

We also analyzed how long projects that were active (but not completed) had been in the program during our evaluation period (e.g., may have applied to be in program in 2022 but still not completed in 2024). We constrained this analysis to projects that applied during the evaluation period and compared the last date of the evaluation (12/31/24) to the application submission date to determine how long still active projects have been in the program.

Application Cancellations

There were 1,067 cancelled projects during our evaluation period. Each project could have multiple reasons for a project being listed as 'inactive' (i.e., GRID's terminology for cancelled). We condensed the 35 distinct cancellation reasons into 10 categories to make analyzing the cancellation reasons easier. This was done by lumping similar reasons together (e.g., 'Construction - Old Roof' and 'Construction - Code Issues' would both fall under a general 'Construction Issues' category).

To determine whether cancellation rates varied by project type (PV-only vs. PV + Storage Paired) we conducted a chi-square test.

Key Characteristics of DAC-SASH Participants

Household Size and Income

Several analyses were conducted to assess the household size and income of DAC-SASH participants. We first compared median household size and income for DAC-SASH participants and surveyed non-participants to qualitatively assess whether there were differences in household size or income between these two groups. To do this we used the income reported in the DAC-SASH tracking data provided by GRID (Total Annual Income) and removed all records with negative incomes or annual incomes equal to $0. We then compared participants' median income to non-participants' income that was collected as part of the non-participant survey. Survey respondents were asked how many people lived in their household and then were shown a corresponding CARE income band and asked if they made more or less than the reported value (e.g., if respondents had four people living in their home, they were shown $64,300 and asked if they made more or less than that number). To determine the median range of this value we approximated each household's income based on whether they reported being above or below their CARE income threshold for their household size, assigning values $100 below or above the relevant CARE band and then identifying the midpoint of the ordered distribution.

We calculated the average annual pre-solar energy use for participants who enrolled in the pilot in 2023 and 2024, and the corresponding average annual energy usage of non-participants during the same periods. The non-part usage was calculated using the IOU provided eligible customer leads files.[15] We de-duplicated raw usage data by normalized address, city, and email combinations. For duplicate records, monthly consumption values were summed when usage patterns differed across records, or the first value was retained when usage was identical. To ensure the non-participant sample excluded program participants, all records matching participant addresses or emails from the corresponding year were removed. Any usage values below zero were filtered out. Annual usage was then calculated by averaging twelve months of consumption data for PG&E, annualizing average monthly values for SDG&E 2023, or averaging annual usage values for SDG&E 2022 data. Participant usage was calculated using the "estimated usage before solar Genability[16]" field from program tracking data, segmented by utility and application year, then averaged across utility-year combinations.

We evaluated whether those that participate in the program are those at the highest levels of the income threshold that the program can serve. We used the income information in the DAC-SASH tracking data provided by GRID (Total Annual Income) with negative incomes and $0 incomes removed. We partitioned participants into the corresponding household bands to determine care eligibility (e.g., one-two person household, three-person household, four-person household) and created a histogram to visually assess whether only the highest income individuals within each household group are served by the program.

Rates and CARE/FERA Status

We evaluated the distribution of rates for completed projects before and after PV installation. For PG&E and SDG&E, we used utility-provided monthly billing data. The "before" rate was identified as the rate schedule in effect during the billing period immediately preceding or closest to the project's PTO date. The "after" rate was determined as the most frequently occurring rate schedule following the PTO date. For PG&E, 3% of the projects did not have sufficient billing data after the PTO date, so their "after" rate was determined using the program tracking data. For SDG&E, three completed projects were excluded from the rates analysis because they did not have billing data provided. For SCE, the billing data provided

[15] We were given leads data from PG&E for 2022 and 2023, SD&GE for 2022, 2023, and 2024. SCE data were not used because of issues around how the lists were generated. See Section 3.1.1 for details.

[16] Genability is the company used to estimate solar use. This name is included in the variable used for the analysis.

contained one static rate for each account throughout time, which did not capture temporal rate schedule changes. Consequently, we used program tracking data for both SCE's "before" and "after" rates.

We also evaluated customer participation in similar qualifying programs (e.g., CARE/FERA, ESA) before and after enrollment in DAC-SASH. We used utility-provided billing and program enrollment data and identified the earliest enrollment date for each program by account, then determined whether this enrollment date occurred before or after the customer's DAC-SASH application date. For PG&E, 10% of projects in the CARE, FERA, and MBL analysis had insufficient billing data prior to the application submission date. For SCE, three completed projects were excluded from the analysis due to missing AMP, CARE/FERA, or MBL enrollment data.

Arrearages

We analyzed instances of arrearages prior to DAC-SASH enrollment as well as how participant arrearages change post program participation. We leveraged monthly arrearage data from the utilities (PG&E, SCE, and SDG&E) for all completed projects that were started during the evaluation period. The data was provided from one year prior to the evaluation start (1/1/2021) through the end of the evaluation (12/31/24). This allowed us to know each participant's arrearage situation prior to participation and track arrearages up to a year after for those individuals who completed projects by the end of 2023. For pre-arrearage data, we used the monthly arrearage value closest to the application submission date. In most cases, this was the same or prior month to their application submission (for example SDG&E had 24 participants where arrearage data from the same month was used, 12 that were in arrears within 1-6 months before enrollment, and 11 records where the arrearage was 7-12 months prior). We also assessed the arrearage in the month that interconnection occurred and one year post interconnection (when possible; this was not feasible for projects completed in 2024).

Key Characteristics of DAC-SASH Projects

We leveraged the DAC-SASH tracking data provided by GRID to create tables and conduct analyses.

Subcontracted Projects

We leveraged DAC-SASH tracking data to explore how subcontractor project numbers vary by GRID office. Projects were classified as subcontracted if the "provider organization name" was filled in, and all other projects were categorized as GRID-installed. To visualize the geographic distribution of installation types, projects were mapped using the latitude and longitude coordinates provided in the tracking data, with color coding applied based on subcontractor status.

3.2.2 Process Assessment

The DAC-SASH process analysis serves to assess the administration of the program (including program costs), the programs marketing activities, and customer participation. To support the process assessment we conducted a total of nine IDIs and 297 web surveys. We detail our methodology for different components below.

Program Administration

Program Expenditures

We compared DAC-SASH invoices from GRID delivered to the CPUC from January 2022 through December 2024 to the budget set by D.18-06-027. Invoices were already broken down by administration costs vs. ME&O costs. We used the DAC-SASH tracking data provided by GRID to determine the amount of customer incentives spent each program year (using the ‘Funding Amount’ variable and determining completed projects as those with a ‘PF Last Incentive Claim Submitted Date’ in alignment with GRID’s counseling on project and cost data).

Project cost analyses used DAC-SASH tracking data provided by GRID. Variables used were in accordance with GRID recommendations (e.g., ‘System Cost Calculated’ = ‘Installation Cost’ + ‘Equipment Cost’ and represents the total cost of the project).

Program Implementation

We interviewed GRID Alternatives as the program administrator to understand the successes and challenges with implementing the DAC-SASH program. We also interviewed two subcontractors to gain insight into the SPP. Interview guides can be found in Appendix A.

Program Marketing Activities

We interviewed IOU representatives from PG&E, SCE, and SDG&E to understand their role in supporting the DAC-SASH program. Interview guides can be found in Appendix A. We also leveraged IOU supplied eligible customer lists (mandated under D.20-12-003) to compare participant and eligible customer locations across IOU and DAC territories.

We reviewed 152 non-participant surveys and 146 participant surveys to evaluate program awareness, drivers, and the effectiveness of DAC-SASH ME&O. We collected data on the language of the survey respondent to ensure that surveys were taken by a representative mix of program languages. During the evaluation period, 71% of DAC-SASH participants spoke English, 22% spoke Spanish, and 7% spoke a combination of other languages. Our participant survey results indicate that we had 74% English speakers, 20% Spanish speakers, and 6% other languages respond to the survey. Data on non-participant language was not available, so understanding how representative the non-participant survey responses were is unknown, but we had 82% English speakers respond to the survey, 14% Spanish speakers, and 4% other languages. Survey guides are available in Appendix A.

Customer Participation

Customer participation was analyzed using the same surveys as the program marketing activities portion of the process analysis.

Cross program enrollment was analyzed by comparing the DAC-SASH application date to program enrollment dates for ESA, AMP, and other energy efficiency or electrification programs provided by the IOUs.

3.2.3 Impact Assessment Methods

Between January 1, 2022 and December 31, 2024, a total of 1,922 DAC-SASH projects were completed and received final incentive payments. The key objectives of the impact assessment are to estimate the energy, environmental, and economic impacts of these completed DAC-SASH projects in 2022 through 2024.

To develop these impacts, we first estimated DAC-SASH systems' PV production, analyzed the potential change in customer energy consumption, and estimated the change in utility load after system installation.

PV Production and Energy Impacts

Several types of PV production estimates are reported throughout Section 6 (Impact Assessment Results). These include Simulated PV production, Observed PV production, and Forecasted PV production.

Simulated PV Production

We simulated hourly PV generation for all completed DAC-SASH projects between January 1, 2022 and December 31, 2024. These simulations were used to develop forecasted PV production estimates and estimate actual PV production for sites with missing or incomplete metered generation data. We created two types of simulations: Typical weather, and actual weather simulations using 2022 through 2024 actual weather data as well as typical meteorological year (TMY) weather data.

PV generation simulations were created using the python package, *pvlib-python*. This package is an open-source software, initially developed by Sandia National Laboratories.[17] *Pvlib-python* uses different simulation models to estimate electricity production of grid-connected PV systems based on various inputs. We chose to use the PVWatts simulation model to best align with the EPBB calculator used to

[17] William F. Holmgren, Clifford W. Hansen, and Mark A. Mikofski. "pvlib python: a python package for modeling solar energy systems." Journal of Open Source Software, 3(29), 884, (2018). https://doi.org/10.21105/joss.00884

calculate incentives.[18] P*vlib-python* requires, at a minimum, the following inputs to simulate hour-by-hour output over a period of one year for any PV system: nameplate capacity (direct current (DC)), tilt, azimuth, inverter efficiency, latitude, longitude, elevation, and associated weather data. Table 3-2 shows the list of inputs required for the p*vlib-python* simulation along with the value or source of value used for this evaluation. Some DAC-SASH projects in the tracking data contained modules with different models, tilt, and/or azimuth. For this reason, each module was simulated individually with *pvlib-python*, and the hourly generation for a given project was calculated as the sum of each module's output within the hour.

TABLE 3-2: PVLIB-PYTHON REQUIRED INPUTS WITH SOURCE OR ASSUMPTION USED

Pvlib-Python Input	Value/Source
Nameplate Capacity (DC)	Program Tracking Data
Tilt	
Azimuth	
Inverter Efficiency	
Weather Data	NSRDB PSM (National Solar Radiation Database Physical Solar Model) v4 Weather Data
▪ Latitude, Longitude, Elevation	
▪ Dry Bulb Temperature	
▪ Direct Normal Irradiance (DNI)	
▪ Global Horizontal Irradiance (GHI)	
▪ Wind Speed	
▪ Diffuse Horizontal Irradiance (DHI)	
▪ Solar Altitude Angle	
Array Type	Fixed – Roof Mounted
Module Type	Standard

We used NSRDB weather data to develop simulated PV production. NSRDB provides both typical year weather files (most representative of a span of years), and historical weather data for sites in a 4x4 km grid across the United States. For typical simulations, we used the typical weather dataset known as TMY2024,[19] which represents typical weather from years spanning from 1998 to 2024.

To select the appropriate weather locations for each DAC-SASH project, we geospatially mapped each DAC-SASH project to find its closest NSRDB location. All projects utilized weather data from a station within four kilometers of the site address.

[18] California Solar Initiative (CSI) EPBB Calculator - Documentation (csi-epbb.com)

[19] Per NSRDB: 'TMYs contain one year of hourly data that best represents median weather conditions over a multiyear period. A TMY file is created by concatenating 12 typical meteorological months from statistically analyzed and selected individual months from the entire set of available years [1998- Present]"

Observed PV Production

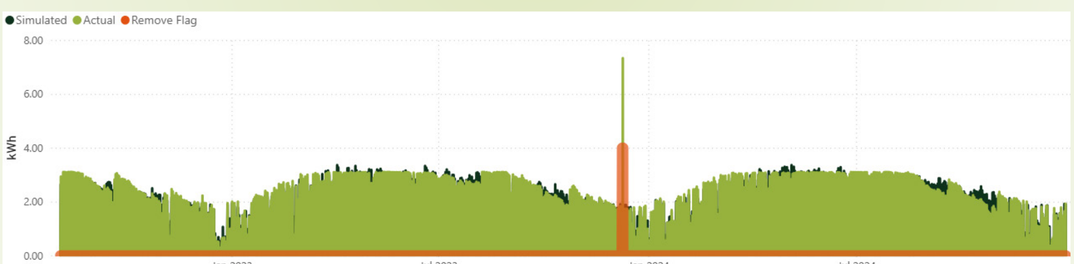
Where available, Observed PV Production represents the actual metered PV generation provided by Sunrun. Of the 1,922 in scope DAC-SASH projects, 1,756 are owned by Sunrun. Of those, the evaluation team received interval PV generation data for 1,743 (99%). We conducted quality control (QC) and validation of the PV production data.

Verdant looked for anomalies in the data, including abnormally high readings,[20] instances where the different data sources did not agree, instances of nighttime generation, and instances where metered data differed significantly from simulated. We flagged cases of abnormal operations, such as where the meter data indicated possible failed inverters or where metered data was poorly performing for unknown reasons. We identified cases where certain time periods should be removed from analysis or where the entire metered dataset for a project was considered unreliable and therefore unusable. In addition to these automatic QC procedures, the team also utilized a PowerBI dashboard to visually assess metered and simulated PV generation. Based on our QC processes, only one project had more than one month of provided generation data flagged as unreliable, and therefore not used in the analysis, and only 42

Quality Control Dashboards

The screenshot below highlights the approach taken to manually review the data collected to ensure quality data. While the text is too small to read, the figure is provided to demonstrate the benefits of a graphical representation of metered data, overlaying different streams of PV generation data (**dark green is PV-Lib simulated**, **light green is Sunrun data**, and **red is a flag for timestamp removal** generated through our automated QC procedure). The QC dashboard is filterable by project number and highlights details about the PV system.

In this example, the **Sunrun data** matches the **PV-Lib simulated** data, during the entire time-period except for a single day in December 2023, where generation far exceeds system capacity. The auto-QC procedure marked this day for removal, indicated by the spike in the red highlighted band.



[20] Readings that are significantly higher than the rated capacity of the system and therefore not physically capable of being generated.

projects had more than one day of generation data flagged for removal from analysis.[21] However, 121 Sunrun owned DAC-SASH projects were missing data for 10% or more of the expected date range (PTO date through December 31, 2024), with 24 of those missing 50% or more of the requested data, and 13 Sunrun owned DAC-SASH projects' PV generation data was completely missing. No PV generation data was requested for the 166 DAC-SASH projects that are not owned by Sunrun. In total, 1,635/1,922 (85%) of projects had QC'd PV generation data for 90% or more of the requested time interval, and 179 projects had no associated PV generation data.

To allow estimates of actual program impacts considering all in-scope projects, it was necessary to estimate Observed PV generation for projects and timestamps where actual generation was not collected, missing or deemed unreliable. To do so, the evaluation team developed year-month-hour-utility-age of system PV ratios using the average hourly observed generation for each month divided by the average hourly simulated generation for each month. These ratios represent an adjustment to allow conversion from simulated PV data to generation levels that are more closely aligned with actual PV generation. For customers missing less than 20% of their actual generation data in each month, project-specific year-month-hour PV ratios were applied to actual-weather based simulated generation to generate estimated Observed PV production. For customers missing more than 20% of their actual generation data (including all non-Sunrun owned systems), utility specific year-month-hour-age of system PV ratios (24 hours x 12 months = 288 ratios per year per system age, in years) were developed and applied. The utility specific PV ratios include the age of system in the groupings to account for any impacts of age-related performance degradation which will naturally be captured in the site-specific year-month-hour ratios.[22] [23]

Forecasted (Expected) PV Production

The evaluation team forecasted the expected hourly and annual PV generation for all 1,922 in scope projects. These forecasted results reflect typical weather PV simulations. Because we don't always expect that installed systems will behave exactly as simulations would expect, we applied the 2024 month-hour PV ratio (defined above) to the typical-weather simulated PV generation to account for differences in observed and simulated data, incorporating the latest available data (2024).

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[21] The primary driver of data being flagged as unreliable were cases where generation significantly exceeded system capacity.

[22] The 2021 CSI reported an average of 1.35% per year degradation in performance of solar PV systems. calmac.org/publications/CSI_Evaluation_Report-2.pdf

[23] Embedded in this approach is the assumption that non-Sunrun owned projects (representing less than 10% of all program systems) are performing similarly relative to their project-specific simulated generation values as Sunrun owned systems are.

PV Realization Rate

As a measure of system performance, we used the annual EPBB PV production from the program tracking data as the basis to calculate a PV realization rate for DAC-SASH projects. Two different DAC-SASH program realization rates were calculated:

- The **forecasted realization rate** reflects the forecasted (expected) PV production divided by the estimated annual EPBB PV production provided in the program tracking data.
- The **observed realization rate** reflects the observed PV production (as defined above) divided by the estimated annual EPBB PV production provided in the program tracking data.

The EPBB annual PV production estimates match the value used to calculate the DAC-SASH incentive. This PV production estimate is developed using the CSI EPBB calculator, driven by the National Renewable Energy Laboratory's (NREL) PVWatts v2 Calculator.[24] Note that the EPBB calculator has not been updated since 2014, and the current version of NREL's PVWatts calculator is now v8 (released in September 2025). The more recent versions of PVWatts, increase performance estimates by approximately 13 percent relative to v2.[25]

Capacity Factor

The PV Production and Energy Impacts Results section also includes estimates of capacity factor. Capacity factor is a metric of system utilization and is defined as the amount of energy generated during a given period divided by the maximum possible amount of energy that could have been generated during that period. Annual capacity factors are useful when comparing utilization across technology types or project sizes. The annual DC capacity factor was calculated as the annual PV generation during all 8,760 hours of a typical year divided by the product of the project's DC nameplate capacity and 8,760.

Utility Energy Impacts

While we calculate changes in Customer Electricity Consumption (see section below), the DAC-SASH utility energy impacts are computed solely with PV production estimates.

Customer Electricity Consumption

Verdant analyzed whether DAC-SASH program participants changed their energy consumption following the installation of solar. Other studies have found that many customers in single-family homes increase their energy consumption after PV systems were installed. However, DAC-SASH participants might not behave similarly to those who install their PV systems without program support. For example, DAC-SASH

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24 CSI & Multifamily Affordable Solar Housing (MASH) Calculator. Developed by AESC Inc. https://csi-epbb.com/

25 Dobos, A. P. *PVWatts Version 5 Manual*. United States. https://doi.org/10.2172/1158421 and https://samrepo.nrelcloud.org/help/pvwatts.html

customers are often provided with education on energy saving practices that could result in decreased consumption after program participation. On the other hand, the additional energy and corresponding bill savings provided by the PV system could lead participants to increase their consumption (often through behavioral changes such as increasing heating, ventilation, and air conditioning (HVAC) usage or electrifying appliances).

For this analysis we used historical AMI consumption data provided at 15-minute or hourly intervals. We requested data starting from one-year prior to the DAC-SASH project's PTO date through to one year post the DAC-SASH project's PTO date. Customers that did not have a full year of consumption data in both the pre-installation and post-installation were excluded from analysis. Additionally, only projects with PTO Dates between January and September 2023 were included in the analysis. This time period was selected because it was important to limit the influence on the pre-period of atypical energy usage related to COVID-19 in 2020-2021. Finally, only customers with complete actual PV generation data in the post-period were included in the analysis.

This analysis included the development of a matched control group of customers to allow the comparison of the usage of solar PV adopters with similar customers who did not install solar PV, followed by statistical modelling to quantify differences in pre and post period energy consumption. Further details on the approach can be found in Appendix B.

Demand Impacts

Coincident peak demand impacts are defined as generation from DAC-SASH PV systems during hours of CAISO or IOU peak demands. The single largest annual CAISO or IOU peak hours provide brief snapshots of program coincident demand impacts. However, analyzing peak demand over the top 200 peak hours can provide a greater insight into how DAC-SASH projects impact the grid during the hours of highest load. By coincidentally generating during CAISO or IOU peak hours, participating DAC-SASH customers allow their electric utility to avoid the purchase of high-cost wholesale energy. At the same time, the electric utility reduces its transmission and distribution losses during hours of high system congestion. These hours are not necessarily when DAC-SASH PV systems have their highest output.

IOU and CAISO load data was obtained from the CAISO OASIS website. Coincident peak demand impacts were estimated at the utility and CAISO system level based on observed PV generation in 2022 through 2024.

Environmental Impacts

GHG impacts were estimated using marginal CO_2 emissions data developed by WattTime as part of the SGIP GHG signal.[26] The WattTime data are considered a reliable approximation of actual conditions during a particular year. CO_2 emission impacts were calculated as the avoided emissions that would have occurred in the absence of the program. The hourly marginal emissions rates and the hourly PV generation were combined to estimate avoided emissions in metrics tons of CO_2.

Bill Impacts

The evaluation team directly estimated the bill credits customers would have received from DAC-SASH completed projects using the DER-CAT model. To calculate bill credits, we estimated the difference between customer bills with and without PV benefits during 2024. The required inputs for bill calculation included hourly PV system generation, hourly customer load, and customer tariff selections. Bill credits were estimated for each in-scope project with complete PV and hourly load data in 2024.

This analysis uses historical AMI usage and PV system generation data from in-scope projects in 2024. Accounts were included only if they had complete 2024 usage and PV generation data, meaning the project was completed before January 1, 2024, owned by Sunrun,[27] and both datasets were sufficiently complete.[28] Additionally, because battery telemetry data was not readily available, projects including battery storage were excluded from this analysis. Projects failing to meet these criteria were excluded from the analysis. Table 3-3 summarizes the share of projects completed prior to 2024 that were included in the analysis, representing the proportion of projects with complete data relative to those that could have had full data available in 2024.

TABLE 3-3: PROJECT REPRESENTATION IN BILL CREDIT ANALYSIS

Utility	% of Projects Included
PG&E	62%
SCE	65%
SDG&E	50%
Total	**63%**

26 http://sgipsignal.com/

27 All PV Generation data was supplied by Sunrun, so only projects owned by Sunrun could be included in the bill impacts assessment

28 PV and consumption datasets were considered sufficiently complete if they contained no missing data between 11:00 AM and 2:00 PM throughout the year, and outside of this window, data gaps did not exceed two consecutive hours

3.2.4 Cost Effectiveness Methods

Verdant calculated cost-effectiveness of DAC-SASH systems using the format and content requirements of the 2001 CPUC California SPM for performing Economic Analysis of Demand-Side Programs and Projects. We quantified cost-effectiveness using the total resource cost (TRC) test, the ratepayer impact measure (RIM) test, and the societal cost test (SCT).[29] Table 3-4 presents the costs and benefits considered for each SPM test.

TABLE 3-4: STANDARD PRACTICE MANUAL COST-EFFECTIVENESS TESTS

SPM Test	Cost	Benefit
TRC	▪ Program Administration Costs ▪ Measure Costs	▪ Avoided Costs ▪ Federal Tax Credits
SCT	▪ Program Administration Costs ▪ Measure Costs	▪ Avoided Costs (including Social Cost of Carbon and Statewide Air Quality Adder) ▪ Federal Tax Credits
RIM	▪ Reduced Revenue (bill savings – reduced CARE subsidy) ▪ Incentive Costs = $0 ▪ Program Administration Costs ($0 when program is funded by greenhouse gas allowance proceeds)	▪ Avoided Costs

Only PV systems with a full year of AMI usage in 2024 were used for this analysis. Cost-effectiveness was examined at the project level and summarized by utility. The total program administrative and ME&O budget-capped costs from 2022 to 2024 of $4.2 Million were apportioned equally to each DAC-SASH project completed in 2022-2024 (1,922 projects). We calculated two versions of the RIM test, the primary version does not include program administration costs since DAC-SASH is primarily funded through greenhouse gas allowance proceeds from California's Cap-and-Trade Program and is not funded directly by ratepayers. The alternative version of the RIM test we calculated does include program administration costs, reflecting a scenario where the program is funded by ratepayers. We excluded non-solar project costs from measure costs. For each project, we used TMY-weather estimated PV generation to calculate bills at year one and year 20 of ownership (incorporating 1.36% annual PV degradation and 4% annual retail rate escalation) using the DER-CAT model. Customers' bills were interpolated linearly between years one and 20. Climate zone specific 20-year TRC and SCT avoided cost values were pulled directly from the 2024 CPUC Avoided Cost Calculator v1b (2024 CPUC ACC). For the SCT, we used the Base Social Cost of

[29] SCT inputs values were adopted in D.24-07-015

Carbon as defined by D.24-07-015.[30] The TRC avoided cost values were also used for the RIM test. We used utility-specific weighted average cost of capital (WACC) rates to determine the net present value (NPV) of avoided costs and reduced revenue in the TRC and RIM tests (PG&E 7.80%, SCE 7.87% and SDG&E 7.67%).[31] The SCT test used a real discount rate of 3%.

Avoided Costs

The TRC avoided costs due to DAC-SASH PV Systems were calculated as part of the modeling described above. The TRC avoided costs were pulled from the CPUC 2024 Avoided Cost Calculator (ACC) v1b. The analysis includes all components of the avoided costs in the 2024 ACC, including: Cap and Trade, GHG adder, GHG rebalancing, energy, generation capacity, transmission capacity, distribution capacity, ancillary services, losses, and methane leakage.

[30] Per D.24-07-015, the Base Social Cost of Carbon = 2020$/metric ton values in the range of approximately $53 in 2020 and approximately $81 in 2045. Exact values for this analysis were taken from outputs of the 2024 CPUC ACC.

[31] Utility WACC was taken from https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/historical-electric-cost-data/rate-of-return

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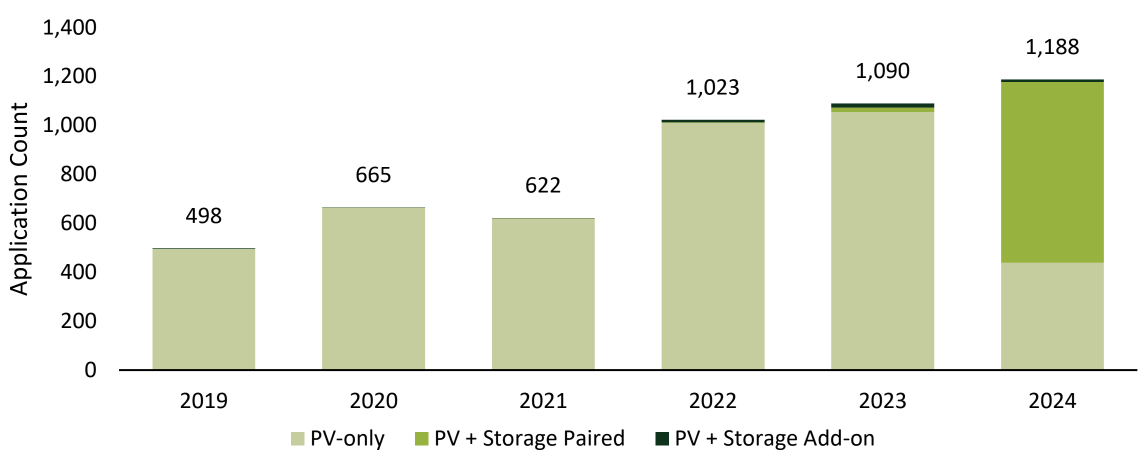
4 PARTICIPANT ASSESSMENT

The DAC-SASH participant assessment used DAC-SASH program tracking data to evaluate the current program status. Verdant assessed where the program currently stands in terms of applications submitted, completed, and cancelled (including time to complete projects), identified the key characteristics of DAC-SASH participants, and characterized different aspects of DAC-SASH projects (e.g., location, system ownership type, subcontracted projects, and Tribal projects). We present our findings below.

4.1 CURRENT PROGRAM STATUS

As shown in Figure 4-1 below, the DAC-SASH Program received 3,301 applications between 2022-2024, an increase from 1,785 applications during the last evaluation period. The active and completed project applications submitted during this period represent 9.5 MW_{AC} of generation capacity. These applications are spread out across three different project types: PV-only (applicant only has a PV system as part of their DAC-SASH project), PV + Storage Add-on (a DAC-SASH PV system is retrofitted with a battery incentivized through SGIP), or PV + Storage Paired (a DAC-SASH PV system and battery system are simultaneously designed and installed with plans to apply for SGIP incentives). The two battery project types were created in 2023 in response to transitions from NEM to the NBT. As Figure 4-1 shows, PV + Storage Paired became the dominant project type in 2024, with more than half submitted applications being PV systems paired with storage.

FIGURE 4-1: APPLICATIONS SUBMITTED IN 2019-2024[32] BY PROJECT TYPE



[32] While 2025 is outside this evaluation, it should be noted that DGStats data indicates a significant decline in project completions in 2025.

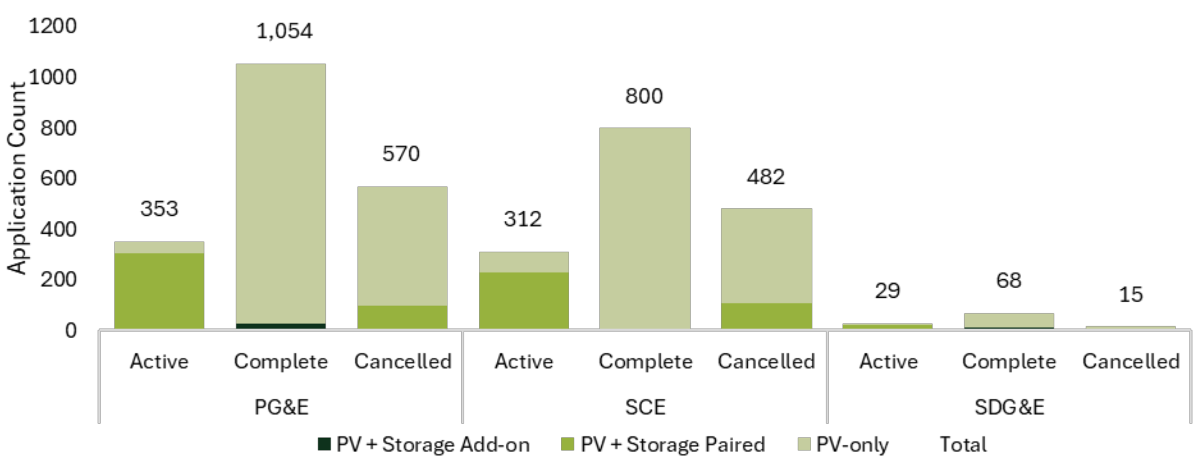
GRID sets internal installation targets that they report in their yearly ME&O reports. Table 4-1 below shows the yearly installation goal for each evaluation year and the completed number of projects.[33] GRID completed over 80% of their targeted installations for both 2022 and 2023, but only 64% of their 2024 goal. We expand more on challenges GRID faced implementing the program and what may be contributing to this in Section 5.1.2.

TABLE 4-1 YEARLY INSTALLATION GOAL VS. ACTUAL COMPLETED PROJECTS BY YEAR

2022		2023		2024	
Goal	Completed	Goal	Completed	Goal	Completed
620	540	892	720	1,038	662

PG&E has the greatest share of projects of the three IOUs, regardless of project type or application status (active, complete, cancelled, Figure 4-2). SDG&E continued to have a low project count making up only 3% of DAC-SASH projects during the 2022 to 2024 timeframe.

FIGURE 4-2: PROJECT TYPE AND STATUS BY IOU FOR ALL DAC-SASH PROJECTS IN 2022-2024



SDG&E's low application count is primarily due to the limited number of DAC-designated areas in SDG&E service territory (which then limits the eligible customer population). As shown in Figure 4-3, there are fewer DACs within SDG&E's service territory compared to other utility regions (note limited blue territories (SDG&E DACs) compared to yellow and green territories (SCE and PG&E DACs)). However, as shown in the map inset below, there do seem to be a few areas in SDG&E where GRID could still pursue DAC-SASH eligible households (green triangles over blue DAC areas).

[33] Using the variable GRID confirmed as how they identify a project has been completed: PF Last Incentive Claim Submitted Date

FIGURE 4-3: DAC-SASH PROJECTS VS. ELIGIBLE HOUSEHOLDS ACROSS IOU DAC TERRITORIES

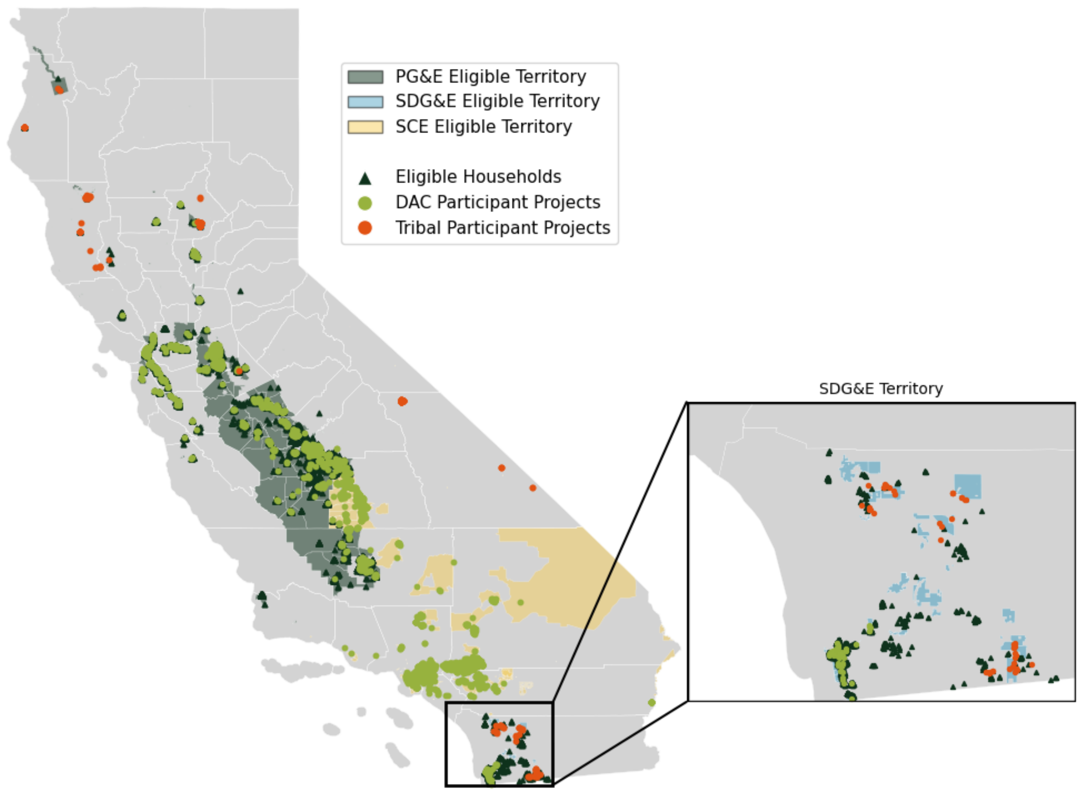


Table 4-2 presents the DAC-SASH application and project capacity (kW_{AC}) information by IOU for all projects submitted, active, cancelled, or completed between 2022 and 2024. Completion rates vary across the three IOUs from 50% (SCE) to 60% (SDG&E) and cancellation rates range from 13% for SDG&E to 30% for SCE and 31% for PG&E.

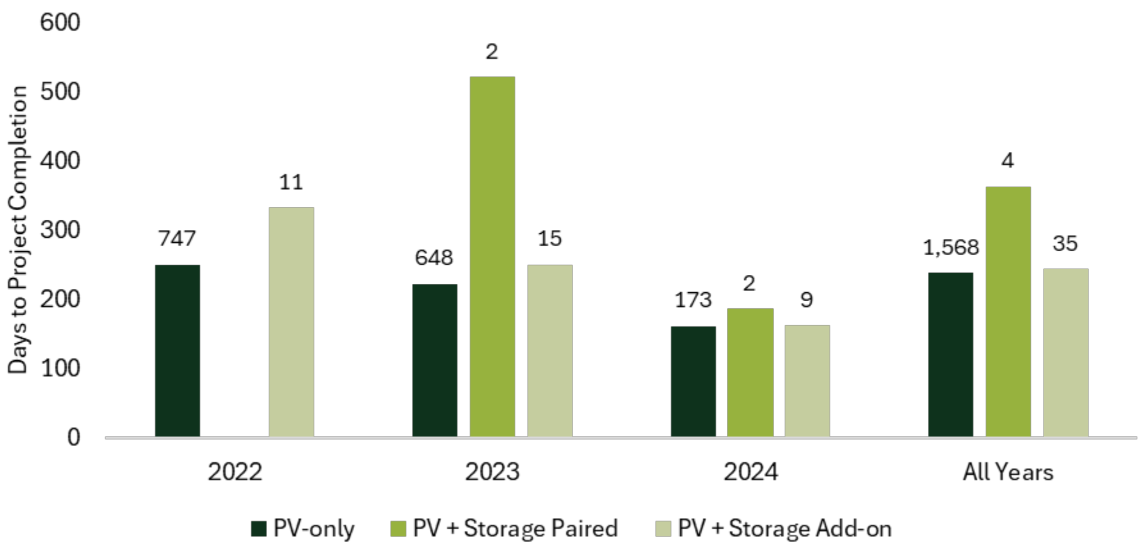
TABLE 4-2: DAC-SASH PROGRAM APPLICATIONS BY UTILITY FOR 2022-2024

Utility	Total Number of Applications (Including Cancelled)	Active & Complete Applications				PV System Capacity (kW_{AC})	
		Active	Active %	Complete	Complete %	Total Active & Complete Capacity	Average Active & Complete Capacity
PG&E	1,977	353	16%	1054	53%	5,819	4.2
SCE	1,594	312	20%	800	50%	4,543	3.8
SDG&E	113	30	27%	68	60%	337	4.2
Total	**3,684**	**695**	**19%**	**1,922**	**52%**	**10,699**	**4.2**

4.1.1 Project Completion Times

The overall time to complete PV-only and PV + Storage Add-on projects decreased from 2022 to 2024. Figure 4-4 shows the median amount of time it took to complete projects submitted in 2022, 2023, and 2024 (the height of the bar indicates the number of days and the number above each bar represents the number of projects completed in that year). There were only four PV + Storage Paired projects that were completed across all three program years making it difficult to robustly compare the completion times for these projects. Future evaluations should look at the time to complete these paired storage projects to more accurately understand how adding storage to a DAC-SASH project impacts the project timeline.

FIGURE 4-4: MEDIAN DAYS TO COMPLETE PROJECTS SUBMITTED IN EACH PROGRAM YEAR (N* = 1,607)



*Numbers over bars represent the total number of projects completed in that year.

As Figure 4-4 above shows, the median time to complete a PV-only project decreased from 251 days in 2022 down to 162 days in 2024. However, we do note that there were five PV-only projects submitted in 2022 that were still not complete in 2024. Three of these projects were later completed in 2025 but two of these projects were still not completed by the time we received the final reporting tracking data (5/27/25).[34] It is unclear from the tracking data what contributes to these long project timelines, even just for PV-only installations, but GRID reports that timelines can be impacted by utility delays (such as delays associated with transformer upgrades and interconnection application processing delays), permitting delays, and delayed client responses when additional approvals, information, and/or

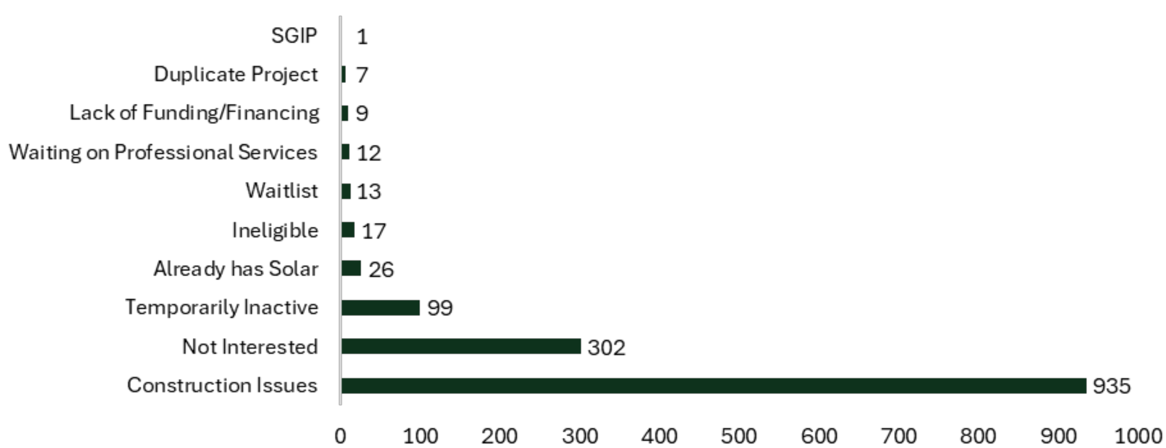
[34] There were also three projects submitted before 2022 that were still not complete as of 12/31/24, but these are not included in the data shown here.

signatures are required. (Section 5.3.2 presents participant survey responses regarding what they felt contributed to their long project timelines.)

4.1.2 Application Cancellations

In 2022-2024, 1,067 DAC-SASH applications were cancelled, representing almost one-third of all projects during the evaluation period. These cancellations represent 2.6 MW_{AC} of lost solar capacity. Figure 4-5 below provides the distribution of cancellation reasons from the DAC-SASH tracking data. Each project can have multiple reasons why it is currently recorded as 'Inactive' (i.e., cancelled). The most frequent reasons were due to construction or siting issues (e.g., old roof, code issues, solar shading, n = 935), the customer was no longer interested (n = 302), or the project is temporarily inactive (with a chance to resume if project issues (like construction updates or SGIP barriers) can be resolved (n = 99)). The fact that construction issues in general are the biggest reason a project gets cancelled indicates a greater problem the DAC-SASH program faces: finding eligible customers with properties that are solar ready (see Section 5.1.2 for more details on this challenge).

FIGURE 4-5: DISTRIBUTION OF DAC-SASH CANCELLATION REASONS



When reviewing cancellation reasons, we saw some issues had to do with SGIP requirements impacting PV + Storage Paired projects (such as needing to be enrolled in a demand response (DR) program but the customer was a community choice aggregator (CCA) customer with no DR programs available to them). Additionally, we heard in interviews and participant surveys that trouble navigating the SGIP has impacted DAC-SASH projects. Namely, the SGIP leads to project delays, has unclear eligibility and documentation requirements (that put stress on DAC-SASH participants needing to re-do applications multiple times), and had eligibility criteria during the study period that made it impossible for some DAC-SASH projects to get their SGIP incentive. While SGIP application and program requirements pose additional burdens to active DAC-SASH projects, we do not find evidence that PV + Storage Paired projects are being cancelled at a higher rate than PV-only projects (chi-square test, $p > 0.07$, Table 4-3). While PV + Storage Paired projects are not cancelled at a higher rate, the table below does show that a much smaller share of battery paired projects have been completed to date.

TABLE 4-3: CANCELLATION RATE BY PROJECT TYPE (2022-2024)

Project Type	Applications	Completed	Completion %	Cancellations	Cancellation %
PV-only	2,882	1,881	65%	863	30%
PV + Storage Paired	761	4	0.5%	204	27%
PV + Storage Add on	41	37	90%	0*	0%
Total	**3,684**	**1,922**	**52%**	**1,067**	**29%**

*These are already completed PV projects that are in the process of having a battery added on. By definition, none of these projects can be cancelled. We include them here for consistency across tables.

Table 4-4 below shows a review of how cancellations differed between GRID offices. We found that the Central Valley office has the highest rate of cancellation (40%) with the second highest median days to cancellation (91 days). This cancellation rate is almost double the Inland Empire office (22%), though the Inland Empire office has a longer median time to cancellation (166 days). The Greater Los Angeles office has the second highest rate of cancellations (35%) despite this office having a much smaller share of DAC-SASH projects (11% compared to Central Valley's 36%). This suggests that this office may have a much harder time finding properties in good enough condition for the DAC-SASH program, but their median 42 days to cancellation puts them as one of the fastest offices to identify projects that won't work (along with North Valley). For all but two offices, construction issues – mainly old roofs – are the most common reason a project is cancelled. See Appendix F for a detailed breakout of different construction issues by GRID office.

TABLE 4-4: RATE, REASON, AND MEDIAN DAYS TO CANCELLATION BY GRID OFFICE

Office	Active + Completed	Cancelled	Total	Cancellation Rate	% of DAC-SASH Projects	Most Common Cancellation Reason	Median Days to Cancellation
Central Valley	781	527	1,308	40%	36%	Construction (Old Roof)	91
Inland Empire	540	148	688	22%	19%	Construction (Old Roof)	166
North Valley	529	143	672	21%	18%	Construction (Old Roof)	42
Bay Area	348	86	434	20%	12%	Construction (Old Roof)	49
Greater Los Angeles	272	146	418	35%	11%	Construction (Old Roof)	42
San Diego	98	15	113	13%	3%	Not Interested	85
Bay Area/North Coast	49	2	51	4%	1%	Not Interested	337
Total	**2,617**	**1,067**	**3,684**	**29%**	**100%**	**Construction**	**82**

Table 4-5 shows that DAC-SASH cancellation rates increased from 5% projects submitted in 2021 to 36% for projects submitted in 2023 and 34% for 2024 projects. Construction issues increased as a cancellation driver from 52% of the reasons a project was cancelled for projects submitted in 2021 to 74% for projects submitted in 2024. We found that eligible customers being uninterested in the program decreases through time (33% for projects submitted in 2021 to 11% in 2024) while some drivers, like lack of funding or financing, remain relatively constant.

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TABLE 4-5: SIMPLIFIED CANCELLATION REASONS BY APPLICATION YEAR

Application Year	2021		2022		2023		2024		Total	
	N	%	N	%	N	T	N	%	N	%
Construction	227	52%	206	61%	311	63%	373	74%	929	66%
Not Interested	25	33%	96	28%	124	25%	55	11%	300	21%
Temporarily Inactive	3	4%	12	4%	27	6%	57	11%	99	7%
Waiting on Professional Services	2	3%	2	1%	5	1%	3	1%	12	1%
Lack of Funding/Financing	0	0%	10	3%	11	2%	3	1%	24	2%
Ineligible	5	7%	7	2%	10	2%	8	2%	30	2%
Battery Storage Issues	0	0%	0	0%	0	0%	6	1%	6	0%
Duplicate Project	1	1%	4	1%	2	0%	0	0%	7	0%
Total Cancelled Reasons	75	5%	337	24%	490	35%	505	36%	1,407	100%
Total Cancelled Projects*	58	5%	260	25%	382	36%	360	34%	1,060**	100%

*Total cancelled projects is how many projects submitted in the corresponding year ended up cancelled. The number is different than total cancelled reasons because each cancelled project can have multiple reasons for cancellation, including multiple construction issues that contributed to the cancellation.
**Seven projects from 2019-2020 are not included in this table

Table 4-6 documents the median number of days it takes for a project to be cancelled for each cancellation category. Notably, identifying that a customer is not interested (135 days) and ineligible (115 days) are two of the categories with the highest number of days to cancel the project. Ineligibility especially should be a relatively simple, straightforward, and fast process that should not take almost four months post application to figure out. While customer interest and commitment to the program can be more varied and nuanced, it is still surprising that it also takes ~4-5 months to identify that a customer with a submitted application is not interested. More stringent pre-screening – for both eligibility and interest – could be beneficial to reduce the time, labor, and cost of keeping these projects in the program for such extensive amounts of time. GRID could explore tools and processes to help build out systems that allow for faster identification of projects that would be ineligible, un-interested, or even screen for major construction issues to help reduce having these projects enter the program or stay in the program for extended periods of time. One easy place to look is to review how the North Valley and Greater LA offices handle projects as both of these offices have the fastest time to cancel projects.

TABLE 4-6: MEDIAN DAYS TO CANCEL A PROJECT BY SIMPLIFIED CANCELLATION REASONS

Cancellation Reason	Median Days to Cancel
Duplicate Project	209
Waiting on Professional Services	181
Not Interested	135
Ineligible	115
Lack of Funding/Financing	88
Battery Storage Issues	79
Temporarily Inactive	72
Construction Issues	69

One concern with cancelled projects is that there could be an inequitable skew towards projects that are less expensive being kept within the program or that there could be inequity in which households have cancelled projects. Table 4-7 below shows that cancelled projects actually have a lower median incentive cost than those that are active or completed. While a true equity analysis is beyond the scope of this evaluation, we do note that households with cancelled projects have a similar median annual income to those with active or completed projects,[35] suggesting that households of all income status within the program have an equal likelihood of having a project completed.

TABLE 4-7: MEDIAN INCENTIVE AND MEDIAN PARTICIPANT INCOME FOR DIFFERENT PROJECT TYPES AND STATUSES

Project Type	Median Incentive			Median Income		
	Active	Complete	Cancelled	Active	Complete	Cancelled
PV-only	$13,884	$13,509	$10,317	$31,524	$39,026	$34,002
PV + Storage Paired	$13,953	$8,526	N/A	$35,222	$29,020	$34,532
PV + Storage Add on	$14,655	$13,884	N/A	$38,094	$39,141	N/A

4.2 KEY CHARACTERISTICS OF DAC-SASH PARTICIPANTS

We explored different household characteristics to identify any correlations with DAC-SASH participation. Characteristics considered included income (a core eligibility requirement), utility rates and CARE/FERA status, energy usage, and arrearages. We report on our findings below.

4.2.1 Household Size and Income

We compared median household size and income for DAC-SASH participants and surveyed non-participants to qualitatively assess whether these aspects were correlated with DAC-SASH enrollment. As non-participants were asked to respond to a range of income values, while the DAC-SASH participants have to provide actual income levels, the assessment is more exploratory than definitive. Table 4-8 below shows household size and income for the two groups but only includes participants with incomes greater than $0 in the tracking data (some income data appears to be erroneous - e.g., -$549,341 listed as annual income). Including records with annual incomes less than or equal to $0 reduces the median participant income to $36,881 and results in a mode of $0 (29 records had income less than $0 and 111 were equal to $0).

[35] We also note a similar number in each household: active projects have a median of three people in a house, completed have four people, and cancelled have a median value of 3.5 people in the home.

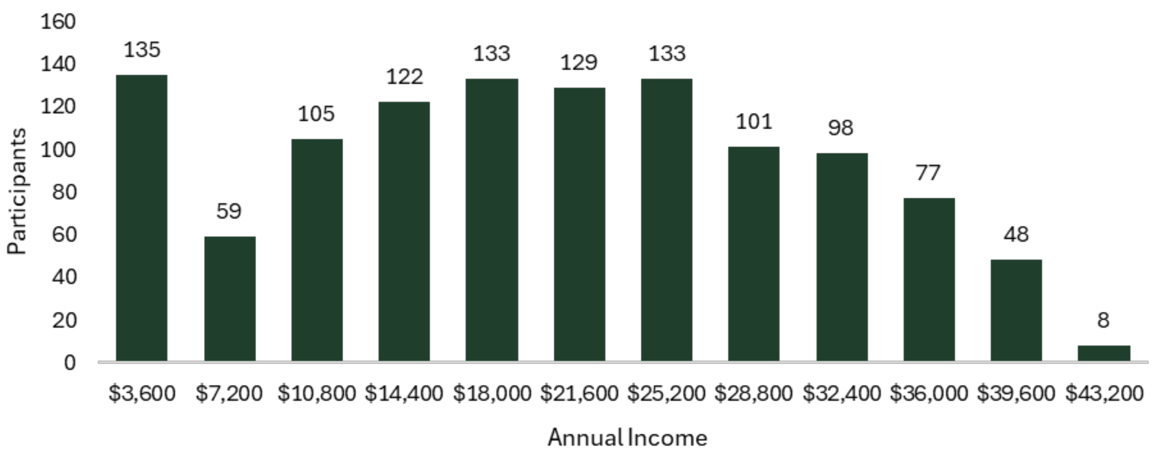
TABLE 4-8: PARTICIPANT AND NON-PARTICIPANT HOUSEHOLD (HH) SIZE AND INCOME*

Population	HH Size Range	Median HH Size	Income (Mode)	Income (Median)
Participants	1-14	4	$12,000	$37,990
Non-Participants	1-12	4	$64,300-$73,300	$64,300-$73,300

*Income data for non-participants comes from survey data where respondents were asked whether their income was above or below certain thresholds, which is why the reported values are ranges. Participant income data comes from DAC-SASH program tracking data. For this table we have removed all negative and zero incomes.

While DAC-SASH has an income requirement (based on CARE/FERA household size vs. income bands), we wanted to understand the distribution of program participants income by household size. Figure 4-6 shows a histogram of participants' income within the first CARE income band (i.e., 1-2 person household). The normal distribution of this data suggests that the program is not serving those with the highest incomes within this band, but rather a wider range of households. In fact, within the first income band, it seems that participation is highest for those whose annual income is lowest.

FIGURE 4-6: HISTOGRAM* OF PARTICIPANTS' ANNUAL INCOME[36] FOR ONE OR TWO PERSON HOUSEHOLDS



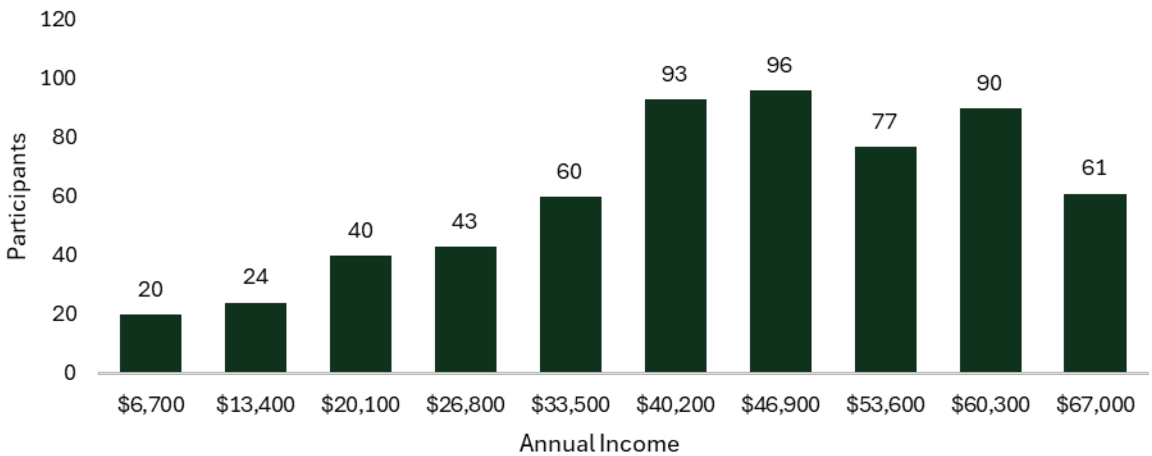
*Each bar on the histogram represents a range of incomes. For example, the $3,600 bar represents those with incomes ranging from $0-$3,600 per year. The $7,200 bar represents those with incomes ranging from $3,601 to $7,200 per year.

However, as you move into higher income bands (e.g. four individuals in a house), the pattern does seem to shift to serving households at the higher ranges within the income band (Figure 4-7). The data we have does not allow us to disentangle whether Figure 4-7 is a consequence of population (there are truly more people who fall into the higher CARE income limits for four people households), resource availability of participants (those with lower annual incomes are strapped for time and resources which impacts their

[36] Income data is pulled from the DAC-SASH tracking data and is not confirmed by the evaluation team. Negative income amounts were removed from this analysis.

ability to participate and home's condition), or program logistics (access to digital marketing and application, cost to update home, etc.), but it is clear that GRID is serving many vulnerable households with great need for this program (n = 127 four person households with <$33,500 annual salary).

FIGURE 4-7: HISTOGRAM* OF PARTICIPANTS' ANNUAL INCOME IN FOUR PEOPLE HOUSEHOLDS



*Each bin represents a range with the number listed as the highest endpoint of the range. For example, $6,700 is the $0-$6,700 income bin.

4.2.2 Rates and CARE/FERA Status

Table 4-9 below shows the distribution of rates for completed projects before and after PV installation. As this table shows, across all three utilities, most participants went on a time-of-use (TOU) rate after installing solar. For PG&E, 62% of customers were on the E-1 tiered rate before installation, but afterward approximately half switched to E-TOU-D. Similarly, SCE customers moved from Schedule D to TOU-D-PRIME, and SDG&E customers transitioned from DR to TOU-DR-1. This shift reflects the economic advantage TOU rates provide to solar customers under NEM 2.0, which was in effect for many of these projects. TOU rates charge higher prices during evening peak hours (e.g., 4 – 9 pm) when solar isn't producing but offer lower daytime rates when solar generation is highest. Customers with battery storage may achieve greater bill savings since they can store solar energy during low-price periods and use it during more expensive peak hours.

TABLE 4-9: MOST COMMON RATES PRE AND POST PV INSTALLATION BY UTILITY*

Utility	Most Common Rates Pre-PV	Most Common Rates Post-PV
PG&E	E-1 (62%)	E-TOU-D (53%)
	E-TOU-C (21%)	E-TOU-C (28%)
	E-TOU-D(11%)	E-ELEC (15%)
SCE	D (75%)	TOU-D-PRIME (45%)
	TOU-D-4-9PM (14%)	TOU-D-4-9PM (44%)
	TOU-D-5-8PM (7%)	TOU-D-5-8PM (11%)
SDG&E	DR (50%)	TOU-DR-1 (70%)
	TOU-DR-1 (40%)	EV-TOU-5 (19%)
	EV-TOU-5 (3%)	DR-SES (1%)

*Note: There was incomplete billing data for the pre-PV rates (PG&E N=1, SDG&E N=3) and post-PV rates (PG&E N=14, SDG&E N=3). For SCE, incomplete billing data was given so the pre- and post-PV rates were calculated using the program tracking data.

Table 4-10 below shows participant enrollment levels in CARE and FERA before and after DAC-SASH enrollment. CARE and FERA enrollment varied by IOU pre-DAC-SASH participation with SCE having the lowest enrollment in either program. Following DAC-SASH enrollment, participation in both CARE and FERA increased, resulting in most DAC-SASH participants being enrolled in one of these two assistance programs.

CARE remains the predominant program among this population, with post-DAC-SASH enrollment rates ranging from 86% to 99% across utilities, compared to FERA's enrollment range of 3% to 15%. Notably, in PG&E territory, FERA enrollment nearly quadrupled, increasing from 4% to 15% following DAC-SASH participation. Additionally, SDG&E demonstrated the highest CARE enrollment rate, with 99% of DAC-SASH participants enrolled in the program.

TABLE 4-10: CARE AND FERA ENROLLMENT RATES BEFORE AND AFTER DAC-SASH ENROLLMENT

Program	PG&E (N=1,054)		SCE* (N = 797)		SDG&E (N=68)	
	% Before	% After	% Before	% After	% Before	% After
CARE	78%	93%	59%	86%	66%	99%
FERA	4%	15%	1%	3%	4%	6%

* Three completed SCE projects were excluded from this analysis because they did not provide program data

4.2.3 Energy Use

Table 4-11 below compares the average annual pre-solar energy use for 2023 and 2024 participants to the average annual energy usage of IOU-identified eligible customer leads for the same periods.[37] PG&E

[37] The 2023 column presents the average annual usage for participants and eligible households in 2022 and the 2024 column presents the average annual usage in 2023.

participants and eligible households show similar energy usage for both program years, however, SDG&E participants energy use was roughly two times larger than eligible households in both program years.

TABLE 4-11: AVERAGE ANNUAL PRE-SOLAR ENERGY USE FOR PARTICIPANTS AND ELIGIBLE HOUSEHOLDS BY IOU

IOU	Group	2023 (kWh)	2024 (kWh)
PG&E	Participants*	8,315	8,972
	Eligible Households	8,140	8,252
SCE	Participants	8,271	8,759
	Eligible Households	N/A**	N/A**
SDG&E	Participants	9,016	7,751
	Eligible Households	4,336	4,917

*NOTE: The participant average solar use was calculated using the "Estimated usage before solar (Genability)" field in the Electric Usage tab of the Project Records Data. See Section 3.2.1 for details.
**SCE eligible customer lead lists were incorrectly generated and so could not be used for this analysis. See Section 3.1.1 for details.

4.2.4 Arrearages

As part of our characterization efforts, we explored the number of participants with arrearages that participated in DAC-SASH. We leveraged monthly utility data to determine which participants with completed projects were in arrears prior to their participation and what the median amount of arrears was, how many participants were in arrears during interconnection, and how many were in arrearages and what they owed one year post installation of their DAC-SASH PV system**. It is important to note that this analysis is exploratory and focused on characterization. As our team did not have a control group to assess the changes in arrearages, did not use a comprehensive model to explore decreases, and as DAC-SASH is not an arrearage reduction program, all results should be taken as exploratory only, and more as a discussion point for the characterization of DAC-SASH participants**. As Table 4-12 shows, all three IOUs show a decrease in the number of people in arrearages one year after the completion of their DAC-SASH projects. We also see a reduction in the median amount of arrearages for PG&E, but not for SCE or SDG&E. Understanding what contributed to the increases in arrearages for these two IOUs is outside the scope of this evaluation.

TABLE 4-12: CUSTOMER ARREARAGE CHARACTERIZATION FOR COMPLETED DAC-SASH PROJECTS

IOU	Participants in Arrears Prior to Participation		Participants in Arrears Post Participation		Participants in Arrears One Year Post Project Completion	
	N	Median $ Amount	N	Median $ Amount	N	Median $ Amount
PG&E	292	$183	246	$142	212	$44
SCE	173	$331	188	$399	131	$441
SDG&E	47	$188	53	$259	30	$629
Total	512		487		373	

*Note: the results are exploratory and were not calculated using a control group or modeling

As Table 4-12 above can have individuals who were not in arrears prior to participating, but who do have arrears at interconnection or even post installation, we wanted to better understand what happens to a consistent cohort of participants who have arrearages throughout the process. Again, these analyses are exploratory, but Table 4-13 below shows the arrearage changes for 123 households who had arrears prior to participation, at interconnection, and a year post project completion. As this table shows, both PG&E and SCE households show a reduction in arrearages one year post interconnection. SDG&E households, however had a marked increase in their arrearages one year post interconnection. Again, it is unclear what could be contributing to this (it could be as simple as true up bills reported as arrearages), but exploring this is outside the scope of the evaluation.

TABLE 4-13: ARREARAGE CHANGES FOR INDIVIDUALS IN ARREARS PRE-DAC-SASH THROUGH ONE YEAR POST INTERCONNECTION

IOU	N	Median Arrears at Application	Median Arrears at Interconnection	Median Arrears One Year Post Interconnection
PG&E	49	$239	$354	$75
SCE	55	$511	$791	$477
SDG&E	19	$565	$715	$1,316

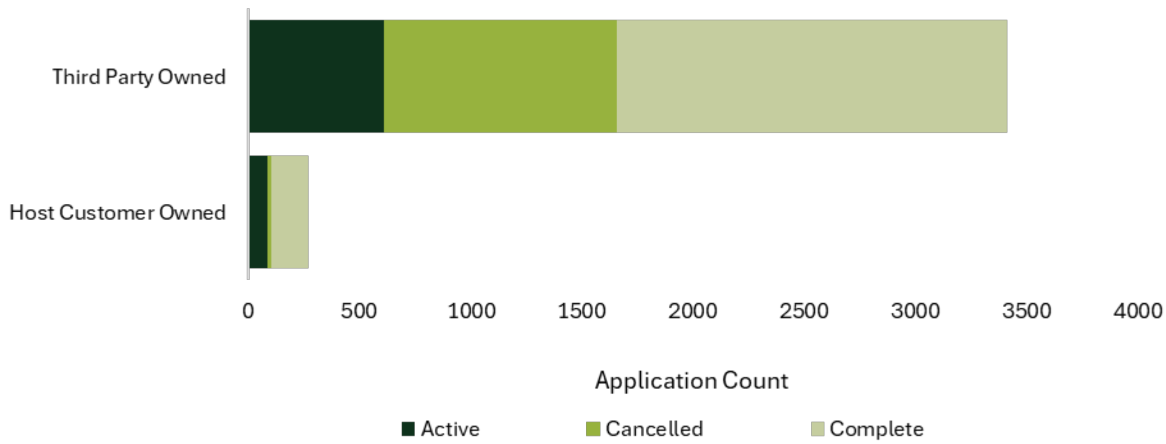
4.3 KEY CHARACTERISTICS OF DAC-SASH PROJECTS

Our team explored the defining characteristics of DAC-SASH projects. Below we report on our findings concerning system ownership type, subcontracted projects, and Tribal projects.

4.3.1 System Ownership Type

Most DAC-SASH projects are third party owned (TPO) as compared to host customer owned (HCO) (Figure 4-8). This is primarily due to TPO projects being more cost effective for GRID (see Section 5.1.1 for cost breakdowns). The only two scenarios where a project must be HCO are if the project is in a Tribal territory or if it is too small to qualify for TPO. As Figure 4-8 below shows, the cancellation rate for TPO projects is far greater than HCO (30% for TPO vs. 7% for HCO). This difference is primarily driven by 75% of HCO projects being Tribal. The low cancellation rate for Tribal projects is covered in Section 4.3.3.

FIGURE 4-8: DISTRIBUTION OF PROGRAM SUBMISSIONS BY SYSTEM PURCHASE TYPE



In Q4 of 2024, GRID submitted Advice Letter 18-E to petition allowing, projects to go over the 5 kW limit.[38] The 2025 DAC-SASH Handbook (published January 24th, 2025) incorporated this change to allow projects to be larger than 5 kW and more appropriately sized to the participating household's historical load. We see in the data that 68 active projects (one from 2023 and 67 from 2024) have sizing beyond the 5 kW limit, likely in response to this handbook change. This is possibly what is responsible for the increases seen in both HCO and TPO active versus competed projects in Table 4-14.

TABLE 4-14: MEDIAN SIZE AND COUNT OF ACTIVE AND COMPLETED HCO VS TPO PROJECTS

Metric	Completed		Active	
	HCO	TPO	HCO	TPO
# of Projects	166	1,756	86	609
System Capacity	3.7 kW	4.5 kW	3.9 kW*	4.7** kW

*21 records do not have size information and 2 have 0 kW reported in tracking data
**48 records do not have size information and 14 have 0 kW reported in tracking data

4.3.2 Subcontracted Projects

The DAC-SASH program had eight subcontractors support projects during 2022-2024. These projects followed two different models: install only or full project management. The install only model entailed subcontractors using GRID's design for the system and materials for the project. Alternatively, the full

[38] DAC-SASH 2025 Marketing, Education, and Outreach Plan

project management model has subcontractors responsible for every step of the process (design through installation). A total of 330 projects during the evaluation period were subcontracted, with 83% completed (Table 4-15). Of these, 90% were direct install (n = 301), two projects were recorded as full project design and management, and the remaining projects (n = 27) did not have an indication of the model being used in the tracking data.

TABLE 4-15: SUBCONTRACTOR VS. GRID INSTALLED PROJECTS

Installer	Active		Complete		Cancelled		Total
	#	%	#	%	#	%	#
Subcontractor	48	14%	274	83%	8	2%	330
GRID	647	19%	1,648	49%	1,059	32%	3,354
Total	**695**	**19%**	**1,922**	**52%**	**1,067**	**29%**	**3,684**

The majority of subcontracted projects fall in the jurisdiction of the Inland Empire office (86% of subcontracted projects, Table 4-16). The SPP install-only model was created by GRID Alternatives Headquarters staff (Program Admin team) and was refined in collaboration with the Inland Empire office. The SPP is currently managed by a staff member from this office.

TABLE 4-16: SUBCONTRACTOR PROJECTS BY OFFICE

Office	GRID Project		Subcontractor Project		Total	
	n	%	N	%	N	%
North Coast*	51	2%	0	0%	51	1%
North Valley	660	20%	12	4%	672	18%
Bay Area	434	13%	0	0%	434	12%
Central Valley	1,301	39%	7	2%	1,308	36%
Greater LA Area	391	12%	27	8%	418	11%
Inland Empire	404	12%	284	86%	688	19%
San Diego	113	3%	0	0%	113	3%
Total	**3,354**	**100%**	**330**	**100%**	**3,684**	**100%**

*Listed as ‘Bay Area/North Coast’ in tracking data

Of note, 18% of subcontracted projects were Tribal (done by the Inland Empire subcontractors), which is high given that Tribal projects made up 6% of all projects. This is in line with reports from GRID that subcontractors can be leveraged to reach more rural communities (like Tribal communities). Figure 4-9 shows the reach that subcontractors can have into areas of the state that are a significant distance away from GRID offices.

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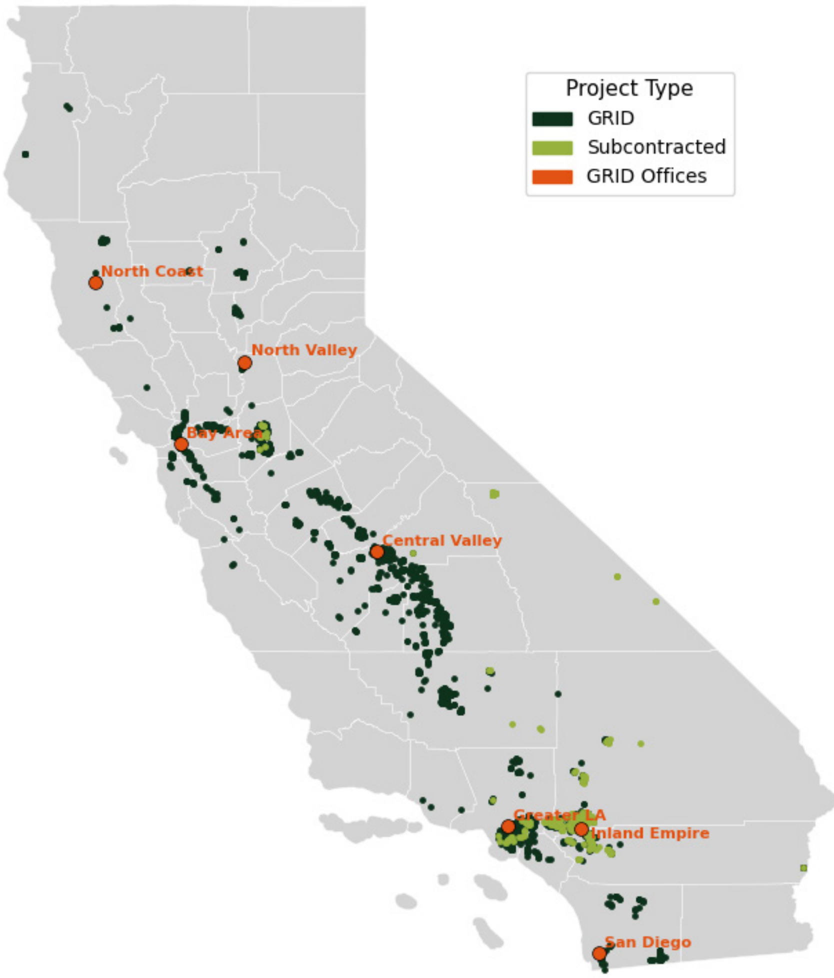
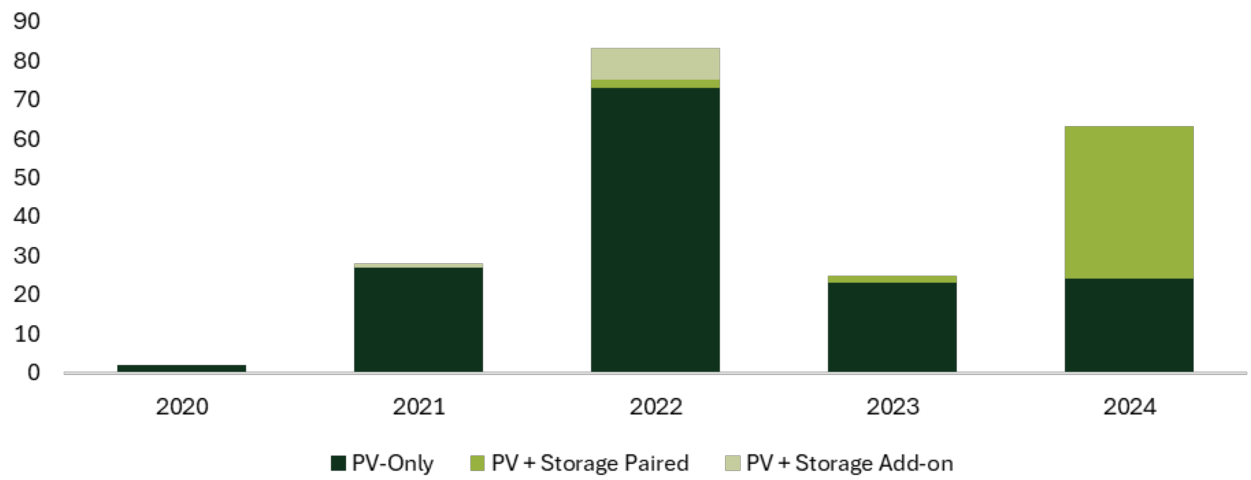
FIGURE 4-9: GRID INSTALLED VS. SUBCONTRACTED INSTALLED PROJECTS IN RELATION TO GRID OFFICES



4.3.3 Tribal Projects

There were 202 Tribal projects in 2022-2024 (6% of all projects). Figure 4-10 shows the total number of Tribal projects by project type over time. As this figure shows, Tribal applications have fluctuated significantly during the evaluation period (from a high of 83 applications in 2022 to a low of 25 in 2023) and also mirrored the overall program shift to primarily PV + Storage Paired projects in 2024.

FIGURE 4-10: TRIBAL PROJECTS BY TYPE OVER TIME



Tribal projects can be found in all three IOU territories, but the strategy for installation differs by region. For example, Tribal projects in PG&E territory and all of SDG&E's Tribal projects are installed by GRID while SCE territory Tribal projects are installed by GRID and subcontractors (Table 4-17). As SDG&E territory has a limited number of DAC regions, we heard that there is a greater focus on Tribal projects in this region. The data confirms this report as nearly 50% of all SDG&E projects are Tribal.

TABLE 4-17: TRIBAL PROJECT DEMOGRAPHICS

IOU	Installer		Status			Total Tribal Projects
	GRID	Subcontractor	Active	Completed	Cancelled	
PG&E	76	0	31	43	2	76
SCE	11	59	14	47	9	70
SDG&E	56	0	18	34	4	56
Total	**143**	**59**	**63**	**124**	**15**	**202**

We also found that Tribal projects have a significantly lower cancellation rate than non-Tribal projects (7% cancellation rate for Tribal vs. 30% for non-Tribal, $p < 0.001$ using a chi-squared test). We conducted multiple analyses to try to determine what may be contributing to this difference in cancellation rates (e.g., cancellation drivers, subcontractor vs. GRID projects, offices), but the difference cannot be explained by project characteristics. GRID shared that outreach for Tribal projects is significantly different than for non-Tribal projects. GRID's typical process for Tribal projects is to work with Tribal leadership to identify potential projects and communicate with clients. GRID shared that while similar collaboration with city or county government leadership is sometimes possible with non-Tribal projects, the involvement is not as consistent or effective because of differences in community size.

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5 PROCESS ASSESSMENT

This section presents the results of the process assessment conducted as part of the 2022-2024 DAC-SASH program evaluation. This process assessment provides insights on the current state of the program and areas where additional program improvements are still needed. This section is organized by the following topical areas:

- An evaluation of the program administration including expenditures and implementation.
- A review of program marketing activities from lead generation through marketing effectiveness.
- An analysis of customer satisfaction, challenges and barriers to participation, and customer's overall experience within the program.

This section presents findings related to the implementation of the DAC-SASH program during the 2022-2024 program period. The findings presented in this section are based upon data collected via in-depth interviews conducted with the DAC-SASH PA (GRID), participating sub-contractors, the three IOUs, partner organizations, and web surveys with DAC-SASH participants and eligible non-participants. Program spending was sourced from GRID invoices that were provided to the CPUC and DAC-SASH tracking data.

5.1 PROGRAM ADMINISTRATION

Our evaluation of program administration included a review of program expenditures and implementation. We compared forecasted budgets to actual spending and conducted a deeper analysis of project costs. We interviewed GRID and their subcontractors to understand what drove program success, where challenges arose, and what improvements could be made. We present our findings below.

5.1.1 Program Expenditures

Program expenditures include costs for program administration, ME&O, and solar installation. We used DAC-SASH invoices to compare forecasted and actual spending. We used DAC-SASH tracking data to review project costs, including how much is spent on solar installation vs. solar readiness and how much of the solar installation is covered by the incentive. Program administration costs that are billed to the DAC-SASH program are tracked and reported separately than costs covered by incentives for program invoicing purposes. As reported in Section 3.1.1, the cost data recorded in the program tracking data has limitations. For example, costs for different components (such as labor) are amalgamated at too high a level to allow for the disentanglement of different activities (e.g., program administration vs. outreach labor vs. installation labor are all combined under one 'labor' cost in the tracking data).[39] There are additional challenges around re-calculation of reported cost categories that impact this section, and solar readiness and/or battery storage costs are often included in total cost calculations. See Section 3.1.1 for more details on cost data limitations and Appendix D for recommendations on how cost data collection could be improved to address these issues.

Program Budget

DAC-SASH has an annual budget of up to $10 million per year from 2019-2030 ($120 million total).[40] The breakdown of this budget is 10% for Program Administration, 4% for Marketing and Outreach, 1% for Evaluation, and 85% for Incentives. Each of the three major California electric IOUs contribute to the program budget, though their contribution varies (PG&E 43.7%, SCE 46%, SDG&E 10.3%). Table 5-1 shows the total DAC-SASH program expenditures from January 2022 through December 2024. It is important to note that GRID can only expense the allotted budget amount per category (e.g., they cannot exceed the allotted $400,000 in ME&O, even if they underspend in another category and have funds available from that underspending). However, funds can be transferred from one year to the next as long as they are used within the same budget category. The table below shows the annual program expenditures over the evaluation period by budget category. We detail the key cost drivers for projects in Section 5.1.2.

TABLE 5-1: PROGRAM EXPENDITURES FOR 2022-2024

Budget Category	Annual Budget Cap	2022	2023	2024	Total
Program Administration[41]	$1,000,000	$1,197,756	$1,053,820	$1,124,909	$3,376,485
Marketing, Education, & Outreach	$400,000	$507,290	$424,368	$505,160	$1,436,818
Customer Incentives	$8,500,00	$6,272,274	$8,977,443	$8,520,654	$23,770,371
Total Program Expenditures	**$10,000,000**	**$7,977,320**	**$10,455,631**	**$10,150,722**	**$28,583,673**

Invoice Process

The evaluation team collected feedback on the invoice process to assess if improvements could be made. Overall, the process was reported to be difficult for new staff or staff outside the program to quickly understand how much is being spent on different categories within the program. One of the aspects noted to be the most challenging was the process of an advanced payment from SCE and a later reconciliation

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[39] Workforce development – both the programs GRID runs or the wages of trainees – are not funded by the DAC-SASH program and GRID does not bill the program for any costs associated with this training.

[40] The program is funded through GHG allowance proceeds from CA's Cap and Trade Program. However, following the passage of AB 1207 and the removal of the 15% carve out for clean energy and energy efficiency programs from GHG auction revenues, GHG funding for DAC SASH will no longer be available, as of July 1, 2026.

[41] This represents GRID's program administration costs. Our understanding is that the breakdown between GRID administration costs and IOU administration costs from total program administration budget is still being sorted out.

for each quarter. This was noted as being challenging for both SCE and CPUC staff. Feedback from invoice reviewers included a recommendation to provide a short summary of important considerations (funding source, funding buckets, etc.) for each invoice along with a summary page of previous invoices (including a column for the invoice number, date, and the amount billed) in a spreadsheet format to quickly identify anomalies.

Key Project Cost Characteristics

Program Incentive Levels

The DAC-SASH incentive over the program period covered by this evaluation was $3/W. The incentive exists to cover the costs of solar installation with any solar readiness or battery storage costs incurred covered by GRID's philanthropic efforts or other funding sources (like the SGIP). Our current evaluation concludes that the $3/W is not sufficient and we provide key details on cost breakdowns for different project types and solar installation vs. solar readiness activities.

Overall Project Cost

The evaluation team reviewed total project costs and DAC-SASH incentives for projects completed in 2022-2024. Table 5-2 shows the median project incentive provided by the DAC-SASH program, the median cost to complete the project, and the range of dollars per watt for installing each project type. This table shows that no completed projects during the evaluation period were at or below the $3/W DAC-SASH incentive. The median $/W metric for PV-only projects was found to be $4.99/W and the PV portion of PV projects with storage added after completion was $5.07/W. The current tracking data makes it difficult to determine what aspects of program installation are covered by the program vs. that are not (i.e., actual solar installation vs. solar readiness; especially true for labor categories like managing the administration around organizing these solar readiness upgrades). As it is possible that some of the reported costs can be attributed to roof repair or other upgrades required to prepare a home for solar, rather than actual solar installation, our team reviewed projects where no professional service upgrades had been recorded in the tracking data. These projects still had a median cost of $20,964 and a median cost per watt of $4.76/W (n = 1,052 projects) suggesting the DAC-SASH incentive is only covering about 63% of these projects.

TABLE 5-2: COMPLETED PROJECT SIZE AND COST BY PROJECT TYPE

Project Type	Project Count	Median Size (CEC AC kW)	Median Cost	Median Incentive	Min $/W	Max $/W	Median $/W
PV-only	1,881	4.5 kW	$21,847	$13,509	$3.17	$17.89	$4.99
PV + Storage Paired*	4	2.8 kW	$44,129	$8,526	$10.14	$20.31	$16.61
PV + Storage Add-on	37	4.6 kW	$22,555	$13,884	$4.40	$7.88	$5.07
Total	**1,922**	**4.5 kW**	**$21,875**	**$13,563**	**$3.17**	**$20.31**	**$4.99**

*These projects' total cost includes cost associated with installing battery storage.

As our analysis of cancellation reasons and interview with GRID staff identified that many of the eligible homes for DAC-SASH require substantial work to become solar ready, we explored how much it costs to ensure a home is ready for this program. We constrained our exploration to complete PV-only projects (n = 1,881) and found that 10% of the cost associated with these projects can be attributed to non-solar installation costs (~$4M).[42] GRID is currently covering these solar readiness costs, in addition to the extra costs incurred for the program that are not covered by the incentive, through fundraising and philanthropy. This is a non-trivial amount of money that GRID is responsible for raising to support the installation of solar PV on eligible customers' homes.

A key transition that impacted the program during our evaluation period was the switch to the NBT.[43] GRID's response to this change was to begin pairing solar with battery storage for as many DAC-SASH projects as they could. While only four PV paired with battery storage projects have been completed, it is possible to see the significant increase in cost between these paired projects and PV-only projects. The median $/W for PV-only is $4.99 while it is $16.61 for PV projects paired with storage. While GRID is pursuing SGIP incentives for these paired projects to offset the cost of battery installation, this represents a large up-front cost that GRID is shouldering for these installations. Future evaluations should consider exploring if the pairing of solar and storage and the increase in upfront funds for the storage system impacts GRID's ability to install the same volume of solar systems.

Equipment and Installation Costs

Table 5-3 shows the breakdown between equipment cost and installation costs for the different project types. Far and away, DAC-SASH project expenses are driven by installation costs. According to the tracking data and conversations with GRID, most of these installation costs are due to labor costs (often associated with challenging installations because of housing conditions).

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[42] These costs are recorded as 'Actual Non Spp' and represent professional service costs associated with hiring subcontractors to do prep work on the home prior to solar installation (e.g., re-roofing or tree trimming)

[43] The Net Billing Tariff aligns export compensation with utility avoided cost values, which can be significantly lower than import retail rates, especially during PV generation hours.

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TABLE 5-3: COMPLETED PROJECT COST BREAKDOWN

Project Type	Project Count	Total Incented	Total Cost	Total Equipment	Total Installation
PV-only	1,881	$23,253,495	$41,527,579	$9,878,248	$31,649,331
PV + Storage Paired	4	$35,712	$182,838	$79,668	$103,170
PV + Storage Add-on	37	$481,164	$841,592	$195,466	$646,126
Total	**1,922**	**$23,770,371**	**$42,552,009**	**$10,153,382**	**$32,398,627**

The tracking data is limited in what cost components are recorded (e.g., labor is not broken out into different components such as solar installation vs. client acquisition) and there is misalignment in how the cost components are combined to total to different expenses (e.g., total installation cost is supposed to include labor + permitting costs but labor costs alone are often higher than the total installation costs). Table 5-4 serves as an example of this: not only do the equipment cost components (e.g., panel, inverter) not equal the total cost of project equipment recorded in the tracking data, but the labor cost recorded in the tracking data is greater than the total invoiced installation cost (despite labor being only one aspect of installation costs). We heard that each GRID office may be recording information differently and some variables get fixed (i.e., amount recorded can no longer be changed) at different steps in the project lifecycle for invoicing, which could be contributing to some of the discrepancies we found when analyzing this data. This makes tracking the true cost of these systems challenging as GRID is likely under-reporting the cost of these systems. To ensure that an accurate incentive cost is set to support the program, we recommend consistently continuing to track the costs incurred for each project past the point when invoices get ‘fixed’.

TABLE 5-4: COMPLETED PROJECT EQUIPMENT AND INSTALLATION COSTS BY PROJECT TYPE

Cost Category		PV-Only	PV + Storage Paired	PV + Storage Add-on	Total
Equipment Costs	**Total***	**$9,878,248**	**$79,668**	**$195,466**	**$10,153,382**
	Panels	$3,380,379	$3,743	$62,974	$3,447,096
	Inverters	$3,037,985	$2,100	$63,464	$3,103,548
	BOS[44]	$2,948,099	$3,971	$67,352	$3,019,422
	Sales Tax	$134,532	--	$1,981	$136,513
Installation Costs	**Total***	**$31,649,331**	**$103,170**	**$646,126**	**$32,398,627**
	Labor**	$33,833,310	$112,073	$671,822	$34,617,205
	Permitting	$10,072	--	--	$10,072

*Total reported in tracking data. This is a different value than the mathematical summation of the distinct components listed in the table
**Includes GRID labor, professional services labor (including subcontractors), and a field called 'total other costs'

Project Type Costs

The team further explored cost breakdowns by different project types to understand how this may impact the cost of a project.

System Ownership Type

As discussed in Section 4.3.1, GRID pursues TPO projects whenever possible because they are more cost-effective than HCO projects. While TPO projects have a slightly higher installation cost (~2% higher when controlling for system size), the equipment cost for TPO and HCO is essentially the same. Table 5-5 shows a similar cost/W, between these two project types, but GRID reported in the previous evaluation that TPO supports covering additional costs that the incentive doesn't cover while the HCO model relies purely on GRID fundraising support to cover the gap. Thus, while TPO projects may be slightly more expensive overall, they are more cost effective for GRID because they support covering the costs the incentive doesn't cover without extra time and effort to find philanthropic funds for the project. Additionally, costs for TPO projects could be offset by the Federal Incentive Tax Credit (ITC) which GRID reports is not accessible for HCO projects given their limited tax liability. Almost 93% of all projects during this evaluation period were TPO and owned by a single TPO partner.

[44] Balance of System (BoS) costs include the parts of the solar PV system that are not modules and inverters. This includes the wiring to connect modules to each other and the inverter(s), framing to support the modules, and all other hardware.

TABLE 5-5: TPO AND HCO COMPLETED PROJECT COST

Ownership Type	Project Count	Median Size (CEC AC kW)	Median Cost	Median Incentive	Median $/W	Median Equipment Cost	Median Installation Cost
TPO	1,756	4.5 kW	$21,979	$13,587	$5.00	$5,213	$16,250
HCO	166	3.7 kW	$17,664	$11,233	$4.98	$5,426	$13,120

Subcontracted Projects

About 14% of the completed projects during the evaluation period were subcontracted. All of the completed subcontractor projects were PV-only installs, so our team compared the costs associated with the PV-only subcontracted projects to PV-only installations completed by GRID. We found that subcontracted projects are roughly 6% more expensive than GRID installed projects (Table 5-6). Both equipment costs and installation costs are slightly higher for these projects despite size being similar. Equipment costs are the biggest driver for this cost difference (median equipment costs are almost 17% higher for subcontracted projects). Almost all of the completed subcontractor projects are direct install (n = 254) which means subcontractors were provided the materials by GRID and thus the material costs should be the same cost as GRID install projects. We were unable to determine what is causing this equipment cost difference; GRID could consider exploring this to decrease subcontractor project costs.

TABLE 5-6: SUBCONTRACTED AND GRID COMPLETED PROJECT COSTS

Installer	Project Count*	Median Size (CEC AC kW)	Median Cost	Median Incentive	Median $/W	Median Equipment Cost	Median Installation Cost
Subcontracted	274	4.6 kW	$22,897	$13,706	$5.26	$5,975	$16,528
GRID	1,607	4.5 kW	$21,673	$13,380	$4.97	$5,122	$16,063

*All subcontracted projects during the evaluation period that are complete are PV-only. We constrained this comparison to just those GRID projects that were PV-only to directly compare the same project type.

5.1.2 Program Implementation

The DAC-SASH program is implemented by GRID Alternatives who in turn is supported by a cadre of subcontractors for a subset of project installations. This section covers the successes of GRID's implementation of the DAC-SASH program, the challenges GRID is facing, as well as an overview of the subcontractor partnership program (SPP) and subcontractors' experiences with the program.

GRID Alternatives

During the 2022-2024 evaluation period, GRID completed 1,922 solar PV projects (four with paired battery storage) and processed 3,301 program applications. This is a large increase in applications and completions compared to the prior evaluation (1,785 approved applications and 964 completions[45] in

[45] From last evaluation report

program years 2019-2021). This increase is partially due to GRID running SASH concurrently to DAC-SASH during the last evaluation. Projects that could qualify for both SASH and DAC-SASH were served by the SASH program while it was active. Since DAC-SASH is now the only active program, all eligible projects are served through this program only (thus increasing application count).

Successes

There are a few aspects of GRID's implementation approach that have contributed to the successful increase in project applications. These include:

Partnerships: GRID partners with a wide array of organizations to create a strong community that supports GRID's implementation of DAC-SASH:

- Philanthropic partners provide support ranging from closing project funding gaps to helping GRID purchase discounted roofing materials
- Local governments, such as the city of Richmond, help with re-roofing to prepare a home for solar
- CBO relationships, like Habitat for Humanity, help with program marketing, job training, and identifying new construction homes with residents that qualify for DAC-SASH
- Tribal partnerships that help bring DAC-SASH benefits to Tribal communities across the state

Creative solutions: GRID exemplifies a willingness and drive to experiment and iterate to bring about program success including leveraging many different strategies to tackle implementation issues.

- Piloting ways to pay for re-roofing and panel upgrades
- Leveraging the subcontractor 'install only' model to expand installation capacity, especially during high demand times
- Leveraging the SGIP to pair storage with DAC-SASH solar for no cost to participants

Customer service improvements: GRID worked to address feedback from the last evaluation to improve their service to participants.

- Collecting more information (post-installation emails and follow up surveys, etc.) to understand customers' experiences with the program, ensure all needs are met, and provide additional benefits (including connecting participants to other qualifying programs)
- Applying a tailored, case-by-case approach for clients in hard-to-reach or complicated eligibility areas

Overall, these strategies demonstrate GRID's determination to problem solve and adapt to offer customers a successful no-cost solar installation.

Challenges

Despite these successes, GRID faced some challenges to program implementation during the evaluation period. These challenges included coordinating with the SGIP for battery paired and add on projects, eligibility criteria, and existing housing conditions.

The Self-Generation Incentive Program (SGIP)

With the change from NEM 2.0 to NEM 3.0, GRID sought to leverage the SGIP, specifically the Equity and Equity Resiliency qualification pathways, to pair DAC-SASH solar projects with battery storage. GRID identified that customers struggled to understand how solar could 'make sense' without a paired storage system under the new rules and thus pairing DAC-SASH solar projects with SGIP-incentivized storage projects would provide greater value to program participants. GRID shared multiple issues navigating the complex and unclear SGIP application system. Most notably, GRID reported about extensive SGIP delays – delays in application processing, delays because of changing SGIP requirements that require system re-design or re-doing paperwork multiple times, and delays in funds. An example of this occurred in March of 2024 when the Residential Solar and Storage Equity (RSSE) budget was announced which allocated a larger incentive for batteries than the previous two Equity budgets and seemed like an excellent fit for DAC-SASH paired solar and storage systems. Multiple delays occurred in releasing these funds with incentive reservations only opening up in June of 2025 – over a year after the budget's announcement.

A review of the tracking data confirms these challenges. Table 5-7 shows the active and completed counts for projects submitted in 2024. PV + Storage Paired projects are the majority of non-cancelled projects (66%), but less than 1% of these projects have been completed by the end of 2024. In contrast, 62% of PV-only projects were completed. This suggests that pairing a battery with a storage system and working through the SGIP may significantly impact completion rates for these projects.

TABLE 5-7: 2024 ACTIVE AND COMPLETED PROJECTS

Project Type	Active		Completed		Total	
	N	%	N	%	N	%
PV-only	104	38%	173	62%	277	34%
PV + Storage Paired	538	>99%	2	<1%	540	66%
Total	**642**	**79%**	**175**	**21%**	**817**	**100%**

GRID also noted that some of the SGIP requirements during the evaluation period disqualified a subset of DAC-SASH customers who resided in community choice aggregator (CCA) territories that did not have demand response programs available to their customers. This meant that these customers either had to change from their CCA to an IOU or wait until either the SGIP rules were changed or their CCA offered a demand response program if they wanted to participate in DAC-SASH. We found evidence of two applications being cancelled because of this issue. Additionally, two other projects changed to be PV-only, citing the SGIP CCA rules as the main driver of this change. There is only one record of a PV + Storage Paired project remaining active after documentation that it was impacted by the CCA rules.[46]

As storage paired systems are now the dominant project type within DAC-SASH, GRID reported that SGIP application issues have caused major disruptions to DAC-SASH projects. This included a slowdown in applications and completions in the last quarter of 2024 and may have contributed to the decline in projects in 2025. While the current evaluation can confirm a drop-off in applications in Q4 of 2024 (176 applications submitted compared to 431 in Q3 of 2024 or 254 in Q4 of 2023) and only 324 applications submitted in 2025,[47] the next evaluation should consider exploring in greater detail the impact of relying on the SGIP for battery storage incentives for DAC-SASH projects.

Eligibility Criteria

The income eligibility criteria for DAC-SASH is defined as being qualified for CARE or FERA. The CARE and FERA income limits are set in relation to the federal poverty guidelines. In higher cost of living areas like San Diego[48] or San Francisco,[49] these income limits don't necessarily capture the entire population in need. GRID has asserted that this impacts the number of people that can qualify for the program in these areas.

Another challenge GRID faces regarding eligibility is using the CalEnviroScreen 3.0 map to determine who truly is eligible for the program. GRID could explore the feasibility of using CalEnviroScreen 3.0 (or 4.0 since it is now available) shape files to create a searchable database that can identify edge cases and make determining eligibility faster and easier.

[46] This project was waitlisted at one point; likely to wait until the situation changed and the project was able to move forward.

[47] Using the variable, 'First Reservation Request Review Date' from the DGStats LowIncome_Applications_Dataset_2026-02-24

[48] Low income in San Diego is defined as $121,250 and very low income is $75,750. This is $40,875 above the income limit for FERA, https://www.hcd.ca.gov/sites/default/files/docs/grants-and-funding/income-limits-2024.pdf

[49] Low income in the San Francisco is defined as $156,650 and very low income is $97,900. This is $76,275 above the income limit for FERA, https://www.hcd.ca.gov/sites/default/files/docs/grants-and-funding/income-limits-2024.pdf

Housing Stock Limitations

The DAC-SASH program serves low-income single-family homeowners in DACs. This population, by definition, typically has limited capital available for the maintenance or renovations often needed to prepare their home for solar. As such, solar readiness – or lack thereof – is a core challenge GRID faces in implementing the DAC-SASH program. As GRID covers the gap for project aspects that are not covered under the incentive (e.g., re-roofing), GRID must ensure that each project can fit within the financial limits they have from their partnerships and fundraising. This in turn impacts which projects GRID can realistically take on, limiting who can participate in the program, and may end up leaving the most in-need unserved because it is not financially possible for GRID to take on these kinds of financially exorbitant projects. This is exacerbated by the fact that GRID also covers funding gaps for the solar installation (i.e., the incentive only covers around 67% of a solar installation project).

Subcontractor Program Participants

The SPP included eight subcontractors during this evaluation cycle. These subcontractors completed 274 projects during 2022-2024, but the distribution was not homogenous across participating subcontractors (Table 5-8). We spoke to two subcontractors who were responsible for a combined 40% of the completed projects during the evaluation period. We report on the successes and challenges of the SPP, as shared by both GRID and the subcontractors we interviewed.

TABLE 5-8: COUNT OF COMPLETE SUBCONTRACTED PROJECTS BY SUBCONTRACTOR

Subcontractor Index	N	%*
Subcontractor 1	108	39%
Subcontractor 2	108	39%
Subcontractor 3	29	11%
Subcontractor 4	15	5%
Subcontractor 5	9	3%
Subcontractor 6	4	1%
Subcontractor 7	1	0%

*Total does not add up to 100% because of rounding

Successes

GRID identified that one of the key successes of the SPP was the reduction in project backlog. Program years 2023 and 2024 experienced dramatic increases in both project applications and installations which had the potential to slow down project timelines. However, by leveraging the SPP, certain offices were able to better manage their workflow and keep more projects moving. The SPP also allowed greater DAC-SASH reach into more rural and Tribal communities.

Subcontractors also shared many positive aspects of their experience with the DAC-SASH SPP. We heard only positive reviews of GRID as a partner and supportive prime contractor. This included positive feedback on everything from support in helping subcontractors find job trainees to responsive and collaborative partnerships with multiple regional offices. We also heard that the consistent work from the program has been helpful in keeping work steady and ensuring a pipeline of prospective projects for the subcontractors.

'So I think this type of program just really helps everybody. It's, it's a domino effect, because, you know, the training that people are getting is setting them up with a career. They can just, if they really wanted to, they can, you know, get hired, get their contracting license, they can do so much. And then, on our side, it keeps small businesses like myself in business. So it's just a win, win.' - Subcontractor

We also asked subcontractors about their experience with the two models – install only vs. full project design and management. While one subcontractor had only done the install-only model, the subcontractor who had done both models reported positive experiences with both (but see challenges below for notes on the full project design and management option).

Challenges faced by subcontractors

When speaking to subcontractors, we identified a few areas that made working on DAC-SASH projects more difficult than typical residential solar projects.

The application process. To participate in DAC-SASH, subcontractors reported that they needed an expensive insurance policy to comply with program requirements. While understandable, the process for approval to work as a subcontractor takes quite a bit of time (according to subcontractors) which leaves subcontractors paying premium monthly insurance prices without project work lined up. This puts financial strain on subcontractors applying to be a part of the DAC-SASH program.

Full design and install model. While we heard from the subcontractor that had done this model that they really enjoy being able to do these types of design and management install projects, we also heard that there is a financial impact to these projects. We heard that, contrary to install-only projects where GRID manages the financial aspects, the subcontractor assumes full financial responsibility. While this would be the norm if they were the sole contractor, we heard that completion timelines for these projects run longer than they are used to in other sectors (i.e., often more than six months for completion). This seems to be due to challenges around communication with customers (e.g., scheduling, contract signing) leading to more extensive delays. Potential ways to relieve this impact could be to allow subcontractors to submit their upfront costs as they are incurred (permits, equipment, etc.) instead of waiting until the end of the project. It may also be helpful for GRID to further streamline the process of getting project stakeholders (customer, representatives, subcontractor) together to enhance communication and ensure speedy contract signing and project scheduling.

5.2 PROGRAM MARKETING ACTIVITIES

During the 2022-2024 evaluation period, GRID leveraged a wide array of strategies to determine project leads. This included referrals from previous DAC-SASH participants,[50] participating in local community events and community outreach (e.g., canvassing), advertising (including social media and direct mailers), and leveraging key partnerships like IOUs, CBOs, and local government to help spread the word about DAC-SASH. GRID's employment of varying strategies to generate project leads clearly paid off during this evaluation period as 2023 and 2024 had the highest applications during the life of the program. Below, we document the process by which GRID generates project leads (focusing specifically on how GRID partners with other organizations to help identify prospective customers), how customers became aware of DAC-SASH, what drove customers to be a part of the program, and the effectiveness of GRID's marketing efforts.

5.2.1 Generating Project Leads

As DAC-SASH is a program with a very specific set of eligibility requirements, the first hurdle of program marketing is establishing a pool of prospective customers to market to. Screening households for eligibility is time consuming and not all DAC and Tribal residents qualify for the program. It then becomes a challenge in and of itself to identify where and to whom it would be most effective to market. GRID has overcome this hurdle by partnering with other organizations and the utilities to help identify qualified leads. We focus on two of GRID's partner groups below to understand what is working well and where improvements could be made to better leverage these relationships to support GRID in their work.

IOU Partnerships

The main way that IOUs contribute to GRID's marketing is by providing lists of eligible customer leads. These lists were mandated under D.20-12-003 and are delivered to GRID on an annual basis. The lists contain information on ESA participants who are on CARE or FERA and reside in a DAC. These lists provide a strong starting point for DAC-SASH outreach as most of the core eligibility requirements are already confirmed by the IOUs. However, there were data challenges with these lists.[51] The lists often contained incomplete or inaccurate information as well as duplicate records making both data cleaning and outreach a challenge. While GRID has created a system to help process the information they receive from the IOUs, there is still a substantial amount of work that is required to confirm basic eligibility aspects that should have been filtered out of the data provided (e.g., confirming customer is in a DAC). Additionally, the data provided to GRID by SCE during the evaluation period was unusable as SCE had been using incorrect inputs

[50] $200 referral bonus offered.

[51] See also Section 3.1 on data limitations for a discussion on how the data issues with these lists impacted the evaluation.

to generate the list. Both GRID and the IOUs affirmed in interviews that they were working collaboratively to address data issues in the eligible customer lists to ensure that GRID has the most up to date and accurate pool of eligible customers. Future evaluations should confirm that these changes have indeed been implemented.

We also heard in interviews that PG&E and SCE support GRID through marketing campaigns. These campaigns are primarily emails sent to identified eligible customers informing them about the DAC-SASH program. GRID shared that these campaigns have helped to bring in numerous leads, especially in SCE's territory. While SDG&E does not participate in general DAC-SASH marketing campaigns, they do support by sending the DAC-SASH materials GRID has created to Tribal communities.

CBO and Program Partners

GRID has a wide array of CBO and program partners throughout the state. These partnerships support everything from helping to finance DAC-SASH projects, to job training support, to marketing. For example, GRID partners with organizations like Habitat for Humanity and other housing development companies to identify houses owned by DAC-SASH qualifying residents. This supports GRID in two ways 1) direct connection to a qualified individual and 2) a home that is likely solar ready and not in need of expensive upgrades. GRID's CBO partnerships also involve having a knowledgeable GRID staff member join CBOs doing outreach and community events in DAC-SASH qualifying areas. This gives GRID access to numerous leads while also building trust with community members and giving them access to a GRID staff member who can answer any questions they have.

We interviewed two DAC-SASH partners to understand their experience with and role in the program. Both partners expressed how happy they were with their partnership with GRID. When asked if they found there were any areas to improve upon, they shared the following feedback.

Increased Partnering

Both interviewees expressed a desire to work more with GRID. One partner that we spoke with noted their partnership with GRID facilitated five of their clients installing solar through the DAC-SASH program. These homes had the added benefit of being solar ready and requiring no upgrades – making them more financially feasible projects for GRID as well. The partner reported working to identify more homes eligible for the DAC-SASH program that they could send to GRID as leads that they have confirmed are in DACs and are currently getting their home rehabilitated through other programs. Having an easier way to identify who is eligible for DAC-SASH and alert GRID to these customers would be beneficial to both parties.

We heard from the other interviewee that they primarily do community outreach and education, often in DACs. The interviewee noted currently partnering with one GRID office which entailed having a GRID staff member attend some of their outreach activities to educate customers and garner interest on DAC-SASH. The interviewee noted attending multiple events in DACs that attract potentially qualifying homeowners where GRID is not actively recruiting. They identified this as a gap that increased partnership with local CBOs and other non-profits could fill. We also heard that while this organization has a strong relationship with one office, it can be challenging to expand that partnership to other GRID offices. It could be beneficial to create opportunities to connect established partners with additional GRID offices.

Improved Marketing

Both interviewees expressed that GRID's marketing could be improved. One interviewee shared, 'I didn't know that this program was available until I started working here'. Interviewees provided the following recommendations to help improve marketing in their communities:

- Present at town halls or conduct informational sessions. Ensure it's at least an hour-long session to explain the program in depth and allow time for questions
- Partner with local schools and market the program during back-to-school activities
- Have a booth at local community resource fairs
- Provide DAC-SASH informational sessions to educate local CBOs that serve people who would qualify for DAC-SASH. These partners can then market the program and help identify potential participants and hot leads for GRID

5.2.2 Program Awareness and Drivers

We surveyed DAC-SASH participants and non-participants to understand how people become aware of DAC-SASH and what the key drivers for program participation were.

Non-Participant Program Awareness

We surveyed 151[52] non-participants[53] and asked them about their experience with DAC-SASH program marketing. The non-participant survey sample came from a list of 'cold leads' or individuals that GRID has

[52] Each email invitation for the survey had an embedded survey question asking if the respondent was familiar with the DAC-SASH program. However, after asking this question, respondents were asked a series of additional questions to determine eligibility to continue the survey (IOU territory, homeowner status, etc.). Sixteen surveys were removed from the analysis because they were deemed ineligible.

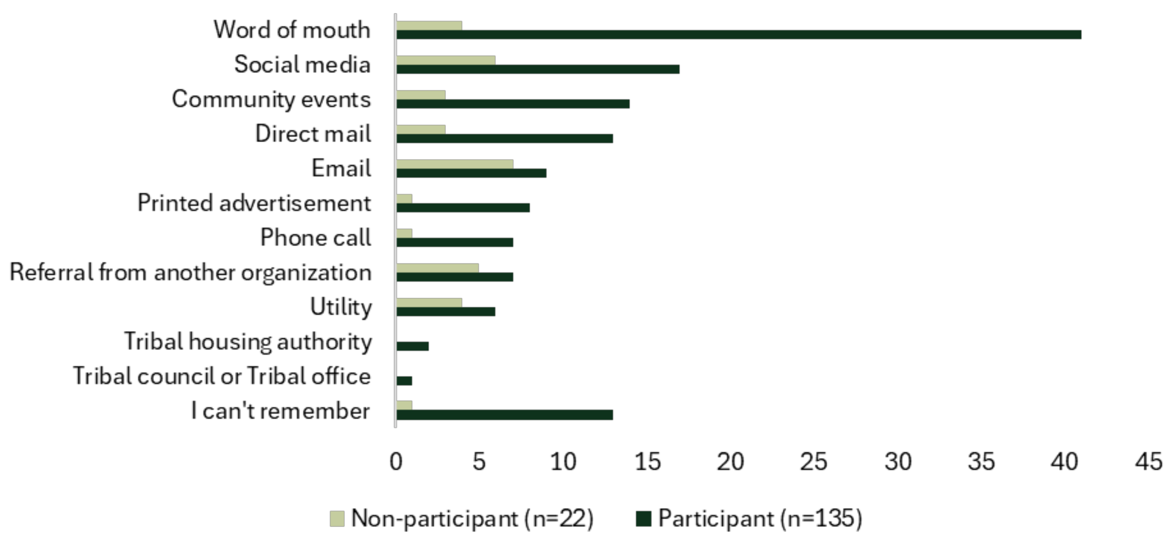
[53] As part of our non-participant survey efforts, we filtered out any respondents that were not 1) in one of the three main IOU service areas (or corresponding CCA) and 2) did not own their own home. Sixteen of the 152 respondents (11%) were deemed ineligible for and removed from the survey because of violating one of these two criteria. An additional 12 respondents indicated they already had solar installed on their house. This left us with 124 respondents who would potentially be eligible for DAC-SASH contributing to the non-participant survey (82%).

marketed to in the past through one of their channels but never submitted an application (Section 3.1). Of these respondents, 19% (n = 29) asserted they were aware of the DAC-SASH program and most (n = 27) correctly identified that the program offered free solar panels and lower electric bills.[54] An additional 16 survey respondents were unsure if they had heard about the program and the remaining 70% of surveyed non-participants (n = 106) reported they had not heard of it.

Primary Sources of Program Awareness

Figure 5-1 below shows the differences in program awareness between participants and non-participants. The top participant source of awareness is word of mouth from family, friends, or neighbors (n=41, 30% of participants). GRID employs a referral incentive ($200) for DAC-SASH participants that encourages others to apply, which, paired with increased trust from knowing someone truly benefitted from the program, could explain this finding. For non-participants, the top two sources of awareness were email (n=7, 32%) and social media (n=6, 27%). Only four non-participants shared that they heard about the program through word of mouth (18%).

FIGURE 5-1: PARTICIPANT AND NON-PARTICIPANT SOURCES OF DAC-SASH AWARENESS



We asked non-participants what the best ways were to reach them with program information. Non-participants reported email and direct mail are the best channels to share this kind of information. Table

54 Respondents were offered the options of: free solar panels, free battery storage, lower electric bills, an 'other' option, and asserting they didn't know what it offered. While most respondents did correctly identify that the program offered free solar panels and lower electric bills, eight respondents also indicated that they thought the program offered free battery storage.

5-9 shows the complete breakdown of results. Two non-participants reported that that door-to-door solicitation and calling are things they do not recommend as marketing channels.

TABLE 5-9: BEST WAYS TO CONTACT PEOPLE WITH INFORMATION ON SOLAR PROGRAMS (N=72)*

Best Way to Contact	N	%
Email	48	67%
Mail to my home	38	53%
Information from my electric company	16	22%
Text messages	12	17%
Social media	6	8%
Community events	4	6%
Phone calls	4	6%
Door-to-door visits	1	1%
Through community groups	1	1%

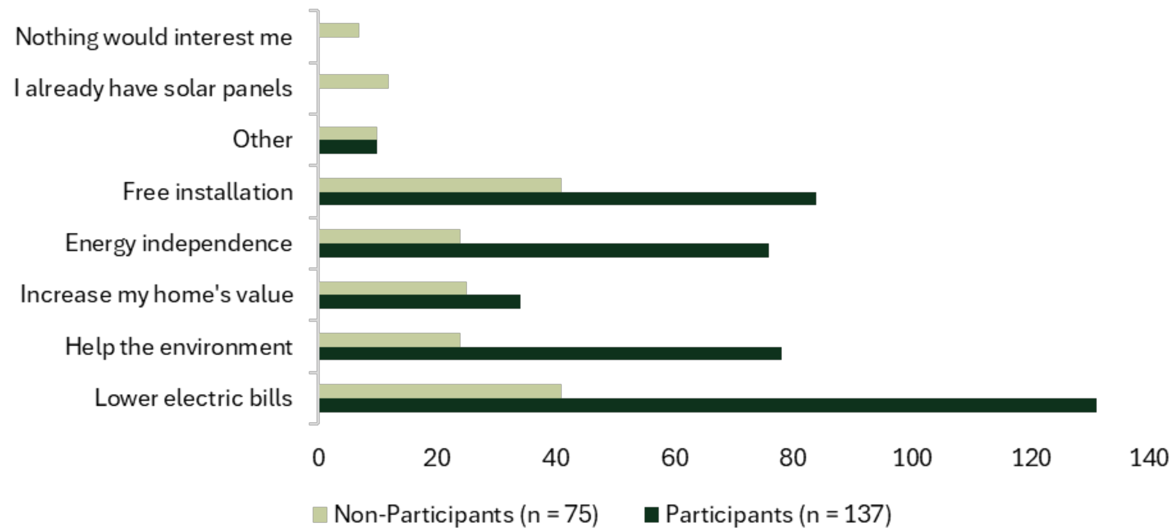
*Multi-select question

Participation Drivers

We asked participants what drove them to take part in the program, and non-participants what would entice them to take part.[55] Figure 5-2 below shows the breakdown of those responses. Each respondent could choose multiple reasons for participating. The two most common reasons for both groups were lower electric bills (96% of participants, 55% of non-participants) and free installation (61% of participants and 55% of non-participants).

55 Participants were asked, ‘Why did you decide to get solar panels through the DAC-SASH program?’ while non-participants were asked, ‘What would make you interested in getting solar panels on your home?’

FIGURE 5-2: PARTICIPANT AND NON-PARTICIPANT DRIVERS* FOR PARTICIPATION



*Only non-participants were given the options of 'nothing would interest me' and 'I already have solar panels'

The team also explored whether participants had a higher incidence of knowing someone with solar. Table 5-10 below shows that both participants and non-participants had a relatively high instance of knowing someone with solar, so this alone is likely not a core driver for participation.

TABLE 5-10: PERCENT OF RESPONDENTS WHO KNOW SOMEONE WITH SOLAR

Survey Group	Knows Someone with Solar	Doesn't Know Anyone with Solar	Unsure
Participants (n = 106)	71%	25%	6%
Non-participants (n = 94)	67%	29%	4%

5.2.3 Marketing Effectiveness and Challenges

We analyzed participant and non-participant survey results to understand what marketing techniques and messages were effective (i.e., got people to participate) and where challenges in marketing occurred.

Effective Marketing Strategies

We explored aspects of GRID's marketing to understand what was effective in enticing customers to participate in the program. As trust is one of the most important factors for implementing these types of programs, we asked participants how they knew the DAC-SASH program was not a scam. Table 5-11 shows that GRID's active outreach (talking to someone in person or on the phone) is the most powerful way to combat mistrust in the legitimacy of the program (n = 87, 65%), followed by the ability to look the program up on GRID's website (n = 68, 51%).

TABLE 5-11: HOW PARTICIPANTS KNEW DAC-SASH WASN'T A SCAM (N = 134)

Reason	Count*	% Respondents
Someone from GRID explained the program to me in person or on the phone	87	65%
I could look it up on the GRID Alternatives' website	68	51%
I could look it up on the California Public Utilities Commission's (CPUC) website	33	25%
Information was easy to understand	30	22%
I had a friend, family member, or neighbor that had participated in the program	28	21%
Information was in my own language	18	13%
Someone from a trusted community organization told me that it was legitimate	16	12%

*Multi-select question so each respondent could choose multiple options

We also heard from respondents that they knew the program was not a scam because they asked about it on Reddit, saw a news article about the program, saw GRID's truck in the neighborhood and connected it to a mailer they had received about the program, or they saw their utility (SCE) promoting it.

We asked Tribal participants (n= 4) if there were any Tribal specific outreach methods they wanted to see GRID employ in their communities. We heard that GRID employs many different trust building actions such as presenting at Tribal council meetings, attending Tribal community events, and even offering services in Tribal languages. We heard from participants that GRID could add (or make more frequent) the following activities to their Tribal marketing plan: partnering with Tribal environmental programs, hiring staff who understand Tribal communities, and creating marketing and informational materials that reflect Tribal values.

We also asked non-participants questions to gauge the effectiveness of DAC-SASH marketing. Non-participant respondents that were familiar with the program were asked whether the marketing they had seen influenced their desire to participate in the program. 62% of these respondents (n=13) stated the marketing did make them interested in participating in the program noting that the accessibility of the program, lower energy costs, and free solar panels were major drivers for that interest. When asked why they did not participate, respondents shared that they were confused about what the program did (n = 4), thought it would cost too much money (n = 2), were worried it was a scam (n = 3), and thought the paperwork seemed too hard (n = 2). Respondents also shared concerns about their roofs, being unable to get more information about the program when they tried, and that they did not think solar was worth it with the new NBT changes.

Improvements

We asked participants if they felt there was anything GRID could improve so that more people could become aware of the program. Fifty-one respondents (38%) shared that yes, they feel there could be improvements in GRID's marketing, and they had ideas on how GRID could improve outreach. Recommendations ranged from encouraging more advertising (on everything from bill inserts – which would require IOU collaboration - to social media) to visiting neighbors during installation to talk about the program. Table 5-12 below shares some examples of ideas participants shared that they felt could help GRID reach more people with more effective messaging. It is important to note that GRID does some of these activities already, which could be taken as a sign (for the activities GRID does do) that they are effective ways to reach people and GRID could consider doing more of them. Additionally, the last marketing improvement presented in the table below is about the website being vague. We heard from both non-participants and participants that the website was not always helpful in finding the program information they wanted. As the website is also a critical component of building trust, we recommend GRID consider adding more specific information about the program and talk with DAC-SASH participants to gather additional feedback on how the website could be improved to increase accessibility, access to program information (including adding information and improving navigation to information), and trust building.

TABLE 5-12: PARTICIPANT RECOMMENDATIONS TO IMPROVE HOW PEOPLE LEARN ABOUT THE PROGRAM

Improvement Type	Participant Recommendation
Marketing	Attend local community events such as block clubs. You can get a person who has qualified to be a testimonial for the remainder of the block.
	Focus on you being the ONLY organization to give free solar panels. And easily allow the user to see the government source / fine print proving they are free.
	Provide documentation that the program is backed by the state of California
	I only learned about the program because representatives were canvasing my neighborhood. But there are more effective methods of community networking. Through senior centers, Edison care program participants, other low-income programs and through referrals from church outreach programs.
	Signs in participant's yards. Visits to the neighbors during installation.
	Leave posters and/or brochures around community.
	Advertise better, honestly it does appear to be a scam their website is pretty vague.
Information	Explain the specifics.
	Perhaps make the financial guidelines easy to look up. As several people have asked me that question.
	Make it known what the qualifications for the program are so, people can know what the income qualifications are.
	GRID needs to be completely honest with people. It is imperative that GRID provide its customers with a full and transparent understanding of both the advantages and the potential drawbacks involved.

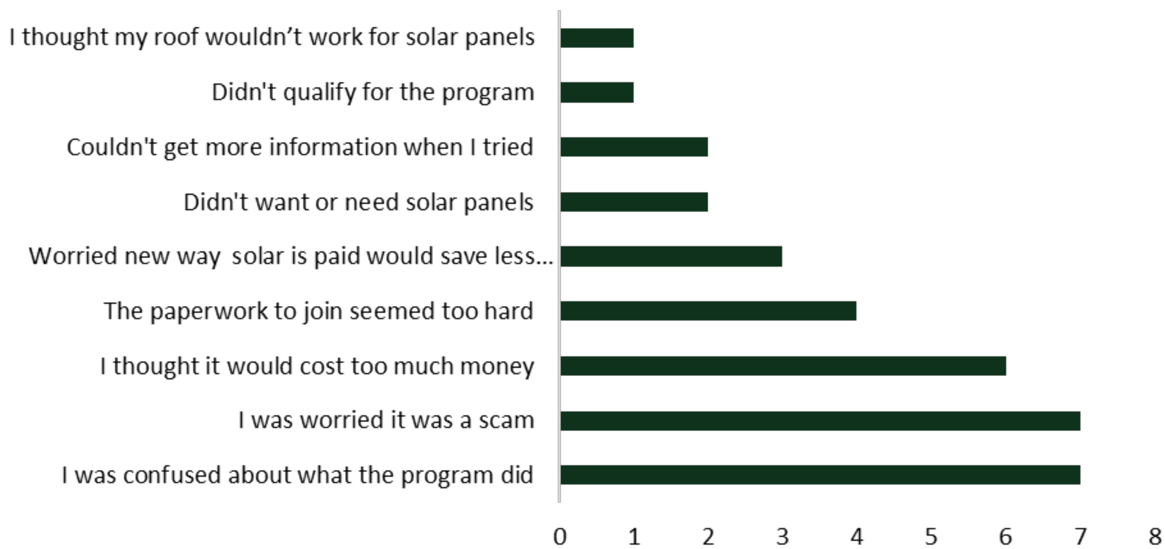
Challenges

We identified some areas in which GRID marketing encountered some challenges. Some of these challenges are general challenges faced by many programs (like fear of scams) while others point to aspects of GRID's specific outreach approach. Below we provide insights into these challenges from the customer web surveys we conducted and in Section 9.1 we provide recommendations on potential ways to overcome some of these challenges.

Lack of Trust

One of the most common (and often difficult to address) reasons for not participating in programs is lack of trust. Fear of scams, doubts of legitimacy and offers, or wariness around data sharing are all common misgivings reported by non-participants in the surveys (as well as many other pilots and programs across CA). Figure 5-3 below shows the reasons non-participants respondents (n = 17) provided for why they are not participating. The two most common reasons were that they were worried the program was a scam and they were confused about what the program did.

FIGURE 5-3: REASONS NON-PARTICIPANTS GAVE FOR NOT PARTICIPATING IN THE PROGRAM



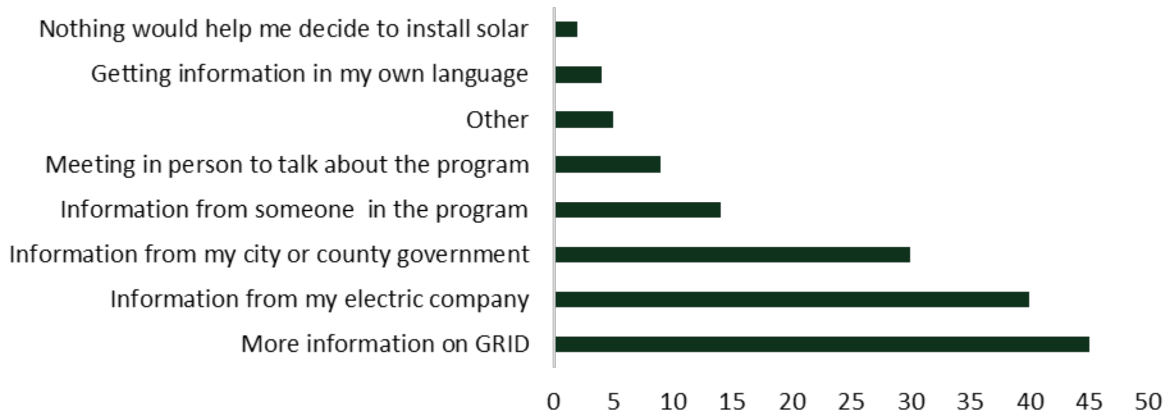
We asked non-participants what made them think the program was a scam (Table 5-13). The two most common reasons were that it looked too good to be true (n = 4) and that they could not verify the program was real (n = 4). Respondents also shared that they felt the program asked for too much information upfront (n = 3).

TABLE 5-13: REASONS NON-PARTICIPANTS THOUGHT THE DAC-SASH PROGRAM WAS A SCAM

Reason respondent thought it was a scam	Count (n)
Looked too good to be true	4
Couldn't verify the program was real	4
Asked for too much personal information upfront	3
Website or materials looked unprofessional	1
Similar to other offers that turned out to be scams	1

We then asked non-participant survey respondents that indicated they thought the program was a scam (n = 7) or who had not heard of the program (n = 66) what would increase their trust in the DAC-SASH program offerings and the top choice was increased information about GRID Alternatives (n = 45, Figure 5-4). Other ways to build trust and legitimacy included program information provided by their electric company (n = 40) or their local government (n = 30). One respondent shared that they would appreciate 'A brochure outlining all my responsibilities and legal information such as who owns the panels, what happens in the event of us selling our home, how long the installation would take, how new my roof needs to be, etc. I would want all the information available to look at on my own, without a salesman to pitch it.' Providing this information online[56] and having materials to share with homeowners during the outreach phase, could be a powerful way GRID can build trust in the program.

FIGURE 5-4: WHAT WOULD MAKE NON-PARTICIPANT RESPONDENTS TRUST THE DAC-SASH PROGRAM MORE?



We also asked non-participants who were familiar with the DAC-SASH program what would make them more likely to sign-up for the program. Table 5-14 below shows that the top driver to DAC-SASH participation was if they knew it was no-cost (free) to them.

TABLE 5-14: WHAT WOULD MAKE RESPONDENTS LIKELY TO SIGN-UP FOR THE DAC-SASH PROGRAM?

Driver	Respondents
Knowing it's no-cost (free)	9
Knowing how much energy I'll save before I sign up	5
Knowing it's backed by the state of California	5
Clearer and simpler information	3
More help with paperwork	2
Having a trusted community group recommend it to me	2
Information in my own language	2
Meeting with someone from my community who has participated or is involved in the program	1
Seeing how solar panels work and impact bills at a neighbor's house	1

[56] GRID does have some of this information on their website. They currently have a 'FAQ' section that covers some of these questions but 1) it may not be intuitive to find (linked at the very bottom of a page asking for name and email to see if you qualify or within multiple drop down selections at the top of the screen) and 2) not everyone has access to the internet or the same website navigational skills which could impede even accessing this information.

'Information needs to be more easily accessible and clear. I need to know for sure exactly how it would financially impact me, either positively or negatively. Just some more transparency please, this field is rife with scams and I don't want to be taken advantage of.' – Non-participant survey respondent

Lack of Interest in Solar

Another hurdle that is difficult to overcome is a complete lack of interest in solar. While not a common response, our survey did have six non-participant respondents who indicated that nothing would make them interested in participating in DAC-SASH or a program like it. When asked why they felt this way, half of these respondents indicated that they didn't trust that the program was truly free (n = 3) and the other half said they simply had no interest in installing solar on their home (n = 3). For those with a lack of trust, it's possible that some of the strategies participants and non-participants shared (interacting with GRID, providing more specific information) could help to alleviate fears and build interest in the program. For those who share they have no interest in getting solar, it could be beneficial for GRID to explore what contributes to a respondent lacking interest (e.g., concerns for their roof, anti-renewable energy, time commitment concerns).

It should be noted that the fact that only three of the 136 of the non-participant survey respondents stated they have no interest in the program indicates that GRID may have an untapped opportunity here. The non-participants in our survey come from a list of 'cold leads' that GRID had marketed to in the past but that never participated in the program. All but six respondents in our survey showed some interest in participating in DAC-SASH or a program like it – suggesting that with some tweaks in strategy to overcome fear of scams or clear up confusion about the program (such as updated marketing, improved information, or a more active connection (community event, phone call, etc.)), these previous 'cold leads' could be funneled into the DAC-SASH program.

5.3 CUSTOMER PARTICIPATION

Our team analyzed DAC-SASH participant survey responses to gather feedback on customers' experiences with the program. We present our findings on customer satisfaction, challenges (including barriers to participation reported by non-participants), experiences with other programs or energy upgrades, perceived bill savings, and feedback around battery storage.

5.3.1 Customer Satisfaction

DAC-SASH survey respondents report 90% satisfaction with their solar panels (n = 146, very satisfied and satisfied combined). We also noted high satisfaction for almost every other DAC-SASH component we asked about (Table 5-15). The one exception to this was with the education they received about their billing and solar true-up (64% reported being satisfied). We discuss more about customers' experience with bill savings, including education, in Sections 5.3.2 and 5.3.4). Satisfaction values were high for participants who had GRID install their system (e.g., 85% overall satisfaction, 86% installation satisfaction, n = 110) or a subcontractor (94% overall satisfaction, 94% installation, n=18) suggesting that both models (GRID or subcontractor installs) are working well.

TABLE 5-15: SATISFACTION BREAKDOWN FOR VARIOUS COMPONENTS OF THE DAC-SASH PROGRAM

Component	N	% Satisfied*
Experience in the DAC-SASH program overall	128	87%
Working with GRID Alternatives	128	88%
The information you received about the DAC-SASH program prior to participating	128	77%
The education about solar panels you received from GRID once you started participating	128	77%
The solar installation process	110	86%
Working with your subcontractor for your solar installation	18	94%
The education about your new billing and solar true ups you received from GRID	128	64%
Your electric bills since installing solar panels	128	78%

*Very satisfied and satisfied combined

Survey respondents also report decreased stress because of their participation in the program. When asked if they were more or less stressed about the cost of their energy since getting their solar panels, 84 respondents (71%) stated they were less stressed. We saw similar levels of decreased stress for respondents' energy use (n = 80, 67% less stressed) and appliance use (n = 77, 65% less stressed) since getting solar panels. Eighty-three respondents (78%) attribute these stress decreases to their solar panels and DAC-SASH participation. Our impact analysis found that DAC-SASH participants tended to increase their electricity consumption post PV installation (Section 6.2). While participants are generally increasing their energy use (net usage increase), their solar system generation exceeds usage increases. As such, bill impact analyses show that savings are still being achieved (Section 6.5) which is likely contributing to the overall sense of stress reduction around energy use.

- *'I feel less stressed because I know that on sunny days my panels produce energy which can help with my energy usage.'*
- *'Compared to other people in smaller living situations with same amount of people in the home 24/7 my bill is nothing compared to theirs. Our electrical bill is no longer a stressful event to open it.'*
- *'It has definitely decreased my worries about my energy bill as I was paying more than $200 and I kept limit on how much we would use our appliances.'*

While most survey respondents had high satisfaction with their DAC-SASH program experience, a few individuals did report some dissatisfaction. The most common reason for dissatisfaction was the feeling that they did not have enough support or information throughout the process. Eight people reported that they felt they didn't receive enough information, with three people sharing the information they did receive was unclear. One respondent also shared that they didn't feel like they were adequately informed of the limitations and challenges they might face as part of their participation but didn't elaborate specifically on what those challenges were.

We also heard from participants that they didn't feel like the number of panels they got through the program supported their actual energy use. Previous handbook rules stated that DAC-SASH was supposed to purposely undersize units with a 5kW cap enforced. This has since changed, but is likely what is driving this sentiment and is something that was outside of GRID's control at the time.

We heard from six people that the installation took a very long time (see Section 4.1.1 for median installation time for each project type). Three people also noted that they didn't get updates when delays or changes occurred which caused some frustration. One respondent shared that, 'it took very long and if I didn't have full trust in the program, this is the time I would begin to question its legitimacy'.

Finally, 13 people reported they weren't saving as much money as they expected with four people sharing they are confused by their bill. One person even stated they are paying more now than before their solar was installed. While we do note that three participants do seem to have increased bills post solar installation (out of 724 analyzed projects), this is not a normal DAC-SASH experience. More information on perceptions of bill savings are presented in Section 5.3.4 and actual bill impacts are in Section 0.

5.3.2 Barriers to and Challenges with Participation

While satisfaction with GRID and program participation is high, we uncovered a few barriers and challenges with program participation.

Participant Reported Challenges

More than half of the participant survey respondents didn't have any issues with participating in the program (n = 66, 55%). For the remaining respondents, the most common challenge faced was long wait times (n = 22, 18%) followed by confusing utility bills (n = 16, 13%). Table 5-16 shows the reported problems faced by survey respondents.

TABLE 5-16: PARTICIPANT REPORTED CHALLENGES (N = 120)

Challenge	N*	%
No challenges	66	55%
Long wait time	22	18%
Confusing utility bills	16	13%
Needed to make updates to my home to get solar	14	12%
Hard to reach someone for help	10	8%
Too much paperwork	9	8%
Hard to understand the program	7	6%
Language barriers	3	3%
Too much time off work for installation or upgrades to prepare for installation	3	3%
Lack of understanding of Tribal community needs	1	1%
Distance from the reservation to the installer offices impacted installation	1	1%
Utility connection issues on Tribal lands	1	1%

*Multi-select response so participants could choose more than one answer

We asked survey respondents follow up questions to better understand what contributed to their reported challenges. For those reporting it was hard to understand the program, five respondents indicated that the program information was too complex. Of the ten respondents that indicated it was hard to reach someone for help, their most common struggle was that no one answered the phone (n = 6), they were put on hold for too long (n = 3), left messages but no one called them back (n = 3), or that the person or people they spoke to couldn't help them (n = 3).

We found that in addition to participants reporting that utility bills were confusing, 43 respondents (33%) reported struggling with GRID's explanation of how their electric bill would change, with two respondents sharing that they never received an explanation of bill changes. This may have contributed to 19 respondents (n = 15%) reporting that they did not feel ready for how their electric bill would change with solar, and 47% of respondents sharing that they had some level of surprise when they got their first solar true up (Table 5-17). It is unknown if GRID uses the term 'solar true up' when explaining bill changes with participants, but if they do, it is worrisome that 21 respondents (16%) do not know this term.

TABLE 5-17: PARTICIPANTS' RESPONSE TO FIRST SOLAR TRUE UP

When you got your first solar true up, were there any surprises?	Count	Percent
No surprises – it was what I expected	48	37%
A few small surprises, but nothing bad	29	22%
Yes, there were some surprises that worried me	22	17%
Yes, there were big surprises that caused problems	11	8%
I don't know what a solar true up is	21	16%
Total	**131**	**100%**

We asked those who were surprised what would have helped them prepare and be less surprised by their first solar true up. The most common response was receiving an example of what a solar true up might look like (n = 29, 47%, Table 5-18).

TABLE 5-18: WHAT RESPONDENTS FELT WOULD HAVE HELPED THEM BE MORE PREPARED FOR THEIR FIRST SOLAR TRUE UP

What would have helped you prepare and be less surprised by your first true up?	Count	Percent*
Examples of what the true up might look like	29	47%
A resource to help with tracking my energy use and budget so I was better prepared financially when the true up came	24	39%
A reminder about what would happen a month before the true up bill	18	29%
More explanation before getting solar	16	26%
Someone to call with billing questions	15	24%
Written materials in my own language about solar billing	9	15%
More time to ask questions	6	10%
Other	5	8%
I felt ready	3	5%
Total	**62**	

*This was a multi-select question so respondents could choose more than one choice.

Regarding solar true up: *'I got a Master's and I still do not understand it. Looks like part of the bill is set aside from which you will pay eventually, in our case $1,000+. If we did not have money saved, this could have ruined us.' – DAC-SASH participant*

Long wait times were reported as the most prevalent challenge faced by participants. The most common answer for what respondents felt contributed to long wait times was waiting for the solar panels to be installed (n = 12, 55%). This was closely followed by the time it takes to get a DAC-SASH application approved (n = 11, 50%), with less respondents sharing issues around the time it took to get their home solar ready (n = 5, 23%). These results are concurrent with tracking data reports on long project timelines in 2022 and 2023. Table 5-19 below shows the median amount of time it takes for projects submitted in each program year to be completed or how long they have been active in the program (not completed or cancelled). While 2024 project completion and active times currently look in-line with market rate installation timeframes (three to six months for project completion), future DAC-SASH program evaluations should explore if the decrease in time to project completion continues or is negatively impacted by the influx of PV + Storage Paired projects.

TABLE 5-19: MEDIAN DAYS TO COMPLETE PROJECTS OR TIME IN PROGRAM FOR EACH PROGRAM SUBMISSION YEAR

Year*	Project Type	Active Projects (#)	Days in Program	Completed Projects (#)	Days to Completion
2022	PV-Only	4	846	747	251
	PV + Storage Paired	1	858	--	--
	PV + Storage Add-on	0	--	11	333
2023	PV-Only	29	488	648	223
	PV + Storage Paired	12	444	2	523
	PV + Storage Add-on	2	415	15	251
2024	PV-Only	104	169	173	162
	PV + Storage Paired	538	145	2	187
	PV + Storage Add-on	2	211	9	163
All Years	PV-Only	**137**	**240**	**1,568**	**239**
	PV + Storage Paired	**551**	**148**	**4**	**364**
	PV + Storage Add-on	**4**	**360**	**35**	**244**

*We constrained this analysis to only those projects that were submitted during the evaluation period. An additional 318 projects were submitted prior to 2022 that were either still active (n = 3) or completed (n=315) during the evaluation period.

Tribal-Specific Barriers and Challenges

As part of reviewing the influence of the DAC-SASH program on Tribal communities, we surveyed Tribal participants and spoke to one of GRID's core Tribal project managers. We wanted to understand specifically what kind of challenges Tribal communities face to better understand how the program could better serve these communities in a more holistic and supportive fashion. We note four key challenges Tribal communities face to DAC-SASH program participation:

- **Paperwork and income verification challenges**. These challenges revolve around gathering required documents (like tax forms and PG&E bills) which can be burdensome for clients, particularly in Tribal communities where financial information can be sensitive or difficult to access.
- **Communication barriers.** Many program resources and materials are not always tailored to Tribal contexts making it hard for clients to understand what's needed or trust the process.
- **Relationship building.** Establishing trust with Tribal communities takes time and can be disrupted when key Tribal contacts leave or roles change within the community.
- **Eligibility mismatches.** Strict income thresholds and requirements don't reflect the multi-generational and unique household realities in Tribal communities.

Survey respondents also noted two additional challenges Tribal customers face to participation. One respondent noted that the distance from the reservation to the GRID office impacted project installation and a second respondent shared encountering issues because the project was on Tribal land (though they did not specify what these issues were).

We asked in our interviews and surveys what could be done to improve the program experience for Tribal communities. We received the following recommendations:

- **Simplify income verification.** Allow Tribal administration to provide a letter certifying household low-income status. This would be similar to how Tribal letters are used for homeownership verification and would be more culturally appropriate.
- **Adjust the eligibility criteria.** Revisit income eligibility amounts to better reflect multi-generational and unique household realities in Tribal communities. This will ensure more families who genuinely need assistance can qualify.
- **Improve internal and external communication.** Continue sharing best practices and resource materials across different GRID offices serving Tribal communities to support relationship-based communication approaches with Tribal partners.

Non-Participant Reported Barriers to Participation

When non-participants who had heard about the program were asked why they didn't sign up, two respondents indicated that they simply couldn't get the information they needed to better understand the program. One of these participants indicated that they never received a response to their inquiry while the other shared that GRID's website for DAC-SASH was confusing to use and didn't have all the information they needed.

We asked respondents that indicated that they didn't know what the program did what would make the information about the program easier to understand. Respondents (n = 7) indicated they would like the information presented in simpler language (n = 3) and in pictures or videos (n = 4). They also shared the importance of hearing from others who had participated (n = 2) with one person wanting to hear specifically from someone who had a system through the program that was more than five years old.

5.3.3 Cross Program Enrollment and Energy Upgrades

DAC-SASH participation is a powerful entry point for utility energy savings programs (especially electrification) as well as individual energy efficiency and electrification upgrades. We evaluated cross program participation and energy upgrades for DAC-SASH survey respondents as well as utility program data for all completed projects during our evaluation period (when available).

Cross Program Enrollment

We wanted to understand the impact of DAC-SASH and getting solar on participants' enrollment in other programs. CARE, FERA, and ESA are all programs tied into DAC-SASH implementation in some fashion (see Section 4.2.2 for information on baseline levels and adoption rates for DAC-SASH participants), but there are a myriad of other programs that DAC-SASH participants could potentially qualify for or leverage for greater savings post solar installation. We asked survey participants if they were participating in any additional programs (Table 5-20). Interestingly, 18 respondents (n = 15%) shared that they weren't participating in any energy programs. It's important to note that this is self-reported data, and it's possible that participants aren't always aware of their participation in these programs or are unfamiliar with the official program names. For example, comparing the table below to Table 5-21 shows that while only 8% self-reported ESA enrollment, data provided by PG&E showed 91% of their DAC-SASH participants were enrolled in ESA.

TABLE 5-20: SURVEY RESPONDENT REPORTED ADDITIONAL ENERGY PROGRAM PARTICIPATION

Energy Program	Count	Percent*
CARE	99	82%
FERA	13	11%
ESA	10	8%
Medical Baseline	23	19%
Weatherization Assistance Program (WAP)	9	7%
Not part of any energy programs	18	15%
Total	**121**	

*This was a multi-select question so respondents could choose more than one option

As our surveys did not capture program data for all completed projects during our evaluation period, we leveraged utility program participation data to explore cross program participation in more detail. Table 5-21 shows the adoption of three state-wide programs post DAC-SASH participation. As DAC-SASH and ESA share similar requirements, cross-coordination between the two programs is baked into the DAC-SASH program (an example being the IOUs sharing ESA participants with GRID for DAC-SASH outreach). GRID provides the IOUs with a list of DAC-SASH participants monthly to be shared with each utility's ESA team for outreach and enrollment. However, as Table 5-21 shows, SCE and SDG&E do not appear to be enrolling as many participants in ESA as PG&E, despite far more opportunity to do so as pre-DAC-SASH ESA enrollment numbers are far lower for these two utilities (though note that SCE did more than quadruple DAC-SASH participant ESA enrollment). Interviews with SCE and SDG&E staff suggest that they are working to address internal issues leading to low ESA outreach and future evaluations should assess if the lack of ESA enrollment has been addressed for these IOUs.

TABLE 5-21: OTHER PROGRAM PARTICIPATION BEFORE AND AFTER ENROLLMENT IN DAC-SASH

Program	PG&E (N=1,054)		SCE* (N = 797)		SDG&E (N=68)	
	% Before	% After	% Before	% After	% Before	% After
ESA	37%	62%	6%	24%	1%	11%
MBL	13%	17%	5%	10%	4%	5%
AMP**	13%	18%	2%	2%	4%	10%

* Three completed SCE projects were excluded from this analysis because they did not provide program data
**Arrearage Management Program

Another program that showed notable increases in participation post DAC-SASH involvement is the SGIP. Table 5-22 shows program participation increases for three different SDG&E programs, including the SGIP. SDG&E had 68 projects completed during our evaluation period, 11 (16%) of which were paired with storage (n = 1) or had storage added on (n = 10). Data from SDG&E indicated that 22% of completed projects have participated in SGIP, suggesting there are additional projects leveraging SGIP outside of DAC-SASH and reaping the benefits of battery storage.

TABLE 5-22: OTHER PROGRAM PARTICIPATION BEFORE AND AFTER ENROLLMENT IN DAC-SASH (SDG&E ONLY)[57]

Program	% Before	% After
Self-Generation Incentive Program (SGIP)	0%	22%
Pre-Owned EV Rebate Program (POEV)	0%	3%
Generator Grant Program (GGP)	1%	2%

Energy Upgrades Post Solar Installation

Respondents were also asked about any energy or electrification upgrades they had completed since getting their solar panels. When asked if they had made any other changes to save energy at home since getting their solar panels, 72 respondents (49% of respondents) shared that they had and 18 respondents (12% of participants) said they plan to. When asked about what improvements had been made, most respondents shared they had installed LED bulbs (n = 56, 78% of those that made changes) and many other respondents reported making a substantial upgrades such as installing battery storage (n = 7, 10%) or an EV charger (n = 14, 19%, Table 5-23).

TABLE 5-23: PARTICIPANT SURVEY RESPONDENTS REPORTED IMPROVEMENTS POST SOLAR INSTALLATION

Improvement	Count	Percent
Changed lights to LED bulbs	56	78%
Sealed air leaks	29	40%
Got a new appliance(s)	25	35%
Got a programmable thermostat	25	35%
Added insulation	14	19%
Got an EV charger	14	19%
Got battery storage	7	10%
Total	**72**	

For respondents who reported purchasing a new appliance, we asked what appliances they got and what energy source (gas, electricity) their new appliance replaced. Twenty-five respondents reported purchasing 67 new appliances ranging from water heaters to kitchen stoves. Of these, we found six

[57] SDG&E was the only IOU to provide additional energy efficiency and electrification programs in accordance with our data requests. While this limitation could be solved with an additional query, there were too many other data delays to ensure that these data could be provided in time for reporting.

instances of electrification (switch from gas to electricity) occurring: one kitchen stove, two water heaters, and three clothes dryers.

While most DAC-SASH survey respondents reported completing or planning an energy saving upgrades post solar installation, there were 31 respondents that shared they had not made any updates and had no plans to. Four of these 31 respondents shared that they had already made all energy upgrades (including weatherization, LED upgrades, energy efficient appliances, etc.), with the remaining respondents sharing that they didn't know what else they could do to save energy (n = 15, 48% of those that said they didn't make changes), upgrades were too expensive (n = 14, 45%), or they didn't feel they had enough time (n = 3, 10%).

5.3.4 Perceived Bill Savings

Section 0 below provides an in-depth analysis of bill savings for DAC-SASH participants. Here, we present survey respondents' perceptions of bill savings, as this is an important aspect of their DAC-SASH program (and solar) experience. We asked respondents what happened to their summer and winter electric bills since their solar panels were installed. Table 5-24 below shows that most respondents report a decrease (either a lot or a little) in both summer and winter months (92% and 79%, respectively).

TABLE 5-24: RESPONDENTS BILL CHANGES SINCE GETTING SOLAR

Bill Change	Summer		Winter	
	Count	Percent	Count	Percent
It went down a lot	86	65%	57	43%
It went down a little	36	27%	47	36%
It stayed about the same	4	3%	15	11%
It went up	6	5%	9	7%
Don't know	0	0%	4	3%
Total	**132**	**100%**	**132**	**100%**

5.3.5 Battery Storage

Starting in 2023, projects that incorporated storage became more prominent in the DAC-SASH program. While only four projects that were paired with storage were completed during our evaluation period, we asked survey respondents a series of questions to explore their interest in installing battery storage and any experience they had with pursuing or getting the technology. When asked if respondents were interested in installing a battery with their solar system, 71 respondents (49% of respondents) affirmed that they had wanted battery storage with their solar system but were unable to get one. When asked why respondents couldn't get one, answers included not being offered the option, not knowing how to get a battery, battery storage was too expensive (even with the SGIP rebate), and being on a waitlist for a battery (with one respondent sharing they've been on a battery storage waitlist for two years). Those that were able to get a battery mostly reported leveraging the SGIP incentive with GRID's help (n = 11 respondents), though one respondent navigated the SGIP on their own and another used Solar Negotiators.

Almost half of survey participants that responded to questions about battery storage indicated they wanted the technology. While battery storage is not an official part of the DAC-SASH program, our evaluation documents how much the technology has become integrated into the program since the NBT. This change in implementation (i.e., the dominance of battery paired systems) now reflects, in some ways, SGIP's RSSE budget category which also incentivizes solar and storage for a similar (and sometimes the same) population. It could be beneficial for a future evaluation to simultaneously assess these two programs to understand the overlap in offerings and populations served as well as the unique value each program brings to serving equity populations.

6 IMPACT ASSESSMENT

This section summarizes the results of the impact assessment and is organized in the following subsections:

- PV Production and Energy Impacts
- Customer Electricity Consumption Change
- Demand Impacts
- Environmental Impacts
- Economic Impacts

6.1 PV PRODUCTION AND ENERGY IMPACTS

Observed PV Production

Observed PV generation totals by utility, as defined in section 3.2.3, are presented in Table 6-1. This table also shows the average total observed electric generation per DAC-SASH project and the annual DC capacity factor by utility. Of the in-scope projects, 512 had PTO dates before the end of 2022. This rose to 1,249 by the end of 2023 and reached the full 1,922 by the end of 2024. Of the projects that became active in each year, ~50% came online before July.

Overall, in scope DAC-SASH projects generated 1,555 MWh of electricity in 2022, 5,676 MWh in 2023, and 10,954 MWh in 2024. The overall capacity factors were consistent across the years, at 16.8% in 2022 and 2023, and 16.6% in 2024. SDG&E systems consistently had higher capacity factors than the other utilities. This is likely related to inherent differences in climate and available solar irradiance in the regions of the SDG&E DAC-SASH project sites as compared to those in PG&E and SCE.

TABLE 6-1: 2022-2024 OBSERVED PV GENERATION FROM COMPLETED DAC-SASH PROJECTS BY UTILITY

Utility	# Projects	Total Observed PV Generation (MWh)	Average Observed PV Generation per Project (kWh)*	Annual Capacity Factor (DC)
2022 Observed Impacts				
PG&E	310	1,005	3,242	16.9%
SCE	181	474	2,616	16.1%
SDG&E	21	76	3,613	18.7%
2022 Total	**512**	**1,555**	**3,036**	**16.8%**
2023 Observed Impacts				
PG&E	698	3,331	4,772	16.7%
SCE	505	2,157	4,271	16.8%
SDG&E	46	189	4,102	18.0%
2023 Total	**1,249**	**5,676**	**4,545**	**16.8%**
2024 Observed Impacts				
PG&E	1,054	6,209	5,891	16.7%
SCE	800	4,358	5,448	16.4%
SDG&E	68	386	5,684	18.2%
2024 Total	**1,922**	**10,954**	**5,699**	**16.6%**

*Many sites were only operational for part of each year.
Note: In some cases, rounding may cause total rows to differ slightly from the sum of per-IOU values.

Forecasted PV Production

Table 6-2 presents the forecasted energy impacts of all in-scope DAC-SASH projects. As discussed in Section 3.2.3, these forecasted results reflect typical weather. Because we don't always expect that installed systems will behave as ideally as simulations would expect, we applied a PV Ratio to the simulated data, which provides a month-hour ratio accounting for differences between observed generation and simulations. The Forecasted PV production for a full year of typical weather from all 1,922 DAC-SASH projects is 12,752 MWh per year.[58]

[58] Note that the forested annual PV production from completed projects represents a full year of PV production. In contrast, the observed PV production presented in the prior section represent partial years for some completed projects depending on the date of installation.

TABLE 6-2: ANNUAL FORECASTED ENERGY IMPACT BY UTILITY

Utility	# Projects	Forecasted Annual Energy Impact (MWh)	Average Forecasted Annual Energy Impact per Project (kWh)	Annual Capacity Factor (DC)
PG&E	1,054	7,039	6,679	16.6%
SCE	800	5,261	6,576	16.6%
SDG&E	68	452	6,645	18.0%
Forecasted Total	**1,922**	**12,752**	**6,635**	**16.6%**

PV Realization Rate

We calculated two realization rates to quantify PV system performance. The forecasted realization rate is the ratio between annual forecasted generation and the annual EPBB estimated generation reported in the program tracking data. The observed realization rate is the ratio between the Observed PV generation from projects with a full year of generation and their annual EPBB estimated generation reported in the program tracking data. The observed realization rate for each year only includes projects with a full year of PV production data in that year.

Table 6-3 summarizes the realization rates by utility. The overall forecast realization rate is 103%, and the observed realization rate in 2024 was also 103%. These findings slightly exceed those from the 2010 CSI evaluation that found that systems receiving EPBB exceeded expectations by 1.6% (or a realization rate of 101.6%), on average.

TABLE 6-3: AVERAGE FULL-YEAR OBSERVED AND FORECASTED REALIZATION RATES BY UTILITY

Utility	Observed Full-Year 2022 PV Generation		Observed Full-Year 2023 PV Generation		Observed Full-Year 2024 PV Generation		Forecasted Full-Year PV Generation	
	# Projects	Realization Rate	# Projects	Realization Rate	# Projects	Realization Rate	# Projects	Realization Rate
PG&E	15	114%	336	107%	728	106%	1,054	105%
SCE	10	113%	204	105%	517	99%	800	100%
SDG&E	3	125%	22	111%	46	108%	68	107%
Total	**28**	**115%**	**562**	**106%**	**1,291**	**103%**	**1,922**	**103%**

Differences in observed and EPBB simulated performance are likely driven by several factors. The primary driver is likely that EPBB estimates are expected to be underestimates of modern system performance, given that they are based on PVWatts v2.[59] Weather differences between the NSRDB location and the site address could also contribute to the difference. Though all sites are within 4km of their mapped NSRDB weather location, PV production can be influenced by highly location specific factors including localized cloud cover. Additionally, systems identified as performing better than the simulations projected could

[59] The current PVWatts version (v8) includes updates that increase production estimates relative to v2 by up to 13%

be due to differences between the as-built configuration and the configuration in the program tracking data. Differences in configurations between as-built systems and program tracking data were previously identified as a source of error for the MASH program in 2009-2010. However, overall program system performance appears strong, with all utilities showing realization rates of 99% or more in all evaluation years.

Yet, realization rates decreased from 2022 to 2024 for all utilities. This decrease is likely due to many factors, including differences in weather conditions across the years. In particular, 2022 had higher solar irradiance levels on average in California than 2023 or 2024. This may have enabled system overperformance relative to the milder irradiance levels in 2023 and 2024. However, increasing age of program systems may also play a role in decreasing realization rates.

Table 6-4 below highlights the realization rates by system age for projects with a full year of data in 2024. Realization rates decrease by system age for all utilities. The decline is most noticeable for SDG&E, where the realization rate for 2+ year old systems is 27% points lower than for 0-1 year old systems. However, it is important to note that the 2024 estimate for 2+ year old SDG&E systems is largely driven by a single system that shows a significant performance decrease (appearing to be a downed module) beginning in May 2024 and lasting through the end of the year. As such, it is likely that results may not be representative of the future degradation rate of all other projects in the SDG&E territory. Realization rates decrease by an average of 2.5% per year across system ages for PG&E projects and 1% per year for SCE projects, which are largely consistent with the estimated average annual degradation rate of 1.35% per year found in the 2010 CSI Report.[60]

TABLE 6-4: AVERAGE FORECASTED PV GENERATION REALIZATION RATE BY SYSTEM AGE

Utility	2024 PV Generation Realization Rate		
	0-1 yr	**1-2yr**	**2+ yr**
PG&E	107%	104%	102%
SCE	100%	99%	98%
SDG&E	112%	106%	85%
Total	**104%**	**102%**	**99%**

This reduction in system performance with age could be attributed to many factors, including impacts of light-induced module degradation,[61] increased module or inverter failures, increased shading associated with growing vegetation, and increased soiling resulting from dust and dirt accumulation if panels are not frequently cleaned.

60 calmac.org/publications/CSI_Evaluation_Report-2.pdf

61 https://pvwatts.nrel.gov/downloads/pvwattsv5.pdf page 10

Table 6-5 below shows the percentage of in-scope projects by grouping of their forecasted realization rate. More than half of completed projects have forecasted performance over 100% of the EPBB forecasted annual production for all utilities, with 83% and 90% of projects forecasted to outperform EPBB estimates for PG&E and SDG&E, respectively. One factor that contributes to the consistency of realization rates exceeding 100% is that EPBB estimates are likely to be slight underestimates of production. Relative to PVLIB simulations (a more recently updated method of estimating PV production), realization rates were still very high but averaged approximately 95%.

TABLE 6-5: COMPLETED PROJECTS RANGE OF FORECASTED PV PRODUCTION REALIZATION RATES BY UTILITY

Completed Project's RR	% of Projects within Realization Rate (RR) Range		
	PG&E	SCE	SDG&E
RR less than 0.8	2%	2%	3%
RR from 0.80 to 0.89	1%	9%	3%
RR from 0.90 to 0.95	3%	16%	0%
RR of 0.95 to 1.0	11%	22%	4%
RR above 1.0	83%	52%	90%
Total # Projects	**1,054**	**800**	**68**

Currently, only 2-3% of projects per utility (representing a total of 36 of 1,922 projects) are forecast to have realization rates below 80% of EPBB estimates. However, as systems continue to age, realization rates may drop if pre-emptive actions, such as routine system maintenance, performance evaluations, and cleanings, are not taken. The evaluation team recommends that future evaluations continue to compute realization rates in a consistent manner to track project performance over time.

6.2 CUSTOMER ELECTRICITY CONSUMPTION IMPACTS

Verdant analyzed whether DAC-SASH participants changed their energy consumption following the installation of solar. Note that the sample size for this analysis was restricted by many factors. First, only customers with PTO dates between January and September 2023 were eligible for the analysis. This time period was selected for two reasons. 1) It was important to limit the influence on the pre-period of atypical energy usage related to COVID-19 in 2020-2021. By including only projects with PTO dates starting in 2023, the earliest included pre-period was 2022 (after COVID-19 energy impacts had largely stabilized). 2) The PG&E and SCE AMI data in the CEC's Snowflake database ended in September 2024. As such, it was necessary to limit the latest eligible PTO date to September 2023 to ensure our ability to obtain a full year of post-period data. Additionally, approximately 40% of DAC-SASH projects were unable to be mapped to the AMI data source for PG&E and SCE. The exact reason for the challenge in mapping is unclear but may be associated with inconsistent anonymization procedures for alternative customer identification fields in the CEC's Snowflake database. Furthermore, only customers with a full year of both pre- and post-period AMI and actual PV generation data were retained in the analysis. As such, while these results offer useful preliminary insights, the limited sample size means they may not be fully representative of the program as a whole, and they should be interpreted accordingly.

Actual and counterfactual (e.g., predicted usage in the case that solar was not installed) monthly customer consumption estimates are presented in Table 6-6 below. Results indicated a statistically significant increase in energy consumption in PG&E and SCE (two-sided t-test), and a trend towards an increase in consumption (though not statistically significant) for SDG&E.

TABLE 6-6: AVERAGE MONTHLY CONSUMPTION CHANGE PER CUSTOMER

Utility	# Participants	Average Monthly Usage (kWh)		Usage Increase (kWh)	Usage Increase (%)	Result Significant at 90% Confidence
		Counterfactual	Actual			
PG&E	188	678.29	769.14	90.85	13%	Yes
SCE	134	610.40	667.39	56.97	9%	Yes
SDG&E	11	374.87	402.67	27.8	7%	No

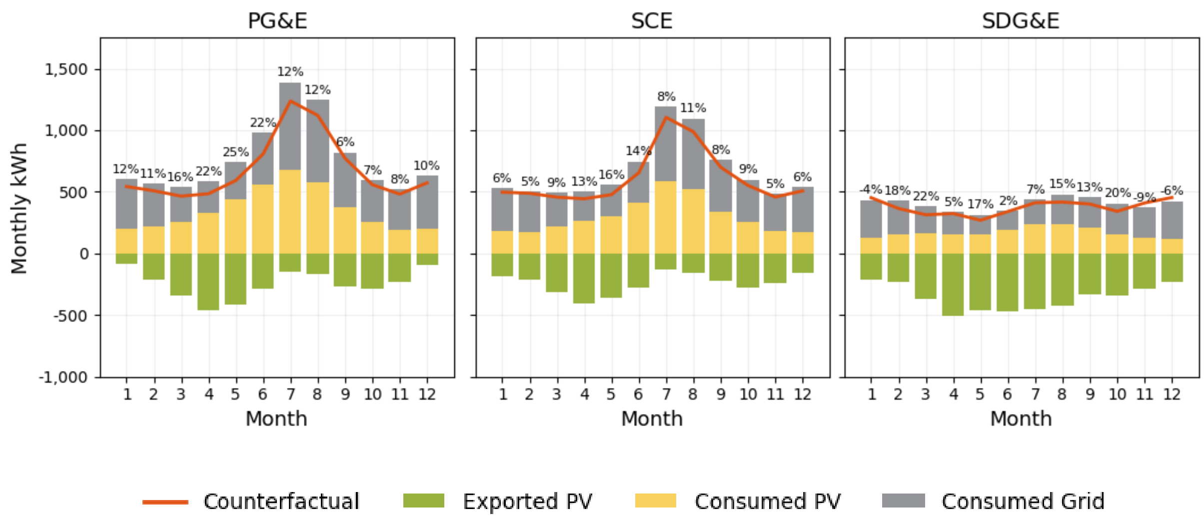
These consumption increases are consistent with other recent work on the energy consumption impacts of solar installation. The 2010 CSI Impact Evaluation Report (2021)[62] found an estimated 7% increase in monthly consumption post-PV adoption for PG&E customers, and a similar recent study (2021) reported that PV installations in SDG&E territory show post-installation increases in usage between 7 and 18%.[63] Additionally, recent work completed by Verdant for the CEC identified usage increases between 11 and 20% for customers in PG&E and SCE territory with PV installation dates in 2023. As such, DAC-SASH participants appear to undergo similar energy-usage behavioral changes as non-program solar installers.

Figure 6-1 shows how consumption changes differ across months for each utility. The numbers above each bar show the percentage by which observed energy usage exceeds the estimated counterfactual. For both PG&E and SCE, the largest consumption increases (as a percentage of counterfactual) occur during the spring and early summer months (May through June). These months are also the highest PV export months. In SDG&E territory, the largest consumption increases occurred in March and October, and SDG&E customers show a trend toward consumption decreases in November through January (though these were not statistically significant).

62 https://www.calmac.org/publications/CSI_Evaluation_Report-2.pdf

63 “Residential Solar and Changes in Consumption of Electricity”, International Energy Program Evaluation Conference (IEPEC) 2022, Collin Elliot and Jean Shelton

FIGURE 6-1: MONTHLY CONSUMPTION CHANGE WITH PV ADOPTION



More research is necessary to understand the primary drivers of these consumption increases. However, results from the survey of 146 DAC-SASH participants (See Section 5) offer some insights. Many DAC-SASH participants made energy-related home improvements following their participation. For example, 10% reported installing an EV Charger at their home after participating in the program. Additionally, six of these customers reported installing electrification measures (including water heaters, laundry appliances, and kitchen stoves).[64] Responses also pointed to substantial uptake of energy efficient measures including upgrades to LED Lighting (38% of responses), sealing air leaks (19%), and the installation of a smart thermostat (17%). Further research would be necessary to assess the relative contributions of these various upgrades, as well as any behavioral changes (such as altering thermostat setpoints), to the overall changes in energy consumption that occur after PV installation.

Per CPUC request, the evaluation team did not incorporate any consumption changes in the remainder of the impact or cost effectiveness estimates. DAC-SASH utility energy impacts are equal to the reported PV production estimates.

6.3 DEMAND IMPACTS

Coincident peak demand impact estimates are defined as observed generation from DAC-SASH PV systems during the highest hours of CAISO or IOU peak demand. The single largest annual CAISO or IOU peak hour impact provides a snapshot of program performance during the most critical grid hour. However, analyzing program performance over the top 200 hours of peak demand provides greater

[64] Question E2: "What improvements have you made? (Please select all the improvements you've made)"

insight into how DAC-SASH projects impact the grid during peak conditions. Electricity generated by DAC-SASH PV systems during peak hours provides utility avoided cost benefits and reduces grid needs during the most critical hours. In this section we present the 2022 through 2024 observed DAC-SASH PV generation during CAISO and IOU annual peak load hours as well as their top 200 load hours. Throughout this section, we report impacts for PV-only systems; systems with batteries are excluded. Battery telemetry data was unavailable for this evaluation, preventing us from accurately estimating the grid impacts these systems would deliver during peak hours. Table 6-7 presents the timing and magnitude of CAISO and IOU peak events in 2022 through 2024.

TABLE 6-7: 2022 THROUGH 2024 CAISO AND IOU PEAK HOURS AND DEMANDS (MW)

Demand Type	Service Area	Peak Demand (MW)	Date	Hour Beginning (PST)
2022				
Net	CAISO	45,295	9/6/2022	6:00:00 PM
Gross	CAISO	51,292	9/6/2022	3:00:00 PM
	PG&E	22,371	9/6/2022	3:00:00 PM
	SCE	24,355	9/7/2022	2:00:00 PM
	SDG&E	4,633	9/7/2022	3:00:00 PM
2023				
Net	CAISO	41,059	8/15/2023	6:00:00 PM
Gross	CAISO	44,092	8/16/2023	4:00:00 PM
	PG&E	19,881	8/15/2023	5:00:00 PM
	SCE	22,124	7/26/2023	3:00:00 PM
	SDG&E	4,016	8/29/2023	5:00:00 PM
2024				
Net	CAISO	43,276	9/5/2024	5:00:00 PM
Gross	CAISO	47,759	9/5/2024	4:00:00 PM
	PG&E	21,159	7/11/2024	5:00:00 PM
	SCE	25,394	9/6/2024	3:00:00 PM
	SDG&E	4,861	9/8/2024	4:00:00 PM

CAISO Peak Hour Impacts

Table 6-8 shows the observed DAC-SASH PV project generation from completed projects during the gross peak CAISO hours, and Table 6-9 shows observed DAC-SASH PV production during the net peak CAISO hours for PV-Only systems.

During 2024, DAC-SASH PV-only projects contributed 1,657 kW of capacity during the CAISO gross peak hour and 531 kW during the net peak hour. PG&E PV-only projects contribute the largest proportion of the gross CAISO peak hour generation, followed by SCE, then SDG&E. The CAISO net peak hour generation follows a similar trend. PG&E had the highest peak hour capacity factor during the Gross and Net CAISO peak hours in all years. The contribution to the net CAISO peak hour is substantially lower than the contribution to the gross peak hour due to lower energy production during the later hours.

TABLE 6-8: 2022 THROUGH 2024 OBSERVED GROSS CAISO PEAK HOUR GENERATION BY UTILITY

	2022		2023		2024	
Utility	Peak Hour Generation (kW)	Capacity Factor	Peak Hour Generation (kW)	Capacity Factor	Peak Hour Generation (kW)	Capacity Factor
PG&E	433	41.2%	447	17.7%	1,062	23.4%
SCE	195	38.3%	411	25.5%	562	16.8%
SDG&E	20	45.0%	30	23.3%	33	14.1%
Total	**648**	**40.4%**	**888**	**20.8%**	**1,658**	**20.4%**

Note: In some cases, rounding may cause total rows to differ slightly from the sum of per-IOU values.

TABLE 6-9: 2022 THROUGH 2024 OBSERVED NET CAISO PEAK HOUR GENERATION BY UTILITY

	2022		2023		2024	
Utility	Peak Hour Generation (kW)	Capacity Factor	Peak Hour Generation (kW)	Capacity Factor	Peak Hour Generation (kW)	Capacity Factor
PG&E	12	1.1%	62	2.4%	377	8.3%
SCE	1	0.1%	20	1.3%	147	4.4%
SDG&E	0	0.0%	0	0.3%	7	2.9%
Total	**13**	**0.8%**	**83**	**1.9%**	**532**	**6.5%**

Note: In some cases, rounding may cause total rows to differ slightly from the sum of per-IOU values.

IOU Peak Hour Impacts

Observed peak hour impacts coincident with IOU annual peak hours for 2022 through 2024 are shown in Table 6-10. The 2024 PG&E peak hour occurred on July 11th between 5 and 6 PM. During this hour, PG&E DAC-SASH projects produced 793 kW with a peak hour capacity factor of 18.3%. SCE's 2024 peak hour was on September 6th between 3 and 4 PM, where coincident generation was observed to be 938 kW with a peak hour capacity factor of 27.9%. SDG&E projects generated 19 kW with a peak hour capacity factor of 8% during the peak hour between 4 and 5 PM on September 8th, 2024. The peak hour capacity factors vary widely across IOUs, as PV system utilization is highly dependent on the sun's position which varies by time of day and time of year.

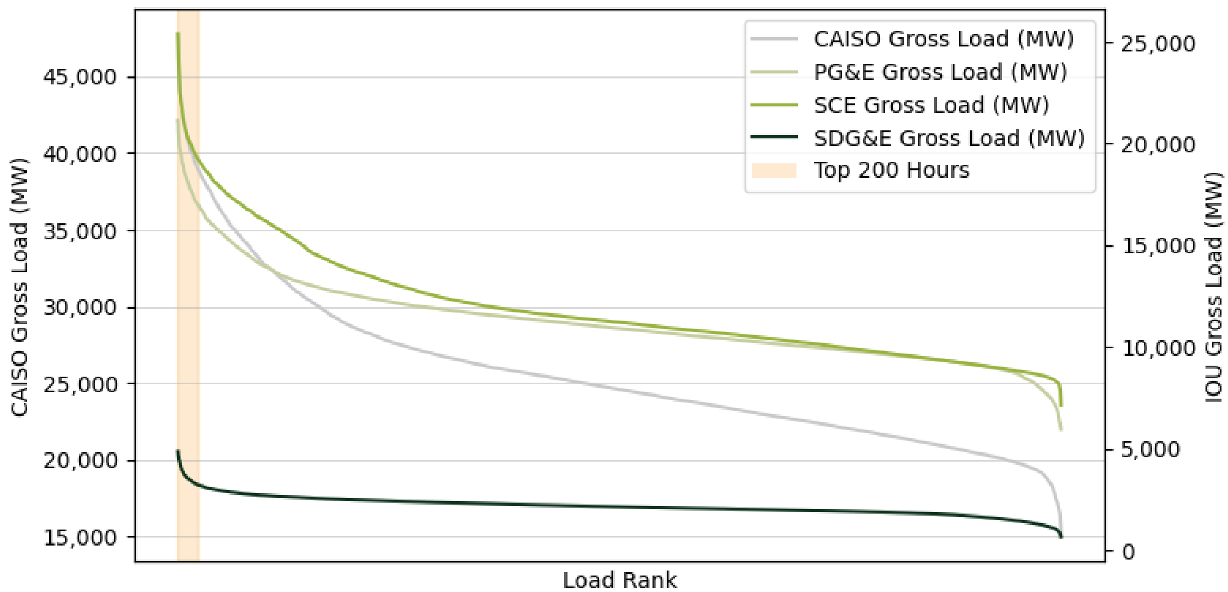
TABLE 6-10: 2022 THROUGH 2024 IOU OBSERVED PEAK HOUR GENERATION

	2022		2023		2024	
Utility	Peak Hour Generation (kW)	Capacity Factor	Peak Hour Generation (kW)	Capacity Factor	Peak Hour Generation (kW)	Capacity Factor
PG&E	433	41.2%	358	14.2%	794	18.3%
SCE	247	48.5%	599	44.4%	938	27.9%
SDG&E	19	43.5%	9	7.0%	19	8.0%

Top 200 Peak Hours

The CAISO and IOU annual peak hour coincident generation is a snapshot of beneficial program impacts. Analyzing the top 200 peak hours results in a more robust measure of impacts during CAISO and IOU peak grid loads. Representing just 2.3% of all the hours in a year, the top 200 peak hours capture the steepest part of load distribution curves. Figure 6-2 shows the 2024 CAISO and IOU load duration curves and indicates the 200-hour mark as the orange bar on the left side.

FIGURE 6-2: 2024 CAISO AND IOU LOAD DURATION CURVES



* Axes are scaled on the left for CAISO and on the right for the IOUs

The distribution of the top 200 hours over the course of a year differs across CAISO and the three IOUs. While peak days generally occur on late summer weekday afternoons, a top 200 hour can occur on weekends, as early as May through as late as October. Table 6-11 and Table 6-12 display the distribution of the top 200 peak hours by month and weekday types in 2022 through 2024.

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TABLE 6-11: 2022 THROUGH 2024 TOP 200 PEAK HOUR DISTRIBUTIONS BY MONTH

Service Area	May	June	July	August	September	October
2022						
CAISO	0	12	13	84	91	0
PG&E	3	32	27	69	69	0
SCE	0	7	9	86	98	0
SDG&E	0	0	0	71	127	2
2023						
CAISO	0	0	109	88	3	0
PG&E	0	7	106	86	0	1
SCE	0	0	104	87	9	0
SDG&E	0	0	70	84	39	7
2024						
CAISO	0	0	90	46	55	9
PG&E	0	10	123	22	20	25
SCE	0	2	51	63	84	0
SDG&E	0	2	25	81	92	0

TABLE 6-12: 2022 THROUGH 2024 TOP 200 PEAK HOUR DISTRIBUTIONS BY WEEKDAY

Service Area	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
	2022		2023		2024	
CAISO	184	16	174	26	175	25
PG&E	186	14	154	46	180	20
SCE	181	19	180	20	175	25
SDG&E	160	40	175	25	162	38

During 2022, the top 200 peak hours occurred mostly in September, with a significant number of hours occurring in August. However, in both 2023 and 2024, the majority of peak hours occurred in July. SDG&E had the most peak hours for 2023 in August and in September for 2024. For CAISO and all IOUs, weekdays dominated top hours, but some top hours also occurred during the weekend. Between 7% and 20% of peak hours were weekend hours from 2022 to 2024.

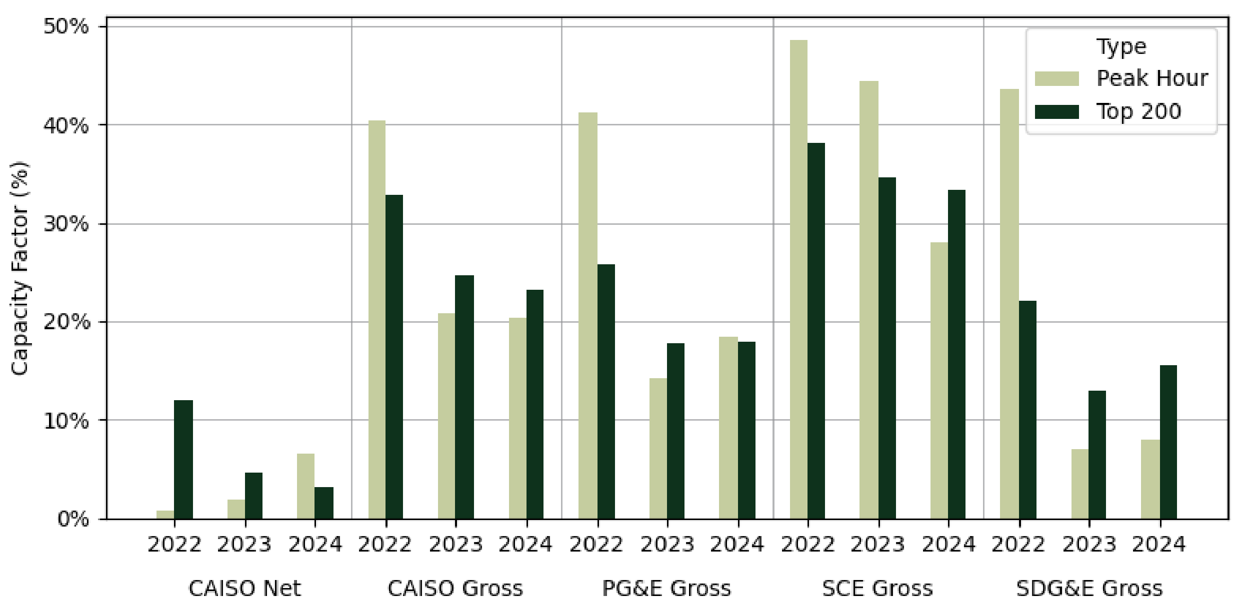
Table 6-13 presents total program observed generation coincident with the three IOU and CAISO gross and net peak hours. Whether the peak hour generation is close to the top 200 average is dependent on how the peak and top hours are distributed in relation to the peak solar output. In some cases (largely in 2022), top hour generation was much higher than average top 200 hour generation.

TABLE 6-13: 2022 THROUGH 2024 COINCIDENT PEAK AND AVERAGE TOP 200-HOUR COINCIDENT PV GENERATION

Demand Type	Utility	2022		2023		2024	
		Observed PV Generation (kW) Coincident with Peak Hour	Average Observed PV Generation (kW) Coincident with Top 200 Hours	Observed PV Generation (kW) Coincident with Peak Hour	Average Observed PV Generation (kW) Coincident with Top 200 Hours	Observed PV Generation (kW) Coincident with Peak Hour	Average Observed PV Generation (kW) Coincident with Top 200 Hours
Net	CAISO	13	162	83	189	532	245
Gross	CAISO	648	448	888	995	1,658	1,828
	PG&E	433	217	358	430	794	788
	SCE	247	164	599	512	938	1,076
	SDG&E	19	10	9	16	19	36

Higher PV production coincident with CAISO and IOU peak hours yields higher benefits to the grid than during other hours. Figure 6-3 shows the capacity factors during the 2022 through 2024 CAISO and IOU peak hour and top 200 hours for PV-Only systems. In all years, SCE saw the highest observed peak and top 200-hour capacity factors.

FIGURE 6-3: 2021 AND 2022 CAISO AND IOU PEAK AND TOP 200-HOUR CAPACITY FACTORS FOR PV-ONLY SYSTEMS



6.4 ENVIRONMENTAL IMPACTS

This section discusses the observed and forecasted GHG impacts of DAC-SASH PV systems. Observed impacts are based on the performance of the 1,922 projects that received final incentive payments between January 1, 2022 and December 31, 2024 starting on each project's permission to operate date. Forecasted impacts estimate the annual impacts for a full year of PV generation for these projects under typical weather conditions. As with the peak hour impacts, results are only presented for PV-only projects throughout this section.

Environmental impacts are calculated as avoided power plant emissions that would have occurred in the absence of the program. This evaluation relies on avoided grid emissions rates developed by WattTime as part of the SGIP GHG Signal efforts. Verdant also estimated the lifetime GHG emissions reductions attributable to proceeds per California Air Resources Board (CARB) reporting requirements. This analysis can be found in Appendix C.

Observed Environmental Impacts

Table 6-14 below highlights the observed GHG reductions for 2022 through 2024 for in scope DAC-SASH projects. The table below presents observed GHG reductions only for the time after the systems were completed (e.g., they include partial year impacts for projects completed during each year).[65] In all years, PG&E systems represent the majority of GHG reductions (ranging from 70% in 2022 to 65% in 2024), consistent with PG&E being responsible for the largest share of DAC-SASH projects.

TABLE 6-14: 2022 THROUGH 2024 OBSERVED GREENHOUSE GAS IMPACTS BY UTILITY FOR PV ONLY PROJECTS

	2022		2023		2024	
Utility	**# Projects**	**Observed GHG Impact [Metric Tons of CO2]**	**# Projects**	**Observed GHG Impact [Metric Tons of CO2]**	**# Projects**	**Observed GHG Impact [Metric Tons of CO2]**
PG&E	307	322	691	910	1,025	1,652
SCE	181	124	505	388	799	839
SDG&E	20	17	41	35	57	68
Total	**508**	**463**	**1,237**	**1,333**	**1,881**	**2,558**

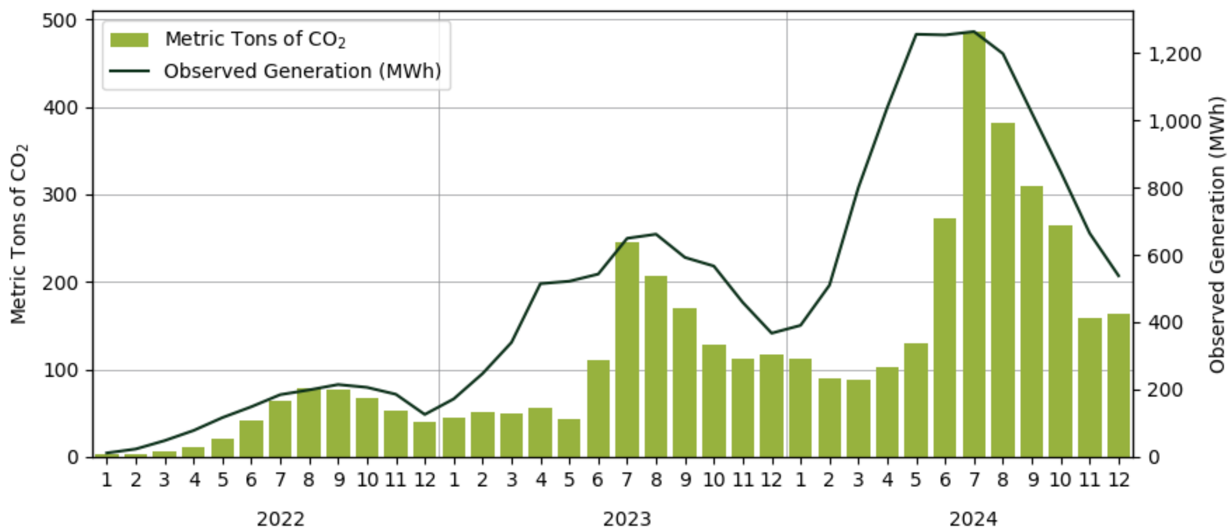
Note: In some cases, rounding may cause total rows to differ slightly from the sum of per-IOU values.

Figure 6-4 shows the observed GHG impacts by month, along with the observed total PV system generation from DAC-SASH PV-Only projects. Note that the magnitude of GHG savings is not directly aligned with the PV system generation. 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. For example, while the

65 The # Projects includes all PV-only projects that received their final incentive payment in that year.

highest monthly electricity production from DAC-SASH projects in 2022 occurred in September, the highest monthly GHG impacts occurred in August. Likewise, in 2023, the highest monthly electricity production occurred in August while the highest monthly GHG impacts occurred in July. In 2024, both the highest electricity generation and highest GHG impacts occurred in July.

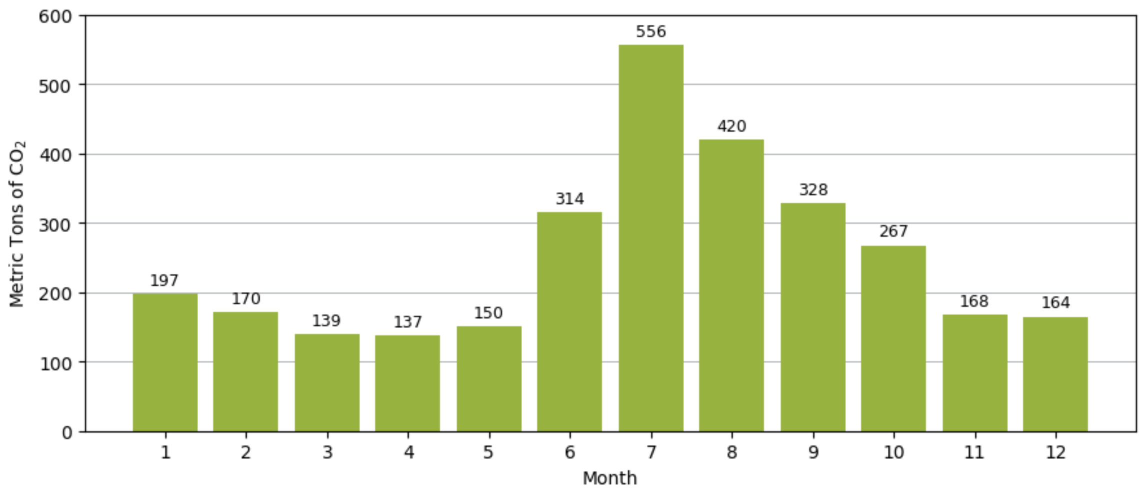
FIGURE 6-4: 2022 THROUGH 2024 OBSERVED GREENHOUSE GAS IMPACTS AND DAC-SASH PROJECT GENERATION BY MONTH FOR PV-ONLY PROJECTS



Forecasted Environmental Impacts

Figure 6-5 presents the forecasted GHG impacts for all in-scope DAC-SASH projects. Under typical weather conditions, these projects have the potential to produce reductions between 137 and 556 metric tons of CO_2 per month, or over 3,000 Metric Tons of CO_2 annually.

FIGURE 6-5: FORECASTED GREENHOUSE GAS IMPACTS FOR PV-ONLY PROJECTS, BY MONTH



Monetary Value of Emissions Reductions

The monetary value of the change in emissions was also calculated by applying the value of GHGs from the 2024 California Avoided Cost Calculator (ACC) to forecasted hourly PV generation.[66] The total value of GHG emissions reductions was based on four ACC factors, the cost of the GHG adder, the cost of the added cap and trade, the cost of the GHG rebalancing, and the cost of methane. Figure 6-6 highlights the forecasted monthly monetary value of all in-scope DAC-SASH projects, by utility. In a typical year, the program has the potential for emissions reductions, assessed as avoided costs, to be valued at around $14,000 during the peak of the summer, and $85,000 annually. Table 6-15 below shows the share of annual avoided costs attributable to each utility, where PG&E projects are forecasted to contribute 56% of annual avoided costs, SCE 40% and SDG&E 3%, consistent with the relative share of projects completed by each utility.

[66] To ensure consistency, TMY generation forecasts for this analysis were developed using the weather data utilized in the development of the 2024 ACC https://www.ethree.com/public_proceedings/energy-efficiency-calculator/

FIGURE 6-6: FORECASTED AVOIDED COSTS FROM GREENHOUSE GAS IMPACTS, BY MONTH

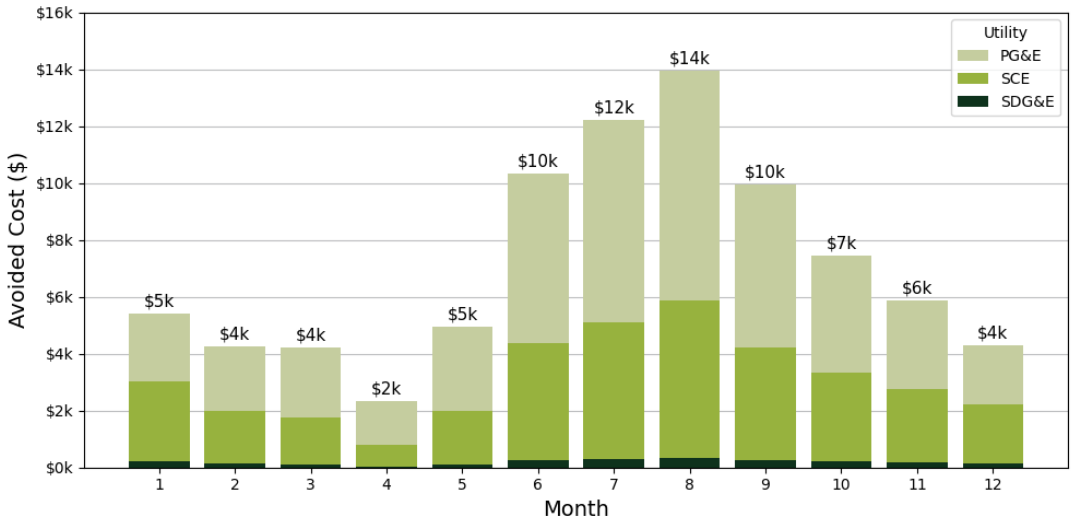


TABLE 6-15: FORECASTED ANNUAL AVOIDED COSTS FROM GREENHOUSE GAS IMPACTS FOR PV-ONLY SYSTEMS, BY UTILITY

Utility	# Projects	Annual Avoided Costs ($)	Proportion of Total
PG&E	1,025	$47,737	56%
SCE	799	$35,054	41%
SDG&E	57	$2,382	3%
Total	**1,881**	**$85,174**	**100%**

Note: In some cases, rounding may cause total rows to differ slightly from the sum of per-IOU values.

6.5 BILL IMPACTS

We estimated the program's bill impacts by directly calculating the bill credits received in 2024 from DAC-SASH PV system generation. The simulated bill impacts represent the change to a customer's bill due to the inclusion or exclusion of PV generation (i.e., customer's consumption is held constant in the pre- and post-installation scenarios). The simulated bill impacts are exclusively an estimate of average bill credits received by customers in 2024 due to DAC-SASH system PV generation. Only projects with a full year of historical usage and PV system generation were included in the analysis. Of all projects that were potentially eligible for this analysis (e.g., began PV generation before January 1, 2024), 63% had sufficiently complete data to be included. While the sample sizes are large enough for PG&E and SCE to develop robust bill impact estimates for the included projects, extrapolating these results to all program systems should be approached with caution.

Bill savings results by utility are presented in Table 6-16, including the average monthly bill savings, the average monthly bill savings per kW capacity, and the average bill savings per kWh generated. The per-household bill impacts in 2024 ranged by utility from 57% to 81% of monthly bill saved. The average monthly bill savings, and savings per capacity and generation metrics in PG&E are generally higher than in the other utilities. This reflects higher baseline bills (average pre-intervention bill of $241, compared to $194 for SCE and $132 for SDG&E). It should be noted that the relative precision for SDG&E is 47.9%, reflecting the small sample size of only seven projects; Therefore, SDG&E results should be interpreted with caution as they are less statistically reliable.

TABLE 6-16: CALCULATED BILL IMPACTS BY UTILITY

Utility	Number of Projects	Average Monthly Bill Savings	Relative Precision at 90% Confidence	Average % of Monthly Bill Saved	Average Monthly Bill Savings per kW Capacity	Average Bill Savings per kWh Generated
PG&E	412	$163	3.5%	68%	$35	$0.28
SCE	305	$110	6.3%	57%	$25	$0.21
SDG&E	7	$108	47.9%	81%	$26	$0.23

7 COST EFFECTIVENESS ASSESSMENT

The cost-effectiveness results for the standard practice manual (SPM) tests are shown below by utility. Overall, the DAC-SASH benefit-to-cost ratios (BCRs) were 0.45 for the TRC, 0.55 for the SCT, and 0.29 for the RIM. The benefits for the TRC and RIM include the same avoided cost value, while the SCT avoided costs includes a social cost of carbon and statewide air quality adder. The TRC and SCT benefits also include federal tax credits. Program administration costs and measure costs are included as part of the overall costs for the TRC and SCT.[67] The RIM costs are reflective of reduced revenue (i.e., bill savings reduced by CARE budget impacts). The table below also presents a version of the RIM test that includes program administration costs (reflecting a scenario where the program is funded by ratepayers). The cost shift incurred by DAC-SASH participation is $18.7 Million (calculated as the total NPV avoided costs less the total NPV reduced revenue). It is not surprising to see the DAC-SASH TRC BCR be less than 1.0 given the high upfront cost of solar PV systems and the additional costs associated with reaching DAC-SASH customers. The RIM test BCR being less than 1.0 is also not surprising given California's high retail rates relative to the avoided cost value in the 2024 ACC, especially in the middle of the day when DAC-SASH systems are avoiding electricity consumption. Note that in energy efficiency, equity programs are exempt from cost-effectiveness testing.

TABLE 7-1: SUMMARY OF COST-EFFECTIVENESS RESULTS BY UTILITY

Utility	TRC	SCT	RIM	RIM including Prog. Admin. Cost
PG&E	0.44	0.52	0.27	0.23
SCE	0.48	0.59	0.33	0.28
SDG&E	0.36	0.40	0.19	0.16
DAC-SASH Total	**0.45**	**0.55**	**0.29**	**0.25**
NPV Total Benefits	$19,140,806	$23,166,199	$7,708,210	$7,708,210
NPV Total Costs	$42,418,930	$42,418,930	$26,432,465	$30,742,741

7.1.1 Avoided Costs

The net present value (NPV) of the total TRC avoided costs per project and per kilowatt of capacity are presented in Table 7-2 below, by utility. Across the three utilities, the lifetime avoided cost per project was highest in SCE ($4,623) and lowest in SDG&E ($2,273).

[67] Program administration costs are not included in the RIM since the program is funded primarily through greenhouse gas allowance proceeds from California's Cap-and-Trade program instead of ratepayer funds.

TABLE 7-2: NET PRESENT VALUE OF TOTAL AVOIDED COSTS BY UTILITY

Utility	NPV Total Avoided Costs	NPV Total Avoided Costs per Project	NPV Total Avoided Costs per kW Capacity (CEC-AC)
PG&E	$3,855,243	$3,658	$880
SCE	$3,698,396	$4,623	$1,127
SDG&E	$154,571	$2,273	$600
DAC-SASH Total	**$7,708,210**	**$4,011**	**$973**

8 PROGRESS ON PRIOR RECOMMENDATIONS

The previous DAC-SASH evaluation provided a number of recommendations. Below we present these recommendations and the progress made to address them.

TABLE 8-1: PROGRESS ON PRIOR RECOMMENDATIONS

Prior Recommendation	Progress Made to Address Recommendation	Additional Improvements to Address the Recommendation
The program should use a combination of dedicated program funding and/or external funding procured by GRID to complete roof repairs, electrical upgrades and required tree trimming for projects to address housing stock barriers.	GRID leverages philanthropic funding along with partnerships (CBO, local government) to support solar readiness efforts for DAC-SASH projects.	Increasing the incentive to $4.75/W would allow GRID to allocate more funding to solar readiness rather than using their own funds to cover both solar readiness and the additional 37% of PV project costs that are not supported by the $3/W incentive.
GRID and Energy Division should consider using the rate of market adoption of solar panel installations over time as a reference point for setting more specific, voluntary benchmarks for the DAC-SASH target population (e.g., DGStats tracks NEM interconnections, which is a proxy for solar installations, going back to 1996).	GRID set voluntary targets, as reported in their ME&O plans.	Future evaluations could consider comparing the DAC-SASH program installation rate to market rate solar adoption of low-income homeowners in DACs. The commission is currently assessing the adoption of distributed energy resources in this population, and this study could be used as a point of comparison for future work.
The program will be best served by establishing annual targets and a program goal for the total number of households to participate before the program ends.	GRID sets annual targets each year (Table 4-1). These are internal targets and are not currently considered program metrics. We find that GRID completed more than 80% of their installation goal for both 2022 and 2023, but only 64% of their goal for 2024.	The CPUC could consider either adopting GRID's internal goals or reviewing the performance of the program to date and using this information to set installation goals for different project types (PV-only and PV + Storage Paired) for the remaining program years. Having set goals allows for more stringent verification of program effectiveness.
GRID should send an annual follow-up letter and email to customers reminding them of related programs (ESA, CARE which requires reenrollment every two years).	GRID reported that they implemented these changes in Q2 2023.	No additional recommendations.

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Prior Recommendation	Progress Made to Address Recommendation	Additional Improvements to Address the Recommendation
GRID could call the utility with the customer while doing the on-site assessment to check if they are enrolled in CARE and to help facilitate the enrollment process if they are not currently enrolled.	Table 4-10**Error! Reference source not found.** in Section 4.2.2 shows there is an increase in CARE and FERA program adoption post participation in DAC-SASH.	
GRID should be coordinating more closely with ESA contractors to provide complementary solar services. ESA and DAC-SASH share the same income eligibility requirements and a growing number of ESA contractors hold the appropriate licensing and expertise to install solar and to provide home radiation services.	This was rejected in the previous evaluation.	No additional recommendations.
GRID should be sure to offer referrals for other programs to low energy users who are not interested in continuing with DACSASH to receive solar.	GRID confirmed they already did this.	No additional recommendations.
We recommend GRID track: o Percent of past installations that received an annual follow up letter from GRID, until all past participants have been reached. o Percent of customer on-site visits where ESA contractor was in attendance.	GRID confirmed that all participants receive an annual follow up letter. The ESA contractor recommendation was rejected.	No additional recommendations.
GRID should send an annual follow up letter and email to customers reminding them of how to check in on their system production. This can be combined with the annual follow-up letter mentioned above.	GRID confirmed that they already do this (it is part of the annual survey).	No additional recommendations.
All program installed inverters should report data to the consumer and GRID should establish program rules and protocols to enable fleet monitoring of incented systems. This will require coordination with the third parties who selected the inverters.	Our impact evaluation confirmed that in-scope projects are maintaining a forecasted performance of 103%. However, we cannot confirm how older systems (pre-2022) are performing at this time. GRID confirmed that they do not have a process for fleetwide monitoring information.	Future evaluations should consider conducting an impact evaluation on all installed projects (back to 2019) to confirm that older systems are performing as expected. If they are not, this recommendation or additional ways of monitoring poor performing systems should be re-visited.

Prior Recommendation	Progress Made to Address Recommendation	Additional Improvements to Address the Recommendation
GRID should do outreach to TPO providers to address monitoring systems that have gone offline.	GRID confirmed that they do not have a process for fleetwide monitoring information. Additionally there is a process in place where the TPO provider reaches out to GRID about system performance issues.	See additional improvements to address the recommendation above.
GRID should allocate a portion of program funding for residents within DACs to travel to approved training programs and to DAC-SASH solar installation volunteer opportunities (i.e., travel stipend).	Workforce development is not funded by the program. GRID reported they would consider this in the future if program funding were to increase.	No additional recommendations.
GRID should continue to batch projects that are further away from regional offices.	Verdant confirmed that GRID continues to batch projects that are further away from regional offices.	No additional recommendations.
GRID should track data on census tracts of trainees and volunteers to understand DAC participation levels on DAC-SASH projects.	Current job trainee data does not specifically report whether job trainees and volunteers are located in DACs.	Job trainee tracking data does contain address for many records (which can be used to determine DAC location status). Ensuring that every job trainee has address information filled in or adding a field to the tracking data that indicates if the job trainee is in a DAC or not would support the tracking and evaluation of whether workforce development efforts are supporting DAC job trainees.
GRID should identify a goal as to how many DAC located trainees or volunteers per project represent successful leveraging.	The current job trainee data did not allow for detailed analysis (such as differentiating job trainees from volunteers). While GRID's current goal is 50 trainees or volunteers from DACs, as volunteers do not support workforce development goals (see Section 3.1.1 for a discussion of why), it is unclear if job trainees from DACs are growing with the program or meeting the goal of 50 trainees. Additionally, as stated above, not all records have an address making it impossible to determine if the job trainee/volunteer is located in a DAC.	Job trainee data should collect clear information on participant status – job trainee, volunteer, or intern. This should be paired with updates on tracking participant DAC status so this goal can be verified.

Prior Recommendation	Progress Made to Address Recommendation	Additional Improvements to Address the Recommendation
GRID should report on SPP projects in their semi-annual report and include the following metrics to facilitate future evaluation: o Number of projects completed with the SPP model o Costs of the SPP projects o Anecdotal challenges or successes working with the partners	Verdant has verified that GRID collects information on the number of SPP projects, SPP costs, and this evaluation explored challenges and success of the SPP in both interviews and surveys.	SPP cost data collection can be improved in-line with general cost data collection recommendations. These are noted Section 3.1.1, Appendix D, and in Section 9.1.
Future evaluations should survey participants that used the SPP model to capture the participant experience.	This evaluation surveyed participants who had been served as part of the SPP model. Satisfaction for these participants is high (94%) suggesting this model is working well from a DAC-SASH participant's perspective.	No additional recommendations.
GRID should continue to grow their partner relationships for the SPP model to ensure that projects further from the GRID offices are also served by the program.	GRID has successfully done this. Notably the Inland Empire has been able to serve more rural Tribal communities by leveraging the SPP (see Section 4.3.2).	No additional recommendations.
We recommend that GRID review Evergreen's analysis of eligible households and consider focusing efforts in areas with higher rates of eligible households. GRID can use this analysis to set up target installations at the regional level.	2023 and 2024 saw an increase in projects suggesting that GRID was able to identify sufficient eligible households to use up the incentive budget for these projects in both years.	No additional recommendations.
We recommend GRID track marketing, outreach and administrative costs at the level of regional offices.	Verdant confirmed that GRID has implemented these tracking changes.	No additional recommendations.
GRID should connect with SDG&E ESA Program team to learn how to improve their engagement efforts.	Interviews with GRID and SDG&E confirm that they are working together on this.	No additional recommendations.
To substantiate the stated need for a higher incentive level, GRID should share data on what staff time is spent fundraising to fill the gap (i.e., to show the total cost of the project to be compared with the incentive level). Though this time is not funded by the program, knowing how much time is spent will strengthen the	GRID has shared that this is not possible due to the nature of procuring philanthropic funds. However, even without tracking this information, it is clear from the cost data reported that the incentive does not fully cover the cost to install solar for this population (though understanding the drivers of this, i.e., specific labor	Review recommendations on cost data collection practices.

Prior Recommendation	Progress Made to Address Recommendation	Additional Improvements to Address the Recommendation
argument to increase the incentive.	categories, remains unclear).	
It may be appropriate to raise the incentive amount beyond the $3/W cap to match the rise in construction costs and inflation (e.g., compare actual program costs over time to the incentive level).	This evaluation concurs.	Increase the incentive to $4.75/W.
Given the large amount of added recommended tracking, we suggest GRID prepare a summary of data gathered to support new program metrics after a year of collection (see last recommendations table regarding data tracking).	This was not available at the time of this evaluation, but we did receive a confirmation that the extensive data we were provided included the updated data tracking from recommendations GRID accepted.	No additional recommendations.
Alternatively, GRID could adjust its program model to allow participants to cover part of their project costs though this would impact GRID's ability to market the program as truly no-cost and would likely identify a new cost barrier that is very likely to exist amongst this population.	DAC-SASH remains no cost for participants. We recommend increasing the incentive covered by the program to support the program.	Increase the incentive to $4.75/W.
GRID should collect number of projects that are originally scoped to be over 5 kW	The 5kW cap was lifted and is no longer impacting program implementation.	No additional recommendations.
GRID should consider conducting research that compares number of installations, average size of installations, and average bill savings of program participants to the same rates for market-rate projects.	The current evaluation team believes this is outside the scope of DAC-SASH implementation..	Future evaluations could consider adding this analysis if data on market rate installations for low-income, single-family homeowners in DACs becomes readily available.
GRID should clarify if the handbook cap overrules the direction of systems sizing "up to 150% of past usage" or if this language allows the program to install programs larger than 5 kW. If the 5 kW cap overrides matching the system to customer usage, this should be reconsidered.	The 5kW cap was lifted and is no longer impacting program implementation.	No additional recommendations.

Prior Recommendation	Progress Made to Address Recommendation	Additional Improvements to Address the Recommendation
GRID should educate customers on the pros and cons of both the TPO or host owned system from the customer perspective, allowing customers to make an educated choice between the two options.	This recommendation was rejected.	No additional recommendations.
GRID should include metrics mapped to the logic model into the handbook. GRID should track: o GRID staff time spend on searching for other sources of gap financing Future evaluations should analyze: o GRID staff time spent on TPO coordination o Full cost agreement for the 25-year PPA o Full amount of TPO payment to GRID o Federal tax rebate amount to TPO	The metrics mapped to the logic model do not appear to be in the V5 or V6 handbook. The evaluation team does not believe it is possible (based on GRID's feedback) to track time spent on searching for gap funding. This evaluation did not analyze staff time spent on TPO coordination, was not able to determine the cost agreement or additional costs/rebates for the 25-year PPA or the TPO payment (not included in cost data).	Ensure the logic model is in the V6 version of the handbook.
Partnered TPO companies should enable, not discriminate against, the enrollment of tribal customers.	This is outside the scope of the current evaluation, but it is clear from the data that GRID has made a concerted effort to support Tribal customers in the DAC-SASH program (see Section 4.3.3).	No additional recommendations.

9 FINDINGS AND RECOMMENDATIONS

In this section we summarize the key participation, process, impact, and cost effectiveness findings presented throughout this report, and offer recommendations to increase the future effectiveness of the DAC-SASH Program. Findings in this section are preceded with a square bullet (■) with indented recommendations. Not all findings have an associated recommendation. The findings and recommendations are organized by topical area below.

9.1 PARTICIPATION AND PROCESS FINDINGS AND RECOMMENDATIONS

The section summarizes the participation and process related findings and recommendations included in Sections 4 and 5 of this report.

Participant Assessment Findings:

- **The DAC-SASH program had its most successful two years in terms of applications submitted in 2023 and 2024.** The program almost doubled its application intake from 1,785 applications during the last evaluation period (2019-2021) to 3,301 during the current evaluation period. However, GRID did not achieve their internal goals for project completions for any of the evaluation years (2022-2024), achieving an 80% completion rate for 2022 and 2023 but only 64% of their internal completion goal for 2024.

- **The DAC-SASH program responded to NBT changes by offering paired or add-on storage options.** As of 2024, more than half of the applications are for PV + Storage Paired projects despite batteries not being incentivized through the program.

- **DAC-SASH participation continues to vary across IOU service territories.** PG&E represents the largest share of total projects, capacity, and eligible properties, followed by SCE and SDG&E. Only 4% of completed projects come from SDG&E's service territory.

- **Time to complete projects declined during the evaluation period.** The median time to complete a PV-only project was 162 days in 2024 compared to 251 days in 2022. 2024 completion timelines are still higher than estimated market rate solar installations (e.g., two to three months).[68] Additionally, there were still five outstanding (active) projects from 2022 and 43 outstanding projects from 2023.

- **Nearly a third of all projects during the evaluation period were recorded as inactive (i.e., cancelled, n = 1,067, 32%).** The most common reason for cancellation was construction issues (e.g., old roof, code issues, solar shading). As a reference, the SGIP equity resiliency budget has approximately 15% cancelled projects during the same time.

[68] https://www.energysage.com/solar/how-long-does-it-take-to-install-solar-panels/

- **Cancellation rate and median days to cancel a project varied by GRID office.** The Central Valley office and Greater Los Angeles offices had the highest cancellation rates (40% and 35% respectively) while the Bay Area/North Coast and Inland Empire offices had the longest median time to cancel projects (337 days and 166 days respectively).

    - **Recommendation:** Review administrative practices for North Valley and Greater Los Angeles offices to identify best practices for quick identification of project feasibility to reduce cancellation times.

- **Total cancelled projects have increased since the last evaluation (5% of projects submitted in 2021 compared to 36% and 34% of projects submitted in 2023 and 2024), primarily driven by increases in construction issues (52% for cancelled projects submitted in 2021 to 74% of projects submitted in 2024).** Other cancellation drivers like lack of funding/financing have remained relatively constant through time while disinterest has decreased through time (33% for projects submitted in 2021 to 11% for projects submitted in 2024).

    - **Recommendation:** Consider adding questions asking if customers have solar, roof age (as this is the most common reason for a project being cancelled in the construction category), and roof type to pre-screening tools. These questions can be optional to answer in case there is worry of answering them being burdensome.

- **The median days to cancellation for projects where the cancellation reason is 'not interested' is 135 days and 115 days for those where projects were cancelled for being ineligible.** In comparison, it takes a median of 69 days for projects with identified construction issues to be cancelled.

    - **Recommendation:** Explore, identify, and create more stringent pre-screening processes and tools for determining eligibility and interest to reduce time, labor, and cost of keeping these projects in the program. This could be added more clearly to the GRID website and communicated to program partners to help support as well.

- **PV-only projects and projects paired with storage are completed at significantly different rates**. At the time of reporting, 65% of PV-only projects have been completed with 30% cancelled, compared to projects paired with storage for which only 0.5% have been completed and 27% cancelled. While it is understandable that paired projects can take longer (especially as they are just coming into the program), significant delays in project completion can negatively impact the program's ability to meet its goals.

    - **Recommendation:** As PV + Storage Paired are now the predominant project type, GRID should identify and implement strategies and approaches to accelerate completion of PV + Storage Paired projects (which may require CPUC involvement to help with SGIP coordination).

- **DAC-SASH effectively serves all income levels that fall under the eligibility criteria.**

- **32% of DAC-SASH participants who applied and completed a project during 2022-2024 were in arrearages before their participation.** This decreased to 23% one-year post installation. The arrearage analysis complete as part of this study was exploratory in nature and did not include the use of a control group and so any observed changes in arrearages cannot be reliably attributed to the program.

- **Subcontracted projects made up 9% of all projects during the evaluation period.** The Inland Empire office leveraged the SPP more than any other office, especially for their rural and Tribal projects. Subcontractors completed 277 projects with high customer satisfaction (94% very satisfied or satisfied).

- **6% of all DAC-SASH projects in 2022-2024 were Tribal.** Tribal projects were found to have a significantly lower cancellation rate than non-Tribal projects.

Process Assessment Findings and Recommendations:

- **There were multiple data limitations that impacted this evaluation.** These included limitations caused by DAC-SASH tracking data and IOU requested data.

    - **Recommendation:** GRID should review the details on DAC-SASH tracking data limitations and detailed recommendations throughout the report to address these issues.

    - **Recommendation**: GRID should report to the CPUC if and when the IOU data issues (namely SCE's eligible customer list) have been resolved.

- **DAC-SASH tracking data is missing important battery storage data that is needed to evaluate the impact of battery storage on the program.** While this is understandable as battery storage is not incentivized through the DAC-SASH program, it does limit the analysis that can be performed on paired projects.

  – **Recommendation:** As storage paired systems have become such an integral part of the program, we recommend the following information be collected to understand the impact of battery storage on the DAC-SASH program:

    - **Capacity (kW and kWh) of storage projects**

    - **Cost (disaggregated into all components)**

    - **SGIP Application Code (if applicable)**

- **The DAC-SASH job trainee data is not collected in a way that supports an assessment of workforce development.** Workforce development has been part of the program since its inception, yet the data necessary to determine its impact is still not available. Additional information needs to be collected for an evaluation of the impact of the DAC-SASH program on the solar workforce to be determined.

  – **Recommendation:** We recommend the following actions to address the data limitations noted in the report:

- Include a variable in the system as well as a standardized and required protocol to report out the status of the worker (trainee, intern, volunteer) for all DAC-SASH job training opportunities

- Collect wage information for all subcontractor job trainees

- Collect information on what role each job trainee fulfilled on each DAC-SASH project and have a specific survey just to evaluate DAC-SASH training opportunities (could be as simple as a few questions they fill out post-installation that are tied to workforce development metrics and goals for the program)

- Ensure basic contact information (including address) is collected for each job trainee. Consider collecting additional hiring data such as, 1) the field the job was in (solar, adjacent, etc.), 2) if the job was a full time position, 3) if the job was a short term or long-term hire, 4) location of the hiring company (in a DAC?), 5) if the trainee moved out of a DAC for work. Schedule regular follow ups for DAC-SASH job trainees to ask: 1) did you get a job and when, 2) where and what role, 3) how much do you get paid

- Data can be collected on site of each job training at the beginning to ensure necessary data is collected prior to the work being conducted (~5 min digital QR code survey or paper survey)

- **DAC-SASH cost data is not recorded in a granular, disaggregated fashion consistently.** This impacts cost analysis and makes it difficult to disentangle the components of what is driving high solar installation costs in this population.

  - **Recommendation:** We recommend including additional fields that separate equipment, labor, solar readiness, storage, and subcontracted service (both for solar readiness and solar installation) components to support more transparent analysis of primary cost drivers and re-calculation of reported cost fields (equipment, labor, total system cost, etc.). Detailed examples of the level of cost data we recommend are included in Appendix D.

  - **Recommendation:** We recommend for GRID to create a detailed data dictionary and data mapping system where cost variables are defined clearly and the relationship between variables is recorded. This would include defining which variables are combined to produce a total variable (e.g., Installation costs = labor + permitting costs). This would include any additional cost fields GRID adds to their tracking system.

- **DAC-SASH cost data is likely an under-reporting of the true costs incurred by GRID to implement the program.** The variables used to represent the total cost for different fields (e.g., installation costs and equipment costs) are less than the summation of the individual components that comprise those total fields (e.g., total installation cost is supposed to include labor + permitting costs but labor costs alone are often higher than the total installation costs). This is possibly due to certain total variables getting fixed at different steps in the project lifecycle for invoicing.

  - **Recommendation:** Continue to track the costs incurred for each project past the point where variables get 'fixed' for invoicing. This will allow the determination of an accurate incentive cost for this program that could mitigate the extensive costs GRID covers to implement this program and other similar endeavors.

- **SCE eligible customer data (as mandated by D.20-12-003) was created using outdated and improper filtering and so was unusable for GRID's marketing activities and for this evaluation.**
  - **Recommendation:** SCE should update their systems to provide GRID with a reliable and accurate list of program-eligible households.
  - **Recommendation:** The CPUC should require GRID to report if and when they have received the mandated SCE data for this year.
  - **Recommendation:** The CPUC and GRID should ensure a process is in place where GRID can track and report on issues like this to the CPUC.
- **The DAC-SASH invoice process can be confusing and challenging.** This is because of multiple funding sources for the program as well as the advance and reconciliation process.
  - **Recommendation:** GRID should consider providing a short summary of important consideration (such as funding source and funding buckets) along with each invoice as well as a summary page of previous invoices in a spreadsheet format to quickly identify anomalies.
- **The median $/W for a PV-only DAC-SASH system with no solar readiness cost is $4.76/W.** The current $3/W incentive only covers about 63% of the project costs. When total project costs are included (i.e., including solar readiness costs covered by GRID), the median $/W increases to $4.99/W for PV-only projects. Projects that include solar paired with a storage system can be as high as $16.61/W (some of which may be covered by SGIP, however the tracking data is not currently set up to determine this).
  - **Recommendation:** Increase the incentive to at least $4.75/W to cover the true cost of installing solar for this population. While this recommendation is based on the cost data for the program, this incentive recommendation is in-line with findings on the cost of residential solar using a solar lease in 2024 from Lawrence Berkley National Laboratory's 2025 U.S. Distributed Solar and Storage Update.[69]
- **Subcontractor projects cost more than GRID installation projects.** Both installation and equipment costs are higher for subcontractor projects. Project tracking data does not provide the data necessary to determine why labor costs of subcontracted projects are higher. For install-only projects, GRID provides subcontractors with the installation equipment, so it's unclear why the equipment costs for these projects are higher.

[69] The median loan-financed residential system cost $4.70/W: https://emp.lbl.gov/sites/default/files/2025-10/Distributed%20Solar%20%26%20Storage-2025%20Data%20Update.pdf

- **Recommendation:** GRID should expand tracking data to include more detailed labor cost data and should explore why subcontracted install-only projects have a higher equipment cost than GRID projects.

- **The 2022-2024 evaluation period had almost1,000 more completed projects than the last evaluation (1,922 completed projects in 2022-2024 compared to 964 completed projects in 2019-2021).** An increase in projects and completions is partially due to the ending of the SASH program which was still running concurrently to DAC-SASH for the last evaluation as well as the ending of the COVID shutdown.

- **GRID faced some implementation challenges during this period such as navigating complicated SGIP requirements for battery storage funding.** Battery paired projects had longer timelines than PV-only projects and were completed at a significantly lower rate (62% of 2024 PV-only projects were completed compared to <1% of battery paired projects despite battery paired projects being the majority of projects that year). We also note that at least two applications were cancelled because of CCA and demand response requirement issues with another two projects switching to PV-only systems to stay in the program.

    - **Recommendation:** Attend one of the quarterly SGIP workshops to share feedback on what issues are occurring. Use this session to get support from the SGIP program administrators to identify and implement solutions to support pairing battery storage with DAC-SASH PV systems.

    - **Recommendation:** Future evaluations should assess the program's ability to complete projects and hit internal goals while pairing storage with DAC-SASH projects.

- **GRID faced implementation challenges because of limited eligible solar ready homes.** These challenges led to the creation of a waitlist as GRID worked to identify additional project funding to ensure the program stays 'no-cost' to participants. Almost a third of DAC-SASH programs are cancelled with the main reason being construction issues – namely roof issues.

- **GRID reported difficulty using the CalEnviroScreen 3.0 map to determine household DAC status and eligibility.**

    - **Recommendation:** GRID could consider exploring the feasibility of using CalEnviroScreen 3.0 (or 4.0) shape files to create an automated search function or a searchable database of zip codes or addresses for edge cases to make determining eligibility easier and faster.

- **Eight subcontractors participated in the SPP during the evaluation period.** Interviewed subcontractors show high satisfaction with the program.

- **The application period to be a subcontractor can be lengthy and expensive**. GRID requires premium insurance for participation which can cause subcontractors financial strain (paying expensive monthly premiums during a lengthy application process).

- **Recommendation**: Allow subcontractors to acquire the necessary insurance after their program application has been approved and prior to them starting on any DAC-SASH projects.

- **Subcontractors carry a greater financial risk with the full design and install model as compared to install only.** Subcontractors are expected to cover all upfront costs for the full project and don't get paid until project completion. As DAC-SASH projects can take longer than market rate projects due to challenges around serving this particular demographic, this can be hard on subcontractors.
  - **Recommendation:** Allow subcontractors to invoice for services as they go or allow for a progress payment (similar to SOMAH) to support subcontractors and lessen the financial burden of long installation projects.

- **GRID partners with IOUs and other program partners (like CBOs) for marketing and generating new leads.** IOUs provide lists of eligible ESA customers located in DACs and CBOs and other program partners connect GRID with their communities and clients. Interviewed partners indicated several ways GRID could better leverage their relationships to improve marketing.
  - **Recommendation:** Expand partner relationships to multiple GRID offices wherever feasible. If a partner organization or a CBO serves communities near multiple GRID offices, they should be connected to each GRID office they work near to help support program outreach and marketing.
  - **Recommendation:** Attend more community events in regions where many people could qualify for DAC-SASH. Include job trainees and interns in these events to explain the DAC-SASH process, how solar works, and increase the benefits of their training.
  - **Recommendation:** Consider educating CBOs, partner organizations, or local community government in depth on the DAC-SASH program in DAC communities so these organizations can market the program and identify hot leads for GRID.
  - **Recommendation:** Consider sharing eligibility determining tools or approaches with partner organizations and CBOs to increase eligible customer identification and screening within their normal operations.
  - **Recommendation:** Consider leveraging community events (such as back to school events, community resource fairs, or townhalls) to market DAC-SASH and educate the community on the program.

- **19% of non-participants asserted they were aware of the DAC-SASH program with most (90% of those aware) being able to identify what the program offered.** Primary sources of awareness for non-participants were email and social media as compared to word of mouth for DAC-SASH participants.

- **Lower electric bills and free solar were the biggest participation drivers for participants and the most enticing reasons to participate for non-participants**. Both DAC-SASH participants and non-participants reported similar levels of knowing someone with solar, suggesting this was not a driving factor for participation. However, as word of mouth was the largest source of program awareness for participants, it's likely that knowing someone who participated in DAC-SASH specifically and could vouch for the program is a driving factor for participation.

- **Recommendation:** Use participant solar installations as education events to speak with neighbors about the program. Ask participants to accompany GRID at neighborhood events or put a DAC-SASH sponsored "Free Solar" sign in their yard to help increase neighbors' awareness and knowledge of the program.

- **The two most effective ways GRID builds trust in the program (i.e., how participants knew the program wasn't a scam) is through direct communication (in person or over the phone) and their website.**

  - **Recommendation:** Consider gathering feedback from participants and other DAC-SASH website users to identify ways to improve the website for ease of access to and accessibility of information, additional information or modified information to build trust and awareness, and best ways to identify legitimacy of the program.

- **GRID employs a wide range of strategies to support Tribal outreach including presenting at Tribal council meetings, attending Tribal community events, and offering in-language services.** We heard from Tribal participants that GRID could add (or make more frequent) additional outreach activities to support greater Tribal enrollment. We heard from Tribal participants that GRID could increase outreach activities to support greater Tribal enrollment.

  - **Recommendation:** Consider adding (or increasing the incidence of) the following activities for Tribal outreach:

    - Partnering with Tribal environmental programs
    - Hiring staff who understand (or are a part of) Tribal communities
    - Creating marketing and information materials that reflect Tribal values

- **51 DAC-SASH participants reported feeling GRID marketing could be improved and provided ideas to support GRID in finding more eligible customers.**

  - **Recommendation:** Review ideas shared by participants in Appendix E to identify if there are any new outreach ideas that could be beneficial.

- **The biggest challenges marketing the DAC-SASH program include a lack of trust, a lack of interest in solar, and identifying eligible customers.**

- **DAC-SASH participant survey respondents report a 90% satisfaction with their solar panels and 87% satisfaction with the program overall.** Participants report high satisfaction (77%-94%) across all components of the DAC-SASH program except for education on billing and solar true ups (64%).

- **Recommendation:** Revisit how billing changes and solar true ups are explained. Consider workshopping the explanation and materials with participants to ensure that information is provided in an accessible and understandable format.

- **Recommendation:** Consider providing participants with an example of a true up bill (with annotated explanations) and share options (like apps) to track solar usage and costs. Provide assistance to participants (from GRID staff or partnering CBOs) to help them understand their first true up bill and answer any other questions they have about their bills or solar systems.

- **DAC-SASH participants surveyed reported decreases in stress around their energy costs (71%), energy use (67%), and appliance use (65%) since participating in the program.**

  - **Recommendation:** Consider leveraging this finding in DAC-SASH marketing (i.e., market that the program can help decrease stress and provide increased quality of life).

- **55% of participants surveyed reported no challenges with participating in the DAC-SASH program.** Those that reported a challenge primarily point to long project timelines (18%), confusing utility bills (13%), and needed home upgrades (12%). Project completion timelines decreased from 2022-2024, but it is currently unknown how battery paired projects will impact timelines moving forward.

  - **Recommendation:** The next evaluation should explore if project completion timelines are negatively impacted by the influx of PV + Storage Paired projects.

- **Tribal projects face challenges including paperwork and income reporting, communication barriers, and greater relationship building to establish trust in the program.**

  - **Recommendation:** Simplify the income verification process by allowing Tribal administration to provide a letter certifying household income status (similar to homeownership verification).

  - **Recommendation:** Revisit income eligibility amounts to better reflect multi-generational and unique household realities in Tribal communities to ensure more families who genuinely need assistance can qualify.

  - **Recommendation:** Continue sharing best practices and resource materials across different GRID offices serving Tribal communities to support relationship-based communication approaches with Tribal partners.

- **ESA participation post DAC-SASH is low at two of the three utilities (24% and 11% for SCE and SDG&E, respectively).** PG&E saw 62% ESA participation post DAC-SASH.

- **60% of participant survey respondents indicated they made a change to save energy at home after their solar panels were installed.** An additional 18% indicated that they had plans to. The primary upgrades reported were installing LED bulbs (n = 56 participants), sealing air leaks (n = 29 participants), or installing high efficiency or electrification appliances (n = 25) or a smart thermostat (n = 25).

- **92% of participants surveyed reported a decrease in their summer energy bill and 79% reported a decrease in their winter bill.**

- **72% of participant survey respondents indicated they wanted to install battery storage with their solar but were unable to do so.**

9.2 IMPACT AND COST-EFFECTIVENESS FINDINGS AND RECOMMENDATIONS

The section summarizes the impact and cost-effectiveness related findings and recommendations included in Sections 6 and 7 of this report.

PV Production and Energy Impact Findings:

- **Observed PV Production**: 1,555 MWh in 2022, 5,676 MWh in 2023, and 10,954 MWh in 2024. The observed capacity factors (DC) were 16.8% in 2022 and 2023 and 16.6% in 2024. The forecast full-year realization rate is 103%.
  - **Recommendation**: Strategize how to collect and provide battery telemetry data for future evaluations. Few DAC-SASH systems in the scope of this evaluation were paired with storage systems. However, there are 553 active projects that are paired with battery storage and should be completed by the next evaluation phase. To enable accurate evaluation activities, particularly for GHG impacts, CAISO peak hour impacts and electricity consumption impacts, it will be necessary to provide data on actual battery usage for at least a subset of DAC-SASH systems.
  - **Recommendation**: Consider additional system maintenance education and assistance**.** DAC-SASH PV systems are currently performing very well relative to expectations. However, as program systems begin to age, the chance of underperformance is likely to increase. Some age-related degradation may be unavoidable, but others, such as increased soiling or disruption from vegetation growth may be preventable with preemptive action. Verdant recommends distributing information to participants with systems over two years old on how to self-monitor system performance. In addition, providing participants with information (and perhaps support) on routine system maintenance is a great way to maintain the strong performance of DAC-SASH systems moving forward, provided that the associated costs do not outweigh the potential program benefits of this assistance.
  - **Recommendation**: Research changing incentive calculations away from EPBB calculator which is based on PVWatts v2. DAC-SASH incentive levels and performance expectations are developed using the EPBB Calculator which is driven by NREL's PVWatts v2 Calculator. The EPBB calculator has not been updated since 2014. The current version of NREL's PVWatts calculator is now v8.5 (released in September 2025). More recent versions of PVWatts have been shown to have higher generation estimates by up to 13%. Therefore, DAC-SASH performance expectations are understated. Verdant recommends researching alternative methods for estimating PV system performance and setting incentive levels that are grounded in more up-to-date methods. This recommendation should be taken in concert with continued monitoring and enforcement

measures to ensure system performance is maximized and maintained. Note that the commission has asked in the May 5th ALJ Ruling Inviting Comments on Potential Modifications to SOMAH whether the EPBB methodology is functional for SOMAH projects and whether there are ways it can be refined to better support SOMAH program goals

- **Forecasted PV Production**: 12,752 MWh annually from completed in-scope projects. Forecasted capacity factor (DC) of 16.6%. The forecasted realization rate is 103%.

Customer Electricity Consumption Findings:

- **DAC-SASH Participants tend to increase energy consumption following PV installation:** Following PV installation, average monthly consumption per project increased by 90 kWh in PG&E and 57 kWh in SCE. Consumption trended towards an increase in SDG&E, but this finding was not statistically significant. Participants may have increased usage through a combination of behavioral changes (such as increased HVAC usage) as well as installation of electrification measures and electric vehicle chargers. These results are supported by the participant survey, where over half of the DAC-SASH participants surveyed reported making energy-related home improvements after their solar panels were installed. In particular, 10% reported installing and EV-charger at their home and six customers reported installing electrification measures (including water heaters, laundry appliances, and kitchen stoves. Further research would be necessary to assess the relative contributions of these various upgrades, as well as any behavioral changes (such as altering thermostat setpoints), to the overall changes in energy consumption that occur after PV installation. Additionally, these results are based on a limited sample size, and future research that includes a larger portion of program systems would help develop deeper understanding of the impact of program participation on post-period electricity consumption.

Demand Impacts Findings:

- **CAISO Gross Peak:** For PV-only projects, coincident generation of 648 kW in 2022, 888 kW in 2023, and 1,658 kW in 2024. Estimated capacity factor of 40.4% in 2022, 20.8% in 2023 and 20.4% in 2024.

- **CAISO Net Peak:** For PV-only projects, coincident generation of 13 kW in 2022, 83 kW in 2024, and 532 kW in 2024. Estimated capacity factor of 0.8% in 2022, 1.9% in 2023, and 6.5% in 2024.

- **IOU Peak**: For PV-only projects, coincident generation ranged from a low of 19 kW in SDG&E to a high of 433 kW in PG&E in 2022. Coincident generation ranged from a low of 9 kW in SDG&E to a high of 599 kW in SCE in 2023. Coincident generation ranged from a low of 19 kW in SDG&E to a high of 599 kW in PG&E in 2024.

Environmental Impacts Findings:

- **Observed Emissions Reductions**: 463 metric tons of CO_2 in 2021, 1,333 in 2023, and 2,558 in 2024.

- **Forecasted Emissions Reductions**: 3,015 metric tons of CO_2 per year from completed projects. The forecasted monetary value of emissions reductions is $85,000 per year from completed projects.

Economic Impacts Findings:

- **PG&E Customer Bill Impacts:** $163 per month, or 68% saved on average monthly bill in 2024 (completed projects).

- **SCE Customer Bill Impacts:** $110 per month, or 57% saved on average monthly bill in 2024 (completed projects).

- **SDG&E Customer Bill Impacts:** $108 per month, or 81% saved on average monthly bill in 2024 (completed projects).

- **Overall Customer Bill Impacts**: $140 per month, or 64% saved on average monthly bill in 2024 (completed projects).

Cost-Effectiveness Assessment Findings:

- **Total Resource Cost Test**: NPV Total Benefits of $19M, NPV Total Costs of $42.4M, Benefit-Cost Ratio of 0.45

- **Societal Cost Test**: NPV Total Benefits of $23M, NPV Total Costs of $42.4M, Benefit-Cost Ratio of 0.55

- **Ratepayer Impact Measure Test**: NPV Total Benefits of $7.7M, NPV Total Costs of $26.4M, Benefit-Cost Ratio of 0.29

APPENDIX A DATA COLLECTION ACTIVITIES, INTERVIEW GUIDES, AND SURVEY INSTRUMENTS

The 2022-2024 evaluation used a variety of data collection methods for the process assessment. Verdant conducted the following interviews and surveys for analysis:

In-depth Interviews (IDIs) and web surveys with program administrators, marketing partners, and participants

- **1 IDI** with the DAC-SASH program administrator,
- **2 IDIs** with participating DAC-SASH subcontractors,
- **3 IDIs** with partnering IOUs,
- **2 IDIs** with partnering community based organizations (CBOs),
- **1 IDI** with GRID's Tribal manager, and
- **297 web surveys** with DAC-SASH participants (n = 146) and non-participants (n = 151).

A.1 INTERVIEW METHODOLOGY AND GUIDES

Verdant used the following guides as part of their data collection outreach. The files can be accessed by double clicking on the icons below to open the files.

A.1.1 Program Administrator

Verdant interviewed GRID Alternatives as part of our data collection efforts to understand program administration.

DAC_SASH PA Interview Guide.pdf

A.1.2 Subcontractor

Verdant interviewed two subcontractors as part of our data collection efforts to understand program administration and the Subcontractor Partnership Program.

DAC_SASH
Subcontractor Intervi

A.1.3 Program Partnerships

Verdant interviewed two of GRID's program partners as part of our data collection efforts to understand DAC-SASH marketing, education, and outreach initiatives.

DAC_SASH CBO
Interview Guide.pdf

A.1.4 Investor-Owned Utilities

Verdant interviewed all three participating utilities as part of our data collection efforts to understand DAC-SASH marketing, education, and outreach initiatives.

DAC_SASH IOU
Interview Guide.pdf

A.1.5 Tribal

Verdant interviewed one of GRID's Tribal project managers as part of our data collection efforts to understand the unique challenges faced by Tribal participants.

DAC_SASH Tribal
Interview Guide.pdf

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A.2 SURVEY METHODOLOGY AND GUIDES

A.2.1 Participant Survey

Verdant sent Qualtrics web surveys to participants who had completed a project during the 2022-2024 evaluation period. Participants were sent an initial invitation email with non-respondents receiving two reminder emails. Participants received a $25 incentive. Table A-1 shows the participant survey population, sample, and response rate for this survey effort.

TABLE A-1: PARTICIPANT SURVEY RESPONSE RATE

IOU	Population	Sample	Bounced	Started	Completed	Survey Total	Response Rate
PG&E	1,054	657	22	16	58	74	11%
SCE	800	694	11	10	54	64	9%
SDG&E	68	61	1	0	8	8	13%
Total	**1,922**	**1,412**	**34**	**26**	**120**	**146**	**10%**

*Using American Association for Public Service Research (AAPOR) calculation for lists

Verdant used the following guide as part of their data collection outreach. The file can be accessed by double clicking on the icon below to open the file.

DAC_SASH
Participant Survey Ins

A.2.2 Non-participant Survey

Verdant sent Qualtrics web surveys to GRID cold leads from contacted during the 2022-2024 evaluation period. Non-participants were sent an initial invitation email with non-respondents receiving two reminder emails. Non-participants received a $20 incentive for completing the survey. Table A-2 shows the non-participant survey population, sample, and response rate for this survey effort.

TABLE A-2: NON-PARTICIPANT SURVEY RESPONSE RATE

IOU	Population	Sample	Bounced	Ineligible	Partial	Complete	Survey Total	Response Rate*
PG&E	482	462	20	6	14	30	50	10%
SCE	1,180	1,140	40	5	18	64	87	7%
SDG&E	29	29	0	0	1	1	2	7%
Other (unknown IOU or LADWP)	1,086	585	97	5	7	0	12	--
Total	2,777	2,216	157	16	40	95	151	--
Total Unknown Removed	**1,691**	**1,631**	**60**	**11**	**33**	**95**	**139**	**8%**

*Using AAPOR calculation for lists

Verdant used the following guide as part of their data collection outreach. The file can be accessed by double clicking on the icon below to open the file.

DAC_SASH NP
Survey Instrument FIN

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APPENDIX B CUSTOMER ELECTRICITY CONSUMPTION CHANGE METHODOLOGY

Verdant utilized a matched control group of non-solar installers along with a difference in differences modelling approach to determine how DAC-SASH participants change their electricity consumption after program participation. This analysis consisted of four core components, as described below:

B.1 DATA SOURCES

This analysis relied on four primary data sources, as described below:

- **Interconnection/Project Data:** Data supplied from GRID and DGSTATs allowed us to identify completed DAC-SASH projects with interconnection dates between January and September 2023. Additionally, this data contained project information such as utility and climate zone, which were necessary for customer segmentation during the modeling process.
  - This analysis focused on new PV installations between January and September 2023 because (1) the latest available AMI data (as described below) was current only through September 2024 and (2) it was important to limit the influence on the pre-period of atypical energy usage related to COVID-19 in 2020-2021.
  - Only customers with at least nine months of both pre and post interconnection AMI data were considered for the analysis.
- **Customer AMI data:** These data included hourly net energy usage. For non-participants, and in the pre-period for participants, these data represent the total energy consumption. In the post-period for participants, these data represent total PV export (when negative) or additional grid consumption beyond generated PV (when positive). These data also included rate and CARE/FERA information, which were necessary for identification of candidate non-participants for the matched control group.
- **Participant PV Generation Data:** This data, provided by Sunrun for the DAC-SASH evaluation, included the metered actual PV generation data for complete DAC-SASH projects from January 2022 through December 2024.
  - Only DAC-SASH participants with at least 9 months of complete metered generation and corresponding net load data during the focal time period were considered for the analysis.
- **NSRDB Weather Data:** These data include hourly temperature, windspeed, and solar irradiance information as well as the latitude, longitude, and elevation of the weather station. These data were used for weather normalization in the statistical modelling step.

B.2 CUSTOMER SEGMENTATION

Residential customer energy usage is sensitive to a variety of customer attributes. As such, to increase the reliability of our models as well as reduce potentially confounding sources of variability, all models were run with bins separated by the following factors:

- **Utility** – Based on the interconnection and AMI data, only including SCE and PG&E.
- **Climate Region** – Derived from Title 24 Climate Zone based on customer location. Because of the limited sample size of DAC-SASH participants, it was necessary to bin similar climate zones together to develop customer segments.
  - The 'Coastal' region was comprised of Climate Zones 3A, 3B, and 6. The 'Coastal-Inland' region was comprised of climate zones 2, 4, 7, and 8. The 'Inland' region was comprised of climate zones 9 through 13. The 'Desert' region was comprised of climate zones 14 and 15, and the 'Mountain' region was equivalent to climate zone 16.
- **CARE/FERA Status** – Because DAC-SASH serves a low-income customer population, only non-solar installers on CARE or FERA rates were considered for inclusion in the matched control group pool.

Table B-1 shows the number of DAC-SASH participants with sufficient data for the analysis in each Climate Region by Utility. Most regions had insufficient data to develop a reliable model. As such, we only modeled regions with at least 20 DAC-SASH participants, with the exception of SDG&E. Only 11 SDG&E DAC-SASH participants were qualified for the analysis (installed in the focal time frame with sufficient data completeness), all in climate zones 7 and 10. As such, the evaluation team proceeded with modelling for this set of SDG&E customers.

TABLE B-1: COUNT OF DAC-SASH PARTICIPANTS IN EACH CLIMATE REGION, BY UTILITY

Climate Region	PG&E	SCE	SDG&E
Coastal	12	4	-
Coastal-Inland	8	25	11
Inland	188	109	-
Mountain	-	11	-
Desert		9	-

B.3 DEVELOPMENT OF THE MATCHED CONTROL GROUP

To develop a robust counterfactual estimate of participant energy usage in the post-period, it was necessary to identify a set of customers who did not install solar PV whose pre-period energy usage resembled those who did.

For this analysis, Euclidean distance matching on pre-period load shapes was used to select one matched control non-participant per PV adopter. A suite of internal models was tested for each customer segment (e.g., by climate zone and utility), with models including combinations of variables such as the average hourly usage during each season as well as each time of day. For each segment, the model that performed best by a combined Bias and Absolute error metric was used to select the final set of matched non-participants.

Importantly, the matched control group was developed using only data from 2022. Because of the significant difference in weather conditions between 2022 and 2023 across California, it was important to limit the matching period to a single, consistent time interval.

B.4 DIFFERENCE IN DIFFERENCES MODELLING

This study employed a regression-based approach by fitting a panel model to approximately one year each of pre- and post-period energy consumption. Models were run on per-customer average month-hour usage data, with separate models being run for each customer segment in each hour of each month. The final model specification is detailed below:

$$\boldsymbol{kWh_{h,m} = \beta_{0,h,m} + \beta_{1,h,m}Post + \beta_{2,h,m}Part + \beta_{3,h,m}Post{:}Part + \beta_{4,h,m}Post{:}Part{:}Wx + \beta_{5,h,m}EV + \beta_{6,h,m}Wx + \varepsilon_{h,m}}$$

Where:

$\boldsymbol{kWh_{h,m}}$	The estimated total consumed kWh usage for a customer during hour *h* in month *m*.
$\boldsymbol{\beta_{0,h,m}}$	The intercept of the regression model during hour *h* in month *m.*
$\boldsymbol{Post}$	A dummy variable to indicate the Post-Period. Its coefficient $\boldsymbol{\beta_{1,h,m}}$ captures the baseline impact of being in the post-period on average daily usage for both parts and non-parts during hour *h* in month *m.*
$\boldsymbol{Part}$	A dummy variable to indicate the Participants. Its coefficient $\boldsymbol{\beta_{2,h,m}}$ captures the baseline impact of being a participant on average daily usage during hour *h* in month *m.*
$\boldsymbol{Post{:}Part}$	A dummy variable indicating Participants in the Post period. Its coefficient $\boldsymbol{\beta_{3,h,m}}$ is the core difference-in-difference impact estimate, representing the non-weather sensitive impact on usage attributable to participants in the post-period.
$\boldsymbol{Post{:}Part{:}Wx}$	Optional. A dummy variable interaction of weather and participation in the post period. Its coefficient $\boldsymbol{\beta_{4,h,m}}$ represents the weather sensitive impact on usage attributable to participants in the post-period. This term is only included in the model in cases where the estimate for $\boldsymbol{\beta_{4,h,m}}$ is statistically significant ($p < 0.05$). When relevant, separate terms are fit for heating and cooling parameters of CDH65 and HDH55.
$\boldsymbol{EV}$	A dummy variable associated with the registration date of an electric vehicle at the site. It's coefficient $\boldsymbol{\beta_{5,h,m}}$ captures the impact of EV presence on daily home energy consumption.
$\boldsymbol{Wx}$	A temperature-based variable. Separate terms are fit for heating and cooling, with the cooling degree day estimate at cutoff 65°F and the heating degree day estimate at 55°F. Coefficients $\boldsymbol{\beta_{6,h,m}}$ account for weather sensitivity within a segment and across months.
$\boldsymbol{\varepsilon_{h,m}}$	The error term

APPENDIX C CALIFORNIA AIR RESOURCES BOARD GREENHOUSE GAS SAVINGS

The estimated lifetime greenhouse gas (GHG) emissions reductions attributable to proceeds were also calculated per the California Air Resources Board (CARB) requirements. The CARB GHG Benefits Estimation Tool was used to develop these estimates, as presented in Table C-1 below. All projects were modeled with a 20-year expected project lifetime and a 0.5 percent annual degradation factor. The CARB GHG Benefits Estimation Tool uses and emissions factor of 0.2 MTCO2e per MWH. The percentage of DAC-SASH projects funded with auction proceeds was calculated by year as the sum of the total incentives for the in-scope projects and the program expenditures divided by the total project costs (excluding non-SPP costs). The total yearly program expenditures were spread out by IOU based on the proportion of incentives paid by that IOU each year.

TABLE C-1: ESTIMATED CARB GHG BENEFITS BY UTILITY

Utility	Year Project Completed	Percentage of Renewable Energy Project Funded with Auction Proceeds (%)	Annual Production (MWh/year)	Estimated Annual GHG Emissions Reductions Attributable to Proceeds Use in Data Year ($MTCO_2e$)	Estimated Lifetime GHG Emission Reductions Attributable to Proceeds Use in Data Year ($MTCO_2e$)
PG&E	2022	79%	2,049	323	6,121
	2023	74%	2,595	387	7,328
	2024	73%	2,395	352	6,665
SCE	2022	81%	1,161	188	3,562
	2023	72%	2,112	304	5,767
	2024	72%	1,988	286	5,419
SDG&E	2022	68%	125	17	324
	2023	59%	154	18	345
	2024	62%	173	22	408
Total			**12,752**	**1,896**	**35,940**

APPENDIX D COST DATA COLLECTION RECOMMENDATION

We suggest collecting the following fields for every cost entry, regardless of category. The goal should be to collect data in such a way that allows for a disentanglement of every cost component going into putting solar on a roof.

It should be possible to know exactly what cost is covered by every incentive dollar and what is driving the cost beyond the incentive.

TABLE D-1: EXAMPLE VARIABLES AND DESCRIPTIONS FOR COST DATA COLLECTION

Variable	Description
Project ID	Unique identifier linking all costs to a single project
Cost Category	High-level cost bucket (Solar Equipment, Labor, Solar Readiness, Storage, Subcontracted Services)
Cost Subcategory	Specific component within category (e.g., Modules, Installation Labor, Panel Upgrade)
Cost Description	Brief description of the cost
Quantity	Number of units or hours
Unit	Each, hours, lump sum, contract
Unit Cost ($)	Cost per unit
Total Cost ($)	Quantity × Unit Cost
Internal or External	Whether cost is incurred by program staff or third party
Cost Type	Estimated or Actual

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TABLE D-2: RECOMMENDED FIELDS FOR COST DATA COLLECTION

Cost Category	Recommended Fields	Notes
Solar Equipment Costs	Modules	Collect each equipment component as a separate cost entry Data should be collected in a way that allows total solar hardware cost to be recalculated and analyzed by component
	Inverters (string or micro)	
	Racking and mounting hardware	
	Electrical balance of system (wiring, disconnects, combiner boxes)	
	Monitoring equipment	
	Sales tax on solar equipment	
	Equipment warranties or extensions	
Labor Costs (Including workforce development and subcontractor projects)	Customer acquisition/education	Labor should be collected by function, not as a bundled total Collect for all GRID labor and subcontractor labor
	Equipment procurement	
	Application processing	
	Program administration	
	Marketing	
	System design/engineering	
	Permitting	
	Installation labor	
	Inspection &PTO support	
	Project management	
	Trainee labor	
	Trainer / supervisory labor	
	Subcontractor labor	
Solar Readiness Costs	Electrical panel upgrades	Solar readiness costs should be tracked separately from solar installation, should be collected in a way that allows for re-calculation, and when added to total cost of solar installation (labor, equipment) should equal GRID's total solar project cost
	Roof repair	
	Partial roof replacement	
	Structural reinforcement	
	Tree trimming	
	Health and safety remediation	
	Other site preparation	
	GRID labor associated with managing this	
Storage Costs	Battery units	Storage costs should be fully separable from solar costs, and should be collected in a way that allows for calculations like 'total project readiness cost', 'total equipment cost for solar and storage', 'total labor cost for solar and storage', etc.
	Battery inverters	
	Storage balance of system	
	Battery installation labor	
	Sales tax on storage equipment	
	Storage software or controls	
	Storage warranties	
	Design labor	
	Storage readiness labor or subcontracting work	

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APPENDIX E PARTICIPANT SURVEY RECOMMENDED ME&O ACTIVITIES

TABLE E-1: PARTICIPANT IDEAS ON HOW GRID COULD IMPROVE OUTREACH FOR DAC-SASH

	Participant Recommendations
Recommendation	*More public articles*
	More publicity and more news articles. Connect with real people or forums so people feel comfortable sharing their story.
	Advertise more
	More advertising. Rate the usage used for a longer period of time to estimate the solar panels.
	Explain the specifics.
	I went to a city-organized community event where I live (Redwood City) about alt. energy, heat pumps etc. to make a presentation about it, and found that nobody who attended was interested. I suspect that this was probably because the sort of people who even found out about the event all knew that they were too wealthy to qualify. This may be an indictment of the city's communications about such events. They may only be breaking through to (say) those with broadband, and who sign up to the city's newsletters. Just looking at my neighborhood in Google sat. view, I can see that there's only a single other solar array in my area, which is predominantly low-income/rental and culturally predominantly Hispanic. It may be that reaching out to landlords of rental units in the area would work, but for homeowners I suspect that door knocking may be the only approach that might possibly work, and that doesn't scale very well.
	Community engagement
	Better explain the services and how other organizations will contact you.
	More flyers being sent out with utility bill as an insert
	Mailers, community outreach and word of mouth. the more you see it the more people will trust it especially in DAC neighborhoods
	Representatives at neighborhood meetings
	Do events in communities like at the Lawndale fairs or festivals
	Attend local community events such as block clubs. You can get a person who has qualified to be a testimonial for the remainder of the block.
	More current customer referral
	More advertisements and more exposure at media such as TV, Internet, and so forth.
	Provide a better referral program
	Maybe flyers that explain that Grid Alternatives is a non-profit organization
	Advertise better, honestly it does appear to be a scam their website is pretty vague

Participant Recommendations
A more focus & dedicated community outreach
Focus on you being the ONLY organization to give free solar panels. And easily allow the user to see the government source / fine print proving they are free.
Place an ad on internet
Provide documentation that the program is backed by the state of California
More advertising and getting the current solar customers to spread the word to others they think may benefit from the program.
I only learned about the program because representatives were canvasing my neighborhood. But there are more effective methods of community networking. Through senior centers, Edison care program participants, other low-income programs and through referrals from church outreach programs.
I think partnering with local community organizations could help improve awareness and access to the program. For example, weatherization programs partners, community-based programs where targeted income persons would be able to access the information.
All the county offices that have assisted programs.
Please explain the benefits to their electricity bills now and in the future.
Share the program on community Facebook pages
Signs in participant's yards. Visits to the neighbors during installation.
More community events
More direct mail flyers
Perhaps make the financial guidelines easy to look up. As several people have asked me that question.
Advertising - I have told so many people about this program and their response always is I never hear of this
Reach out to community programs that help people pay their utility bills like Red Cross
Host community workshops or have booths at community events.
Make it known what the qualifications for the program are so, people can know what the income qualifications are.
Community bulletins, HOA meetings
Probably more social media presence.
Grid needs to be completely honest with people. It is imperative that Grid provide its customers with a full and transparent understanding of both the advantages and the potential drawbacks involved.