



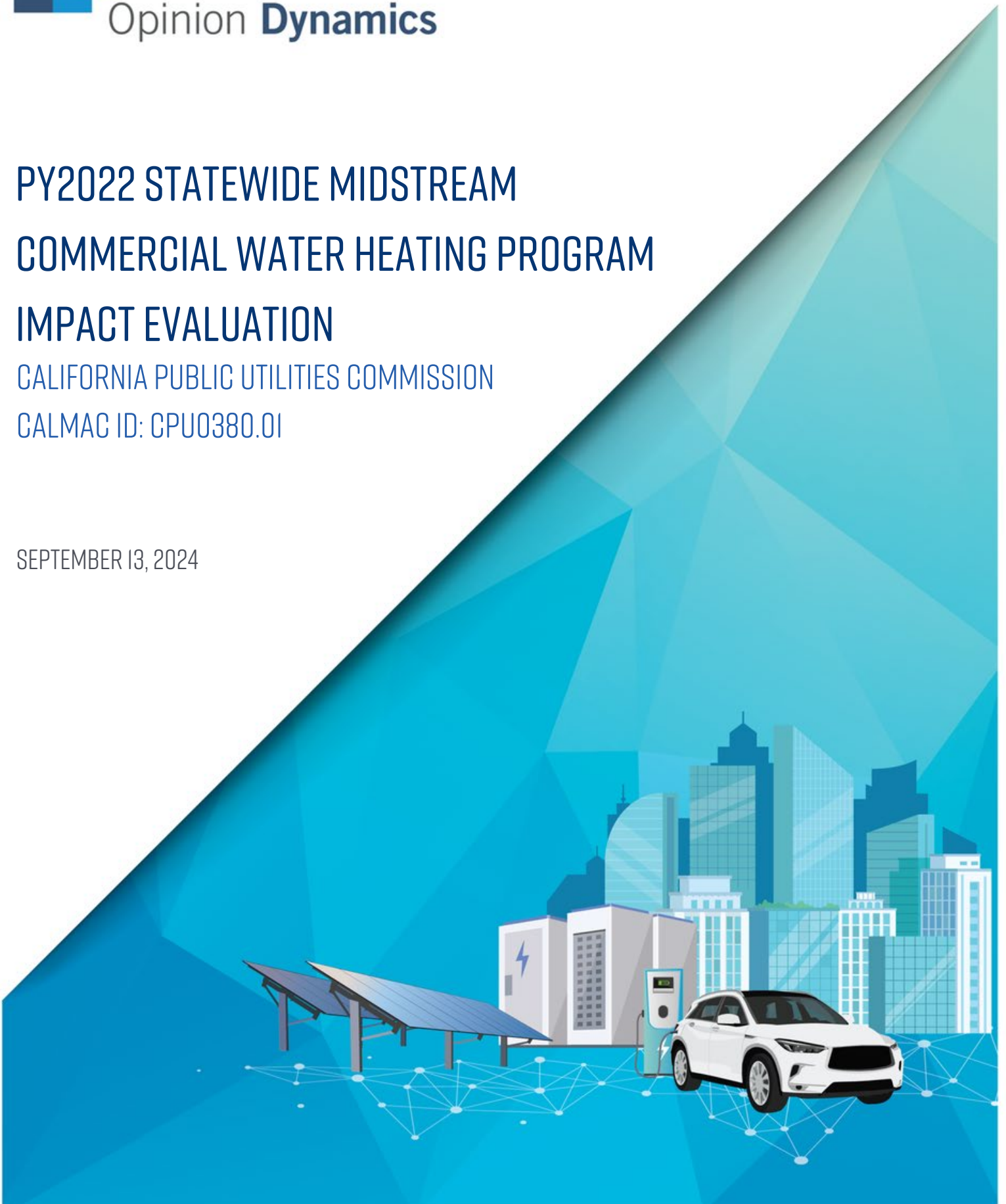
Opinion **Dynamics**

PY2022 STATEWIDE MIDSTREAM COMMERCIAL WATER HEATING PROGRAM IMPACT EVALUATION

CALIFORNIA PUBLIC UTILITIES COMMISSION

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CONTENTS

1. Executive Summary.....	6	6.2 PTLM Review and Verification Process Mapping.....	45
1.1 Study Approach.....	7	6.3 Net Impact Results.....	48
1.2 Results.....	10	6.4 Cost-Effectiveness and Total System Benefit ...	49
1.3 Key Findings & Recommendations.....	15	6.5 Marketing & Education	50
2. Glossary	18	6.6 Participation Process	52
3. Background	21	6.6.1 Onboarding.....	52
3.1 PY2022 Allocations by PA	23	6.6.2 Data Submission Portal	53
3.2 Program Measures and Building Types....	23	6.6.3 End-User Data Collection	53
4. Evaluation Objectives.....	26	6.6.4 Statewide Implementation.....	55
4.1 Research Questions.....	26	6.7 Equipment Offerings	57
5. Methods	28	6.7.1 Contractor Coupons	58
5.1 Program Staff and Stakeholder Interviews ...	28	6.7.2 Qualified Products List.....	58
5.2 Program Data and Materials Review	28	6.7.3 Barriers to Increasing Sales of All-Electric Equipment	59
5.3 Program Theory Logic model Review and Verification Process Mapping.....	29	6.8 Participation Assessment	61
5.4 Net Savings Methodology.....	29	6.8.1 DAC and HTR Communities	62
5.5 Distributor Interviews.....	30	6.8.2 Serving DAC and HTR Customers..	63
5.6 Contractor Survey	30	6.9 Satisfaction.....	64
5.7 Innovation Review.....	31	6.9.1 Distributor	64
5.8 Gross Savings Estimates.....	31	6.9.2 Contractor	65
5.9 Cost-Effectiveness and Total System Benefit (TSB)	35	7. Conclusion and Recommendations.....	67
5.10 Participation and Program Performance Assessment.....	35	Appendix A. Data Standardized High-Level Savings	70
6. Results	36	Gross and Net First Year Savings.....	70
6.1 Gross Savings Results	36	Gross and Net Lifecycle Savings	70
6.1.1 Database Review	36	Gross and Net Lifecycle Savings by IOU ...	71
6.1.2 Reported Savings Review	36	Appendix B. Response to Recommendation	72
6.1.3 Desk Reviews	39	Appendix C. Data Collection Instruments	75
6.1.4 Evaluation Results and Population-Level Gross Savings	42	Distributor In-Depth Interview Guide.....	75

Contractor Web Survey Instrument.....	75
Appendix D. Response Rate and Outreach	
Disposition Summaries.....	76
Distributor In-Depth Interviews	76
Contractor Survey.....	76
Contractor Survey Disposition Summary...	76
Response Rate Calculations	77
Appendix E. Net Savings Methodology.....	79
Stocking.....	79
Upselling.....	81
Price	83

TABLES & FIGURES

Table 1. PY2022 CEDARS First-Year Reported Savings by Measure Category.....	6	Table 13. Total First-Year Therm Savings and Claims by Building Type	24
Table 2. PY2022 CEDARS Reported Savings by IOU Service Territory	7	Table 14. Research Questions for the SWWH Program Evaluation.....	26
Table 3. PY2022 Implementer Data Total Measures Installed and End-Users Served.....	7	Table 15. Summary of Data Sources.....	28
Table 4. CEDARS vs. Implementer Total Program Impacts by Measure Category.....	8	Table 16. Distributor Interview Disposition & Savings Summary.....	30
Table 5. Implementer Final Gross Savings and Desk Review Sample Quotas.....	9	Table 17. Contractor Sample Summary	31
Table 6. Desk Review Sample Offering Category and Program-Level Gross Realization Rates	11	Table 18. Process-Related Innovations.....	31
Table 7. Program-Level Reported and Evaluated	12	Table 19. Measure/Offering Categories and eTRM Measure Package-Offering ID Summary.....	32
Table 8. Cost Effectiveness and TSB Results	13	Table 20. Reported Savings Summary by Offering Category from CEDARS Program Data.....	33
Table 9. Midstream Water Heating Program Quantitative Targets and Claims.....	22	Table 21. Summary of Desk Review Sample Quotas	33
Table 10. Statewide Program Energy and Weighted Cost-Benefit Allocation Factors.....	23	Table 22. Final Savings Summary by Offering Category for Implementer Program Data	34
Table 11. Total Statewide Program Savings by Measure Category.....	23	Table 23. Engineering Desk Review Sample Counts and Implementer Final Savings Totals	34
Table 12. Deemed Measure Claims by Measure Category.....	24	Table 24. Comparison of Reported Savings from CEDARS and Implementer Program Tracking Data ..	36
		Table 25. eTRM Measure Package and Versions Used for Calculations Savings by Measure Category	38

Table 26. Revised Final Savings Summary.....	39	Table 49. Barriers to Increasing Adoption of High-Efficiency Water Heating Equipment Among DACs...	64
Table 27. Reported and Evaluated Building Type Changes Summary for Sample	40	Table 50. Gross and Net First Year CEDARS Program Therm Savings.....	70
Table 28. eTRM Measure Packages and Offering IDs used for Evaluated Savings.....	41	Table 51. Gross and Net First Year CEDARS Program kWh Savings	70
Table 29. Measure Package Offering ID Adjustments for the Desk Review Sample	41	Table 52. Gross and Net First Year CEDARS Program kW Savings	70
Table 30. Gas Savings Gross Realization Rates for Desk Review Sample by Offering Category	43	Table 53. Gross and Net Lifecycle CEDARS Program Therm Savings.....	71
Table 31. Electric Savings Gross Realization Rates for Desk Review Sample by Offering Category	43	Table 54. Gross and Net Lifecycle CEDARS Program kWh Savings	71
Table 32. Population Level Electric Savings Gross Realization Rates for Desk Review Sample by Offering Category.....	43	Table 55. Total Statewide Program Savings Distributed by IOU	71
Table 33. Use of Com Building Type in CEDARS Reported Claims	44	Table 56. Distributor Disposition Summary	76
Table 34. Program Influence Pathways.....	45	Table 57. Contractor Survey Disposition Summary ..	76
Table 35. Interviewed/Surveyed Market Actor’s Ex Ante Savings Representation.....	48	Table 58. Email Outreach Final Disposition Summary	77
Table 36. Annual First Year Net Impacts.....	49	Table 59. Phone Outreach Final Disposition Summary	77
Table 37. PY2022 Program Performance to Goals ..	49	Figure 1. Net to Gross Results	12
Table 38. Cost-effectiveness and TSB Results	49	Figure 2. Percent of End-Users by County	15
Table 39. Suggestions to Streamline End-User Data Collection.....	55	Figure 3. eTRM Commercial Boiler Measure Package (SWWH005) Version History.....	37
Table 40. Types of Equipment Stocked and Sold by Distributors.....	58	Figure 4. eTRM Commercial Tankless Water Heater Measure Package (SWWH006) Version History.....	37
Table 41. Barriers to Increasing Installations of HPWHs.....	59	Figure 5. Statewide Midstream Water Heating Program End-User Data Collection.....	47
Table 42. Suggestions for Increasing Sales of HPWHs	60	Figure 6. Net to Gross Results	48
Table 43. Barriers to Increasing Electric Resistance Water Heaters	60	Figure 7. Contractors’ Understanding of Program Goals	51
Table 45. PY2022 Implementer Data Total Measures Installed and End-Users Served.....	61	Figure 8. Contractor Satisfaction on Program Information Received.....	51
Table 46. Quality Assurance Verification Business Firmographics	62	Figure 9. Types of Support Received by the Program	53
Table 47. Number of DAC Zip Codes Served by Program	63	Figure 10. Distributors Explanation of Program Eligibility Requirements	54
Table 48. Number of Measures Installed in HTRs/DACs.....	63	Figure 11. Ease of End-user Data Collection.....	54

Figure 12. IOU Territories Served by Distributors and Contractors.....	56
Figure 13. Percent of End-Users by County.....	57
Figure 14. Water Heating Products Installed by Contractors Overall	59
Figure 15. Contractors Serving DACs or HTR Customers	64
Figure 16. Distributor Satisfaction with Program Components.....	65

Figure 17. Contractor Satisfaction with Program Overall	65
Figure 18. Contractor Satisfaction with Program Components	66
Figure 19. FR Stocking Score	80
Figure 20. FR Upselling Score	82
Figure 21. FR Price Score	84

I. EXECUTIVE SUMMARY

This report presents impact evaluation results for the Statewide Third-Party Midstream¹ Commercial Water Heating Program (SWWH), otherwise referred to as ‘the Program,’ for the program year 2022 (PY2022), conducted for the California Public Utilities Commission (CPUC). SoCalGas is the Program Administrator (PA) for the Program. DNV Energy Services USA Inc (hereafter referred to as ‘the implementer’) is the program implementer.

The Program offers water heating measures to the commercial sector, including multifamily properties. It works with midstream market actors (distributors and contractors) to offer point-of-sale (POS) rebates² to contractors serving customers in all four California Investor-Owned Utility (IOU) territories.³ All customers with a non-residential rate structure served by one of the four IOUs—SoCalGas, Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E)—are eligible for incentives.

The Program primarily incentivized gas-fired water heating equipment, including tankless water heaters (TWHs), domestic hot water (DHW) boilers, and storage water heaters (SWHs). In PY2022, the Program incentivized one fuel substitution heat pump water heater (HPWH).⁴ As presented in Table 1, by measure category⁵, TWHs accounted for the majority of therm savings (76%) and claims⁶ in the California Energy Data and Reporting System (CEDARS)⁷ reported savings database. Electric savings are negative for TWHs, DHW boilers, and SWHs because high-efficiency gas water heaters with power vents use an electric fan or blower, which increases electrical consumption. The single heat pump water heater was a fuel substitution measure, which also resulted in added electrical load.

Table 1. PY2022 CEDARS First-Year Reported Savings by Measure Category

Measure Category	Claims	First-Year Reported Gross Gas Savings (therms)	Percent of Program Therm Savings	First-Year Reported Gross Electricity Impacts (kWh)
Tankless Water Heaters	2,466	2,415,795	76%	-310,745
Domestic Hot Water Boilers	145	488,521	15%	-36,967
Storage Water Heaters	411	272,719	9%	-38,338
Heat Pump Water Heaters	1	603	0%	-4,570
Total	3,023	3,177,638	100%	-390,620

Table 2 shows the total savings reported in the CEDARS database for PY2022 by IOU.

¹ Midstream energy efficiency programs provide incentives and conduct outreach within the ‘middle’ of a given supply chain by targeting, distributors, and/or contractors.

² Instant point of sale rebates are intended to contractors to purchase energy efficient equipment by lowering the costs of the equipment through an instant discount – in the case of the Statewide Midstream Water Heating Program, the incentives were passed from the contractor to the end-user.

³ “Implementation Plan for Statewide Midstream Water Heating.” Version 4. March 2021.

⁴ These energy efficient technologies are referred to as program “measures” throughout this report.

⁵ The measure category is a general term used to define the category of equipment based on the program tracking data “Product Type” value.

⁶ Claims, or claimed savings, are expected energy and demand savings associated with program measures submitted by each IOU on a quarterly basis.

⁷ California Energy Data and Reporting System (CEDARS) is a public database that includes program data on annual budget filings, quarterly savings claims, and monthly report summaries by the PAs.

Table 2. PY2022 CEDARS Reported Savings by IOU Service Territory

IOU	Claims	First Year kW		First Year kWh		Lifecycle Net kWh	First Year Therms		Lifecycle Net Therms
		Gross	Net	Gross	Net		Gross	Net	
PG&E	3,023	-21.25	-12.75	-173,435	-104,873	-2,026,100	1,601,530	961,039	18,805,398
SCE	3,023	-19.19	-11.51	-156,639	-94,716	-1,829,878	0	0	0
SoCalGas	3,023	0.00	0.00	0	0	0	1,328,253	797,053	15,596,541
SDG&E	3,023	-7.42	-4.45	-60,546	-36,611	-707,310	247,856	148,732	2,910,359
Total	12,092	-47.86	-28.71	-390,620	-236,200	-4,563,288	3,177,638	1,906,824	37,312,298

According to program tracking data provided by the implementation team⁸, the Program served 1,074 unique commercial customers by address in PY2022. The majority of commercial customers received a TWH (70%), followed by SWH (25%) as shown in Table 3.

Table 3. PY2022 Implementer Data Total Measures Installed and End-Users Served

Measure Category	Fuel Type	Total Units	Unique End-User Addresses Served	Percent of End-User Addresses Served
Tankless Water Heaters	Gas	2,390	750	70%
Storage Water Heaters	Gas	449	267	25%
Domestic Hot Water Boilers	Gas	128	70	7%
Heat Pump Water Heaters	Electric	1	1	0.1%
Total	N/A	2,968	1,074	N/A

I.I STUDY APPROACH

Overall, the research objectives of this evaluation were to:

- Estimate the gross⁹ and net¹⁰ energy and demand impacts;
- Understand the effectiveness of innovative implementation processes¹¹ for the midstream distribution model; and
- Understand the types of end-use customers served.

To evaluate the above research objectives, we conducted several evaluation activities, including:

⁸ The evaluation team was unable to replicate the total number of units in the CEDARs database. This table shows the total number of units installed at end-user commercial customer addresses according to the implementer's database. More information about this difference is provided in the rest of the Executive Summary and the report.

⁹ Gross savings measures changes in energy consumption that result directly from program-related actions taken by participants of an energy efficiency program, regardless of why they participated.

¹⁰ Net savings are changes in energy use that are attributable to a particular energy efficiency program and take into consideration savings from participants who would not have purchased energy efficient technologies without the influence of the program. Savings attributable to participants who would have purchased energy efficient technologies with or without the program influence are excluded from net savings. These participants who were not influenced by the program are considered free riders.

¹¹ The original rationale for the IOU PA portfolio requirement for third-party EE programs was to encourage innovation and achieve more cost-effective energy savings. More information on SWWH-specific innovation strategies is provided in the Program Implementation Plan (PIP)

Gross Savings Analysis: We evaluated the therm, kWh, and kW impacts of the Program through measure package¹² validation of a sample of PY2022 projects.¹³ Specifically, we reviewed CEDARS and the program implementer’s tracking data, designed and selected a sample of projects for desk reviews¹⁴, conducted desk reviews for all sample projects, calculated project-level evaluated results and realization rates, and estimated program-level results by applying realization rates to CEDARS claims. We discuss each of these in further detail below.

- **Database Review:** We reviewed both the implementer’s detailed tracking data and CEDARS data to determine the types of measures incentivized and the total savings each measure category represents. We discovered discrepancies in the number of measures and total savings compared to CEDARS data. We found that the PAs program data used the most applicable eTRM¹⁵ measure packages to upload the tracking data into CEDARS, but the final implementer tracking data relied on incorrect measure packages. The reported CEDARS data show 8% higher overall claimed savings, with the largest discrepancy among the DHW boiler measures, which show 102% higher reported savings in the CEDARS database than the implementer’s database. This discrepancy is primarily due to eTRM measure package revisions that occurred in 2022 and appear to have not been applied by the implementer, even though the effective versions were available and active for PY2022. A comparison of the implementer’s final tracking data and CEDARS-reported savings by offering category¹⁶ is provided in Table 4.

Table 4. CEDARS vs. Implementer Total Program Impacts by Measure Category

Offering Category	CEDARS Reported Gross Impacts (therms)	Implementer Final Gross Impacts (therms)	Therms Percent Difference (CEDARS / Implementer)
Small Instant TWH	1,871,344	1,799,340	4%
Large Instant TWH	544,451	581,178	-6%
Large DHW Boiler	488,521	242,180	102%
Large Storage WH	272,719	324,481	-16%
HPWH	603	603	0%
Total	3,177,638	2,947,782	8%

- **Sample Design:** Our sampling strategy aimed for 90% confidence and 10% precision in therm savings at the program level. The sample was stratified by offering category. We defined the sample unit as a unique combination of end-user addresses and offering category (i.e., a “project”). The 65-point sample quota was distributed at the offering category level to ensure a balanced representation across categories, except for the single fuel substitution project. Final total therm savings for the implementer’s tracking data and quotas used for the desk review sample are presented by offering category in Table 5.

¹² The “measure package” (formally referred to as “workpaper”) is the energy efficiency measure documentation that is needed to make a deemed energy efficiency claim. See CPUC Resolution E-5152 (August 5, 2021) for additional details.

¹³ For sampling purposes, program claims were grouped by end-user address and offering category combinations. A unique end-user address and offering category combinations are referred to as “projects” throughout the report.

¹⁴ A desk review involves reviewing project documentation, program tracking data, site pictures, and third-party verification, such as contacting the end-user.

¹⁵ The California electronic Technical Reference Manual (eTRM) is an online application that serves as the repository for all statewide deemed measures for California.

¹⁶ Offering category is a dimension we created that separates each measure category into eTRM size offerings, as size is a primary driver of eTRM inputs for a given measure category. For example, the tankless water heater measure package has two heating capacity size groups (<200 kBtuh and ≥ 200 kBtuh), which we labeled small and large, respectively.

Table 5. Implementer Final Gross Savings and Desk Review Sample Quotas

Offering Category	Implementer Final Gross Savings (therms)	Percent of Program Therm Savings	Desk Review Sample Quotas	Total Number of Sample Units
Small Instant TWH	1,799,340	61%	15	820
Large Instant TWH	581,178	20%	25	250
Large DHW Boiler	242,180	8%	15	83
Large Storage WH	324,481	11%	10	312
Total	2,947,782	100%	65	1,465

Note: The single fuel substitution HPWH project was not evaluated, and savings were passed through.

- Engineering Desk Review:** We performed engineering desk reviews for the sampled projects, including reviewing and updating key data parameters such as business types and construction status, validating the accuracy of the Air Conditioning, Heating, and Refrigeration Institute reference number (AHRI)¹⁷ and alignment with eTRM measure packages. Based on the updated parameters and measure packages, we then calculated revised project-level savings.
 - We were unable to reproduce the claimed savings values in the program tracking data using the measure package versions effective for 2022. Through conversations with the PA, Database for Energy Efficient Resources (DEER) staff¹⁸, and eTRM support staff, we found that some packages underwent a significant number of revisions during 2022, resulting in discrepancies in the application of eTRM measure packages between the implementer’s tracking data and CEDARS data. Therefore, while the implementer’s tracking data relied, in part, on out-of-date measure packages, CEDARS data did not. To address this issue, we utilized the implementer’s tracking data parameters but implemented the eTRM measure packages that are effective for 2022 to calculate “revised final” savings to serve as the basis of the desk review gross realization rates (GRRs)¹⁹. Since our evaluated savings estimates used this same set of eTRM measure packages as the basis, the revised final savings and CEDARS savings were now consistent. This step was necessary to avoid double penalizing program savings for misaligned measure package assignments discovered in the implementer’s final program tracking data but not in CEDARS.
- Population-Level Gross Savings:** We then extrapolated the findings of the desk reviews to the entire program population within an offering category. The final GRRs for each Offering Category are multiplied by the total claimed savings for each offering category from CEDARS to calculate evaluated savings.

Net Savings Approach: We estimated Program free ridership (FR)²⁰ by assessing the Program’s influence on efficient water heating sales through three pathways: distributor stocking practices, distributor upselling, and equipment price.²¹ We gathered data from distributor interviews to assess the Program’s effect on their stocking and upselling. Questions focused on the influence of the Program on distributors’ stocking practices, their ability to upsell high-efficiency water heating equipment to contractors, and the impact of the instant incentive on sales. Then, we conducted a contractor survey to evaluate the overall impact of these changes on market outcomes. The contractor survey asked questions related to the impact of distributor stocking on the contractor’s decision-making, the influence of the instant incentive

¹⁷ The AHRI directory is the primary source of certified equipment and provides certified rated efficiency and heating capacity values. Heating capacity and efficiency values are essential for aligning evaluated equipment with the correct eTRM measure package.

¹⁸ DEER ex-ante review staff support the review and development of eTRM measure packages and all the associated systems.

¹⁹ Refers to the ratio of evaluated savings over the original claimed savings without any adjustments for program influence.

²⁰ Program participants who would have installed the program measure or equipment in the absence of the program. A free ridership score can vary from zero to one, where a score of zero indicates complete influence by the program and a score of one indicates that the individual was not at all influenced by the program.

²¹ Appendix E contains Additional information regarding the NTG methodology used, including process models and questions.

on the contractor's overall sales, and the influence of the distributor upselling on the contractor's purchase of program-eligible equipment. This approach recognizes that distributors and contractors are key intervention points in the Program, as per the program theory logic model (PTLM). This approach does not depend on end-user feedback since the program aims to impact overall market dynamics through Midstream intervention rather than focusing on individual installations directly. We derived FR scores for each pathway (stocking, upselling, and price) from distributor and contractor responses. Then we weighted them based on the savings associated with each distributor and contractor, respectively. The final distributor attribution score within each pathway represents the Program's impact on distributor practices within that pathway. The final contractor attribution score within each pathway represents the distributor's impact on contractor sales of program-qualified equipment. Overall Program FR is calculated as the minimum FR across the three pathways. The results of the FR analysis were used to calculate the net savings for the Program.

Distributor Interviews: We conducted in-depth interviews with 17 out of 46 distributors active in PY2022, representing 57% of gross program savings. Our interview process aimed to reach the distributors that represented the highest gross savings according to program tracking data while also randomly selecting a subset of distributors that account for smaller shares of savings to ensure a well-rounded and representative sample of responses. Beyond the FR research objectives stated above, these interviews sought to understand the distributor's perception of the Program, gauge their satisfaction with the Program (including program training and processes), and identify challenges and opportunities, particularly related to Program innovations. We also explored the effectiveness of implementer innovation tactics such as the data submission portal and one-on-one distributor support.

Contractor Survey: We fielded a web survey with contractors who purchased at least one incentivized piece of water heating equipment through a participating distributor. The survey achieved a 7.3% response rate from a sample of 524 unique contractor contacts. Contractor responses represented 32% of gross program savings. Beyond the FR research objectives stated above, we explored contractors' perceptions of the Program, including satisfaction with Program training, processes, data collection, and challenges and opportunities, particularly related to Program innovations. We also sought to understand contractor's perceptions of high-efficiency all-electric water heating equipment in the commercial market.

Participation Analysis: We analyzed the Program records to characterize the participation of hard-to-reach (HTR)²² customers and customers in disadvantaged communities (DACs)²³ by examining the demographic distribution of participants, including their geographic region, business size, and the CalEnviroScreen²⁴ score of the area where their business was located. Secondly, we assessed the number of HTR customers and measures installed in DACs.

1.2 RESULTS

GROSS SAVINGS RESULTS

The program-level GRRs are 79.2% for gas and 86.3% for electricity. Small Instant TWHs accounted for the majority of therm savings and were the most affected (64% GRR) by changes to the evaluation measure package, which eliminated the storage water heater baseline assumption and applied multifamily-specific measure packages instead of commercial measure packages. For electric savings, the Large DHW Boiler had the most significant difference (9%

²² Hard to reach (HTR): The criteria for commercial HTR end-users are defined by a combination of a geographic requirements plus at least one of the following criteria: primary language of customer(s) is not English, business size, or leased or rented facility.

²³ Disadvantaged Communities (DAC) are areas in California with customers or end-users who experience a combination of economic, health, and environmental burdens. More details can be found here: [Disadvantaged Communities](#)

²⁴ California Environmental Protection Agency (CalEPA). SB 535 Disadvantaged Communities.

<https://oehha.ca.gov/calenviroscreen/sb535>

GRR), primarily due to the update to multifamily-specific measure packages that have zero kWh impacts. Table 6 shows the GRR and evaluated savings by offering category and for the Program overall.

Table 6. Desk Review Sample Offering Category and Program-Level Gross Realization Rates

Offering Category	Desk Review Therms Gross Realization Rates (GRR)	CEDARS First Year Total Therms	Evaluated Therms	Desk Review kWh Gross Realization Rates (GRR)	CEDARS First Year Total kWh	Evaluated kWh
Small Instant TWH	64%	1,871,344	1,205,781	93%	-240,346	-224,416
Large Instant TWH	103%	544,451	558,971	99%	-70,400	-69,533
Large DHW Boiler	94%	488,521	457,606	9%	-36,967	-3,444
Large Storage WH	107%	272,719	292,438	99%	-38,338	-37,825
HPWH	100%	603	603	100%	-4,570	-4,570
Program Totals		3,177,638	2,515,399		-390,620	-339,788
Gross Realization Rates			79.2%			87.0%

Note: The single HPWH project was not evaluated, and savings were passed through.

NET SAVINGS RESULTS

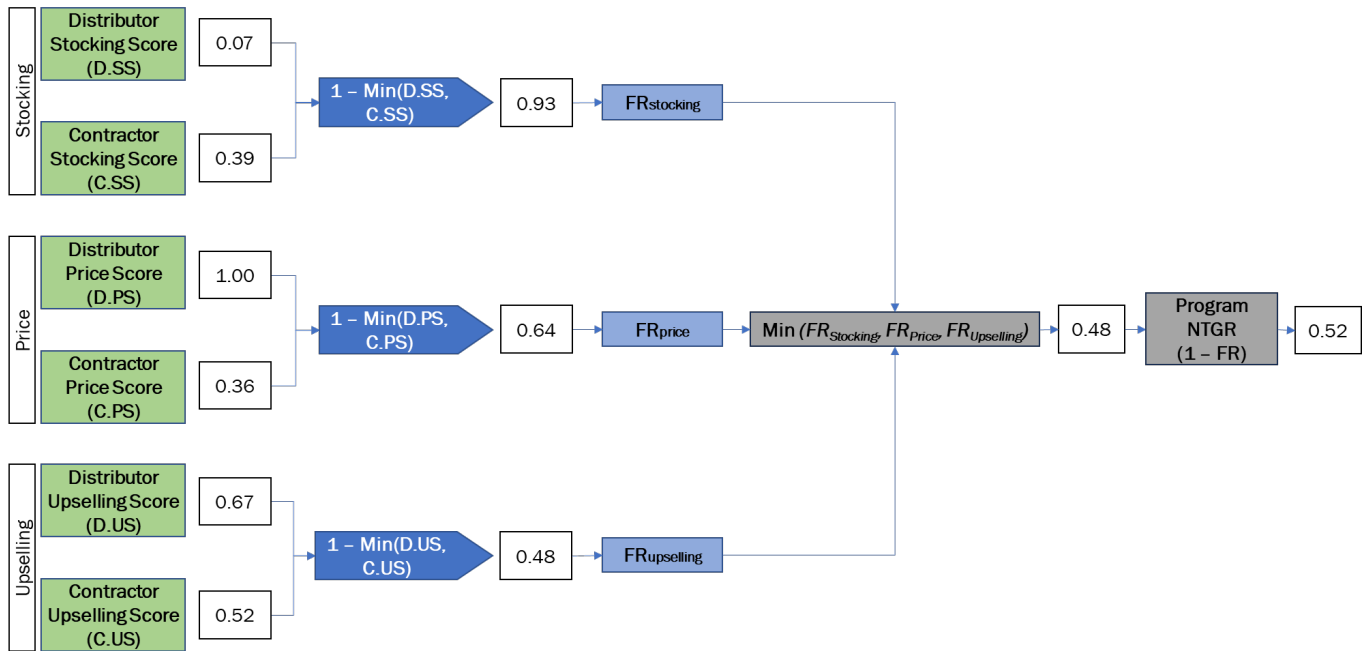
We investigated three pathways of influence, including distributor stocking practices, distributor upselling, and equipment price on participating distributors and contractors, resulting in six scores. We calculate the Pathway FR Score as one minus the minimum of the distributor and contractor Attribution Scores²⁵. The overall Program FR is calculated as the minimum Pathway FR Score. Please refer to Section 5 for more details on the FR methodology.

A free ridership score can vary from zero to one, where a score of zero indicates complete influence by the program, and a score of one indicates that the individual was not at all influenced by the program. Among the different Pathway FR Scores, the upselling pathway had the lowest FR rate of 0.48, much lower than the price pathway (0.64) or the stocking pathway (0.93). The Program seems to have moderately influenced distributor upselling practices, and distributor upselling, in turn, moderately impacted contractor decision-making. On the other hand, in the stocking pathway, the Program has a minimal impact on distributor stocking practices and stocking practices were shown to have a limited impact on contractor purchasing decisions. Distributors are automatically assigned an attribution score of 1.0 within the price pathway because the program provides an instant incentive that is passed through to contractors, but the price seems to have a limited impact on contractor purchasing decisions. All distributors mentioned that the SWWH Program helps them increase sales of high-efficiency equipment, giving them a competitive advantage. We estimated the Program's FR to be 0.48, resulting in a net-to-gross ratio (NTGR) of 0.52.²⁶ As a point of comparison, the eTRM assumes a 0.60 NTG ratio for all measure packages included in this evaluation. Figure 1 provides an overview of the scores of each stakeholder for each pathway and the overall FR and NTG results.

²⁵ Attribution is a calculated value indicating the extent to which a participant's actions can be ascribed to the influence of a program (i.e. to program marketing, education, or rebates). An attribution score can vary from zero to one, where a score of zero indicates no program influence and a score of one indicates complete program influence.

²⁶ The net-to-gross ratio (NTGR) is calculated as 1 minus free ridership score. Gross savings are multiplied by the NTGR to arrive at net savings.

Figure 1. Net to Gross Results



We applied the Program NTGR to the evaluated first year gross savings to develop the evaluated first year net savings. The evaluated net savings were then divided by the reported net savings to calculate the net realization rate, as shown in Table 7.

Table 7. Program-Level Reported and Evaluated

Fuel Type	Reported First Year Gross Savings	Evaluated First Year Gross Savings	Gross Realization Rate (GRR)	Reported First Year Net Savings	Evaluated First Year Net Savings	Net Realization Rate
Gas (therms)	3,177,638	2,515,399	79.2%	1,906,824	1,305,402	68.5%
Electricity (kWh)	-390,620	-339,788	86.4%	-236,200	-176,338	74.7%

Note: The single fuel substitution HPWH project was not evaluated and savings were passed-through.

COST EFFECTIVENESS AND TOTAL SYSTEM BENEFITS

The evaluation team calculated the Program's cost effectiveness and calculated Total System Benefits (TSB)²⁷ based on the evaluated GRRs and NTGR, using the Cost Effectiveness Tool (CET) available on the CEDARS website. Table 38

²⁷ TSB represents the combined lifecycle energy, capacity, and greenhouse gas benefits of an energy efficiency program, represented in a dollar value.

below shows the claimed and evaluated Total Resource Cost (TRC)²⁸ ratios, Program Administrator Cost (PAC)²⁹ ratios, and TSB for the PY2022 SWWH Program.

Table 8. Cost Effectiveness and TSB Results

Component	Claimed	Evaluated
TRC Ratio	2.77	1.96
PAC Ratio	3.44	2.39
TSB	\$32,885,759	\$22,786,010

DISTRIBUTOR AND CONTRACTOR FEEDBACK

The Program's one-on-one support was highly valued by distributors and instrumental in their successful participation and overall satisfaction. The majority of distributors (13 out of 15) reported receiving personalized assistance from the implementation team, which they found crucial for navigating the Program. Distributors also expressed high overall satisfaction with the types of equipment listed in the qualified product list (QPL), coordination with the implementation team, and their participation.

Despite initial difficulties, most distributors found the data submission portal user-friendly and effective once they understood its logistics. Almost all distributors (13 of 15) initially faced issues using the portal such as submission issues and navigating the portal, but the implementer successfully resolved all of these issues except one. The remaining distributor mentioned that while their issue with the portal was not resolved, the implementer has assisted them in submitting their applications. Distributors appreciated features like automatic verification of customer zip codes and water heater equipment eligibility for incentives. However, two distributors reported some discrepancies in incentive amounts and product listings, causing concerns about accuracy and potential undercharging. Specifically, depending on the type of project, these distributors reported that the downloadable Excel spreadsheet was straightforward, whereas the portal sometimes had the same product listed twice, with two different rebates.

Contractors generally felt that eligibility requirements were clearly explained, but most distributors encountered difficulties with the contractor's end-user data collection. Distributors reported that some contractors were initially reluctant to provide end-user information but became cooperative once they understood the incentive was tied to data completeness. To address these challenges, some distributors had to re-contact contractors to fill in incomplete information and found that providing checklists helped clarify data collection needs for contractors. While two-thirds of responding contractors found end-user data collection somewhat or very easy, one-third found it somewhat or very hard, suggesting a need for improved communication and streamlined processes.

Despite efforts to innovate through an online coupon tool for purchasing program-eligible equipment from big box stores, the majority of contractors were unaware of the tool and did not utilize it. About a fifth of contractors reported shopping at big box stores for commercial equipment in 2022, indicating potential demand for such purchasing avenues. However, only 13% of the contractors surveyed were aware of the online coupon tool provided by the Program, and none of them reported using it.

The Program is easier to participate in than other incentive programs, according to most distributors. Additionally, most distributors did not notice a difference in implementation between service territories. Distributors found that

²⁸ The TRC test measures the cost effectiveness of a program, including both the participants' and the utility's costs. A TRC value of one or higher indicates the program was cost effective as evaluated under the TRC.

²⁹ The PAC test measures the cost effectiveness of a program, including only the utility's costs. A PAC value of one or higher indicates the program was cost effective as evaluated under the PAC.

reimbursement requests were processed in a timely manner, with five receiving reimbursements in only one week. Although some experienced delays of up to a month, 13 of 15 distributors reported no issues with the reimbursement process. Seven of eight distributors selling equipment in multiple IOU service territories mentioned consistent project approval times, with only slight delays in PG&E's service territory. Most distributors highlighted the Program's user-friendly data submission portal, broader qualified product list (QPL), and better incentives compared to other programs they had participated in.³⁰

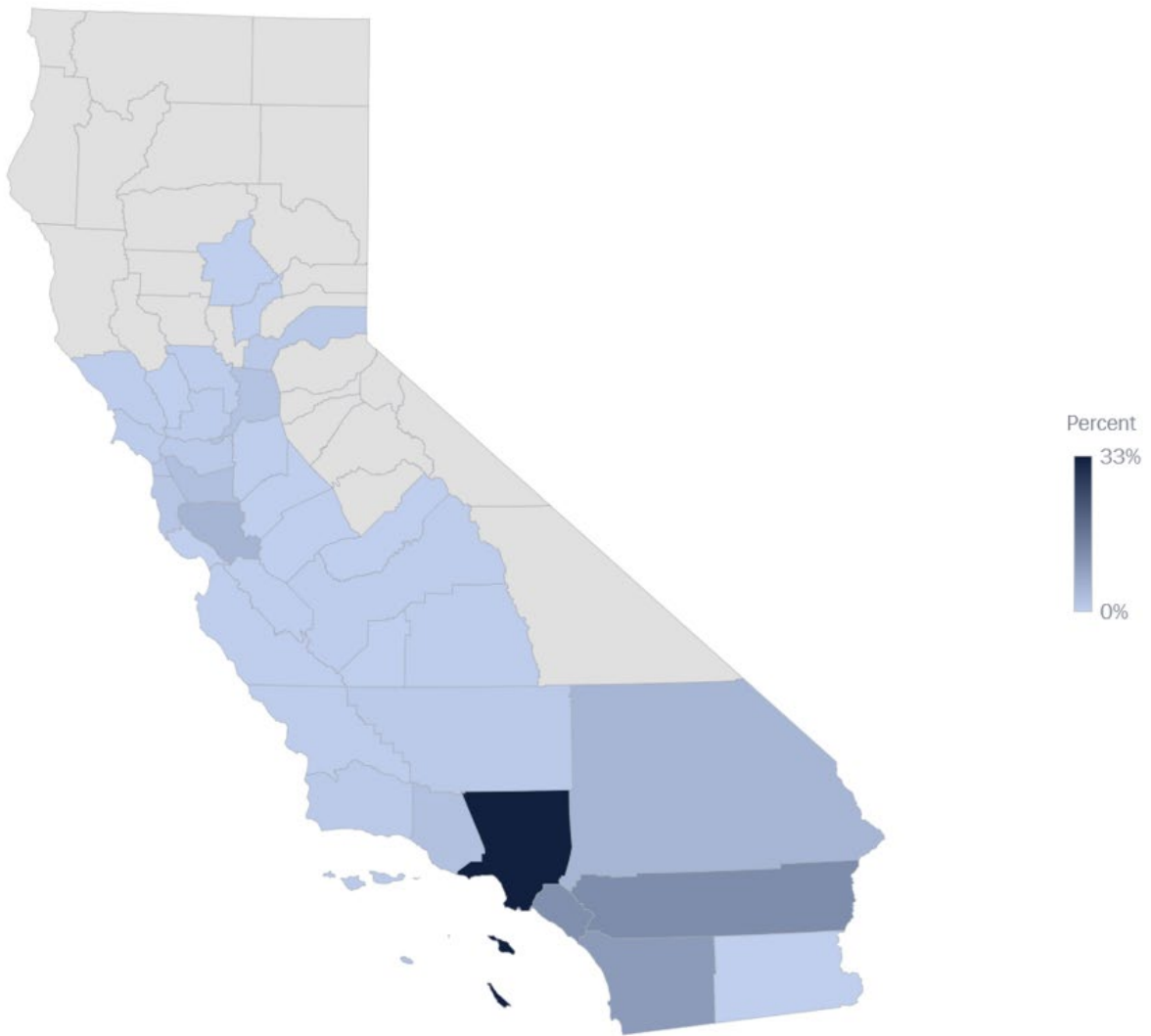
Distributors primarily stock and sell gas equipment, with approximately 80% of commercial sales comprising gas equipment, contributing to the limited adoption of electric HPWHs. Labor costs, panel upgrades, and fuel switching were identified as primary barriers to HPWH installation in commercial applications, highlighting financial and technical challenges. Additional barriers include low customer awareness and contractors' lack of knowledge and experience in HPWH installation and maintenance, further hindering adoption efforts. To help increase HPWH sales, responding contractors suggested increasing marketing, education, and outreach (ME&O) and training activities to increase contractor and end-user customer awareness. Contractors also felt that increased equipment rebates or incentives would help increase HPWH sales. Other suggestions include streamlining program participation processes, improving the equipment or technology, and decreasing electric costs.

Participating distributors and contractors are primarily located in Southern California, and correspondingly, the majority of commercial customers are also located in Southern California. Most participating businesses were located in Southern California counties, as shown in Figure 2. This is unsurprising given that the legacy program was in a Southern California IOU and the Program recently transitioned to Statewide implementation in 2021. The PIP³¹ also states that one of the implementer's tactics to grow the distributor network was to prioritize distributors that were enrolled in SoCalGas' legacy program to build legitimacy among the distributor community. By fostering trust within these networks, the Program anticipates leveraging that momentum to attract more distributors. Establishing a distributor network is a process that requires time but given the progress that the implementation team made in 2022 to serve Northern California counties, we anticipate participation to expand across California in the forthcoming implementation years.

³⁰ A qualified products list (QPL) is a list of equipment that is eligible for incentives through the Program.

³¹ SoCalGas. "Implementation Plan for Statewide Midstream Water Heating." Version 4. March 2021.

Figure 2. Percent of End-Users by County



1.3 KEY FINDINGS & RECOMMENDATIONS

Key Finding	Recipient	Recommendation
Impact-Related Findings		
Final savings in the program implementer’s tracking data did not align with the eTRM measure package versions effective for PY2022 for large tankless water heaters (TWH) and commercial domestic hot water (DHW) boilers. The program tracking data only indicates the basic measure and offering ID (e.g., SWWH005E, SWWH006C)	Implementer	<ul style="list-style-type: none"> Implement QA/QC procedures to ensure final implementer savings use eTRM measure package versions effective for the program year. In the program tracking data, clearly indicate the version of the eTRM measure package used to develop savings. If possible, also include the actual eTRM permutation file used.
Almost a third of the PY2022 therm savings come from claims using a “Com” building type, and most “Com” projects in the desk review sample were	Implementer	<ul style="list-style-type: none"> If residential multifamily applications continue to be valid for this program, use multifamily-specific eTRM measure packages and

Key Finding	Recipient	Recommendation
<p>multifamily sites. For water heating equipment installed in multifamily buildings, the Program used commercial eTRM measures and the “Com” (commercial sector average) building type instead of a multifamily building type. Another minor issue that was documented in the desk review process was the mischaracterization of building types, such as a nursing home that was mischaracterized as a restaurant (8 of 75 claims).</p>		<p>permutations to develop reported savings instead of the commercial measure packages, which do not include a multifamily building type.</p> <ul style="list-style-type: none"> Quality assurance processes should be reviewed or established to validate the building type assigned to end-users.
<p>The SWWH Program used the eTRM TWH measure package, which assumes a SWH baseline. However, this assumption does not make sense for newly constructed buildings and is also not applicable if the incentivized TWH is replacing an existing, failed TWH or boiler. Six completed end-user surveys to investigate this issue found that only half of the projects replaced an SWH.</p>	Implementer	<ul style="list-style-type: none"> Conduct a more robust baseline study to determine the mixture of SWHs and TWHs replaced by incentivized TWHs in existing buildings. For TWHs installed in new construction buildings or replacing existing TWHs, apply the small/medium (<200 kBtuh) commercial boiler measure package (SWWH005), which uses code-minimum efficiency equipment as the baseline. Do not use the commercial TWH measure package (SWWH006) for midstream programs since the SWH baseline cannot be validated. The program implementation team should use a code-minimum TWH as the baseline.
<p>The evaluation team was unable to match up the records in the implementer’s program tracking data with the records in the CEDARS database. The evaluation team was unable to recreate the savings in the CEDARS database, in part, because of its complex nature. The database records four entries (one for each IOU) for each record in the implementer data. Further, the PA did not rely on implementer final savings for CEDARS claims, but calculated final savings claims based on a subset of implementer tracking data.</p>	Implementer / PA	<ul style="list-style-type: none"> Provide a clear and transparent process to trace CEDARS data to the original savings record in the implementer’s program tracking data at a record level. The PA should fully document the process of translating final implementer data into reported CEDARS claims.
<p>A valid end-user address for the equipment installation was provided for almost all desk review sites and is fully populated in the program tracking data. End-user contact information (e.g., email and phone) was primarily populated with duplicated contractor information. Only about a third of the claims contained end-user contact information.</p>	Implementer	<ul style="list-style-type: none"> Business name and address are often sufficient to verify the business type and location of an end-user for an impact evaluation. However, verifying the replaced equipment, building information, and/or primary or secondary configurations often requires the input of the end-user or installing contractor. Therefore, the implementation team should improve the collection of end-user phone and email contact information to facilitate end-user research and evaluation.
<p>The implementer provided invoices for all sampled projects and included specific data requirements on invoices in addition to the typical items (i.e., equipment make, model, quantity, etc.) that greatly facilitated evaluability, including end-user address, serial numbers, program name, and incentive amount.</p>	Implementer	<ul style="list-style-type: none"> No Recommendation
<p>The implementer maintained a QPL from certified sources to validate equipment program eligibility, track key equipment performance characteristics (i.e., product type, heating capacity, and efficiency) and used these values to map to the correct eTRM</p>	Implementer	<ul style="list-style-type: none"> Consider making the QPL, including the eTRM measure package matching, an integral part of the program tracking data for future evaluations.

Key Finding	Recipient	Recommendation
Measure Package. The QPL accuracy was also verified for the desk review sample. The QPL with eTRM measure package mapping was integral to the savings development process.		
Process-Related Findings		
One-on-one support provided by the Program's implementation team was highly valued by distributors and instrumental in their successful participation.	Implementer	<ul style="list-style-type: none"> No Recommendation
While contractors generally found eligibility requirements clear, distributors faced challenges with contractor end-user data collection, with some contractors initially hesitant to provide information.	Implementer	<ul style="list-style-type: none"> Enhance communication and streamline processes between distributors and contractors to improve end-user data collection. Provide comprehensive training and resources to distributors to assist in training contractors to ensure they understand the importance of data completeness for program incentives. Provide contractors with standardized checklists and regular communication of Program protocols to facilitate efficient and accurate data collection processes.
The majority of contractors did not shop at big box stores or utilize the Program's online coupon tool, with only 13% aware of the tool and none using it to purchase program-eligible equipment.	Implementer	<ul style="list-style-type: none"> To increase the effectiveness and adoption of the online coupon tool, the Program implementer should enhance awareness and promotion of the tool among contractors. This could include targeted communication campaigns, training sessions on how to use the tool, and demonstrating the benefits and ease of purchasing equipment from big box stores using the coupons.
The Program is successfully working with participating distributors to incentivize efficient water heating equipment, but most participating businesses and contractors are concentrated in Southern California. The PIP highlights the implementer's strategy of prioritizing distributors from SoCalGas' legacy program to establish credibility, aiming to leverage this trust to attract additional distributors. Yet, given that the program launched in May of 2021 we would expect participation to be more dispersed across the state by 2022.	Implementer	<ul style="list-style-type: none"> The Program implementer should target outreach efforts and support to distributors and contractors in other parts of the state beyond southern California. This could include tailored marketing campaigns, incentives, and training programs to increase awareness and participation statewide.
Based on our desk reviews, the program likely incentivized some in-unit water heating measures, which would only be valid if the multifamily building in which they were installed is master metered. Further, the process of verifying the eligibility of multifamily installations was described as ad hoc in program staff interviews.	Implementer / PA	<ul style="list-style-type: none"> The Program administrator and implementer should formalize a process of verifying the eligibility of multifamily installations to ensure equipment is only installed on non-residential/commercial rate meters.
Distributors are largely satisfied with the comprehensiveness of the QPL, with no significant omissions reported. Over half of the distributors worked with the implementation team to add new products, finding the process relatively seamless.	Implementer	<ul style="list-style-type: none"> No Recommendation

2. GLOSSARY

- **Attribution Scores** – A calculated value indicating the extent to which a participant's actions can be attributed to the influence of a program (i.e. to program marketing, education, or rebates).
- **CalEnvironScreen** – CalEnvironScreen is an analytical tool created by the California Environmental Protection Agency (CalEPA) that combines different types of census tract-specific information into a score to determine which communities are the most burdened or “disadvantaged” (see disadvantaged communities definition).
- **California Energy Data and Reporting System (CEDARS)** – CEDARS is a public database that includes program data on annual budget filings, quarterly savings claims, and monthly report summaries by the Program Administrators (PAs).
- **Database for Energy Efficiency Resources (DEER)** – This database contains information on energy-efficient technologies and measures. DEER provides estimates of the energy savings potential for these technologies in residential and non-residential applications.
- **Desk Review** - A desk review involves reviewing project documentation, program tracking data, site pictures, and third-party verification, such as contacting the end-user.
- **Disadvantaged Communities (DAC)** – DACs are areas in California with customers or end-users who experience a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, the presence of hazardous wastes, and a high incidence of asthma and heart disease. DACs are tracked through the [CalEnvironScreen Map](#) (see definition).
- **Electronic Technical Reference Manual (eTRM)** – The eTRM is an online application that serves as the repository for all statewide deemed measures for California.
- **End-User** – A program participant who benefits directly from the energy efficiency program
- **Free Ridership (FR)** – Program participants who would have installed the program measure or equipment in the absence of the program. A score of 0 indicates heavy influence by the program, while a score of 1 indicates that the individual was a full free rider of the program.
- **Gross Realization Rate (GRR)** – Refers to the ratio of evaluated savings over the original claimed savings without any adjustments for program influence.
- **Gross Savings** – Gross savings measures changes in energy consumption that result directly from program-related actions taken by participants of an energy efficiency program, regardless of why they participated.
- **Hard-To-Reach (HTR)** – The criteria for commercial HTR end-users comprise a combination of geographic requirements plus at least one of the following criteria: primary language of customer(s) is not English, business size, or leased or rented facility.
- **Implementer** – A program implementer is a third-party entity contracted by a PA to design, implement, and deliver third-party programs.
- **Investor-Owned Utilities (IOU)** – A private company that provides a utility, such as water, natural gas, or electricity, to a specific service area. California IOUs are regulated by the CPUC.

- **Key Performance Indicators (KPI)** – A quantifiable measure of performance used to track progress toward goals and objectives.
- **Measure** – Energy-efficient technologies are often referred to as “measures” in evaluation reporting.
- **Measure Category** – The general category of equipment to which a specific piece of equipment belongs.
- **Measure Package** – The “measure package” (formally referred to as “workpaper”) is the energy efficiency measure documentation that is needed to make a deemed energy efficiency claim. See CPUC Resolution E-5152 (August 5, 2021) for additional details.
- **Metric million British thermal unit (MMBtu)** – A unit traditionally used to measure heat content or energy value. MMBtu is the common unit upon which sampling is based.
- **Midstream** – Midstream energy efficiency programs provide incentives and conduct outreach within the ‘middle’ of a given supply chain by targeting distributors and/or contractors.
- **Net Savings** – Net savings are changes in energy use that are attributable to a particular energy efficiency program and take into consideration savings from participants who would not have purchased energy-efficient technologies without the influence of the program. Savings attributable to participants who would have purchased energy-efficient technologies with or without the program influence are excluded from net savings. These participants who were not influenced by the program are considered free riders.
- **Net-To-Gross Ratio (NTGR)** – The NTGR is calculated as one minus free ridership score. Gross savings are multiplied by the NTGR to arrive at net savings.
- **New Construction (NC)** – The NC MAT is used where equipment is installed in either a new area or an area that has been subject to a major renovation to expand the capacity of existing systems or to serve a new load.
- **Normal Replacement (NR)** – The NR MAT is used where existing equipment (including Add-On Equipment) has either failed, no longer meets current or anticipated needs, or is planned to be replaced for reasons unrelated to the program. The NR MAT may be applied to any measure or program, with certain exceptions and without a burden of proof. This MAT includes measures that previously fit into the now-retired Replace on Burnout (ROB) MAT.
- **Personal Identifiable Information (PII)** – Any information that directly identifies an individual (e.g., name, address, social security number or other identifying number or code, telephone number, email address, etc.)
- **Point of Sale (POS)** – Instant point of sale rebates are intended to encourage contractors to purchase energy-efficient equipment by lowering the costs of the equipment through an instant discount. In the case of the Statewide Midstream Water Heating Program, the incentives were passed from the contractor to the end-user.
- **Program Administrator (PA)** – An entity tasked with the functions of portfolio management of energy efficiency programs and program choice (i.e., Marin Clean Energy [MCE], Pacific Gas & Electric [PG&E], Southern California Edison [SCE], Southern California Gas [SCG], San Diego Gas & Electric [SDG&E]).

- **Program Administrator Cost Test:** The PAC test measures the cost-effectiveness of a program, including only the utility's costs. A PAC value of one or higher indicates the program was cost effective as evaluated under the PAC.
- **Program Theory Logic Model (PTLM)** – A visual way to illustrate the resources or inputs required to implement a program, the activities and outputs of a program, and the desired program outcomes (short-term, mid-, and long-term).
- **Statewide** – Energy efficiency programs or activities that are essentially similar in design and available in all CPUC-regulated utility service areas in California, administered by a CPUC-specified PA.
- **Total Resource Cost (TRC)** – The TRC test measures the cost-effectiveness of a program, including both the participant's and the utility's costs. A TRC value of one or higher indicates the program was cost-effective as evaluated under the TRC.
- **Viable Electric Alternative (VEA)** – A process initiated by CPUC Decision D. 23-04-035 to establish a framework for “...reducing ratepayer-funded incentives for natural gas energy efficiency measures” that have a cost-effective electric alternative.

3. BACKGROUND

This report presents Opinion Dynamics' energy impact evaluation for the PY2022 SWWH Program completed on behalf of the CPUC. DNV-ES began implementing the Program in 2021. The focus of this study is the first full year of implementation, PY2022.

The SWWH Program offers deemed water heating measures to the commercial sector, including multifamily properties. It works with midstream market actors (distributors and contractors) to offer point-of-sale (POS) rebates to contractors serving customers across the combined California IOU service territories. All customers with a non-residential rate structure served by one of the four IOUs—SoCalGas, PG&E, SCE, and SDG&E—are eligible for incentives. The Program follows a statewide implementation model³² and a third-party (3P) model³³ introduced by CPUC decision 16-08-019.³⁴ The statewide implementation and 3P models dictate that the lead Program Administrator (PA), SoCalGas, works with the 3P program implementer, DNV-ES, to uniformly deliver the program statewide. The PIP provides further details on program design.³⁵

The Program offers deemed POS rebates to contractors that serve customers and incentives to midstream market actors, mostly distributors, to facilitate and influence sales of high-efficiency natural gas and electric water heating equipment. Additionally, the Program advocates for increased awareness and sales of high-efficiency equipment through various outreach, training, and advertising activities. Additional details and program materials can be found on the Program's website.³⁶

The program's overarching goals are to deliver significant energy savings to the California IOUs and foster sustained market adoption of high-efficiency equipment. In support of these goals, the Program has the following objectives:

1. Increase the available stock of high-efficiency equipment so that these models are available to customers for quick replacement situations.
2. Influence participants to integrate energy efficiency considerations into their sales processes and upsell high-efficiency equipment.
3. Influence other market actors (e.g., franchisors, manufacturer representatives, manufacturers, and design consultants) to integrate energy efficiency considerations into their equipment specification, sales, and promotional techniques.
4. Increase opportunities for customers to receive rebates on high-efficiency equipment.
5. Support market adoption of new, high-efficiency technologies.
6. Increase adoption of high-efficiency equipment among hard-to-reach (HTR) customers and those in disadvantaged communities (DACs).
7. Increase awareness of high-efficiency equipment options and benefits in the statewide midstream water heating market.

³² According to the CPUC Decision 16-08-019, "a program or subprogram that is designed to be delivered uniformly throughout the four large investor-owned utility service territories. Each statewide program and/or subprogram shall be consistent across territories and overseen by a single lead program administrator. One or more statewide implementers, under contract to the lead administrator, should design and deliver the program or subprogram."

³³ According to the CPUC Decision 16-08-019 "to be designated as a 'third party,' the program must be proposed, designed, implemented, and delivered by non-utility personnel under contract to a utility program administrator. Statewide programs may also be considered to be 'third party' to the extent they meet this definition."

³⁴ "Decision Providing Guidance for Initial Energy Efficiency Rolling Portfolio Business Plan Filings." August 2016.

³⁵ SoCalGas. "Implementation Plan for Statewide Midstream Water Heating." Version 4. March 2021.

³⁶ <https://www.statewide-waterheating.com/>

8. Influence equipment manufacturers to develop new high-efficiency models and technologies.

The PIP also provides a list of innovations³⁷ that the Program design incorporates:

- **Measure Workpaper Innovation:** The implementer, when appropriate, may draft measure packages with sponsorship from SoCalGas to develop new and innovative energy efficiency measures with highly credible savings values.
- **Enrollment Innovation:** The implementer understands the demands placed upon distributors and consistently works to find solutions and incentives to motivate them. An enrollment stipend and an annual performance stipend will financially motivate distributor participation. Distributor performance will be based on sales or kWh/therms.
- **Market Segment Innovation:** Midstream programs have often avoided participation from “big box” stores (e.g., Home Depot and Lowe’s) because they are unwilling to record customer information at the point of sale. The implementer will develop and apply an online coupon tool where approved contractors can generate mobile-friendly coupons to allow big box stores to participate in the midstream program without slowing their POS process.
- **Administrative Process Innovation:** The implementer uses a “Midstream Portal” to provide a more streamlined implementation process. The portal reduces the time it takes distributors to enter transactions and receive their payments, minimizes the risk of rejected transactions for distributors, and helps distributors connect with their market.
- **Data Analytics Innovation:** The implementer has developed a Program Data Dashboard to enable utilities and program managers to interact with data and create an intelligent methodology that deepens engagement with distributors, manufacturers, customers, and utility account managers. The dashboard presents near real-time information to SoCalGas managers and participating distributors in the field as well as historical information, performance snapshots, and program forecasting models. The implementer also provides monthly reports on the status of the program and how fieldwork impacts Program metrics.

D.18-01-004 required that third-party implementers design and implement at least 60% of the IOUs’ energy efficiency portfolio budgets by the end of 2022.³⁸ One of the primary reasons for shifting programs to 3P implementation was to encourage innovation. Given the importance of innovation in 3P implementation, program success with the above list and any other innovations were especially important considerations for our evaluation.

Quantitative program targets for electricity and gas savings from the PIP are presented in Table 9. The PY2022 goals are most relevant to this PY2022 evaluation. The SWWH Program was also estimated to achieve 40% electric savings in 2022³⁹; however, did not achieve this goal. Additional detail about program savings is provided throughout this report.

Table 9. Midstream Water Heating Program Quantitative Targets and Claims

Program Targets	2021 Target	2021 Claims	2022 Target	2022 Claims	2023 Target	Total Target
Gross Energy Savings (kWh)	3,052,621	-65,624	4,466,149	-390,620	5,594,047	13,112,817
Net Energy Savings (kWh)	1,864,367	-42,928	2,873,720	-236,200	3,599,650	8,337,737
Gross Energy Savings (therms)	2,124,703	451,172	2,552,848	3,177,638	3,192,068	7,869,618
Net Energy Savings (therms)	1,274,822	294,056	1,531,709	1,906,824	1,915,241	4,721,771
Gross Demand Reduction (kW)	3,053	0	4,055	-48	5,078	12,186

³⁷ The original rationale for the IOU PA portfolio requirement for third-party EE programs was to encourage innovation and achieve more cost-effective energy savings

³⁸ <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M205/K560/205560586.PDF>

³⁹ “Allocation Factors.” CEDARS. Accessed June 28, 2024. https://cedars.sound-data.com/programs/statewide/SW_MCWH/detail/.

Program Targets	2021 Target	2021 Claims	2022 Target	2022 Claims	2023 Target	Total Target
Net Demand Reduction (kW)	1,831	0	2,425	-29	3,037	7,293

Note: For PY2022, there was only one fuel substitution measure claim, and the rest were gas measures.

Source: "Group A, Evaluation, Measurement & Verification of Program Year 2021 Workplan – Final". DNV for CPUC. August 2022

3.1 PY2022 ALLOCATIONS BY PA

For statewide programs, the individual project claims from the implementer’s tracking system are split into four CEDARS sub-claims to allow for the assignment of savings across the participating IOUs. The program savings total is calculated by adding up the individual IOU values, except for the number of claims, which is the same for all IOUs and reflects the duplicate records. The electric, gas, and weighted cost allocation factors for each IOU are included in the program description summary on CEDARS. The weighted factor is used to allocate statewide cost and benefit fields (i.e., everything except electric and gas savings), which use the electric and gas factors. This approach ensures that all participating PAs have the same total resource cost (TRC) for each statewide program. Allocation factors by IOU are provided in Table 10. The resultant PY2022 gas and electricity energy impact claims for each of the four IOUs are provided in Table 54 in Appendix A.

Table 10. Statewide Program Energy and Weighted Cost-Benefit Allocation Factors

IOU	Electric	Gas	Weighted
PG&E	0.4400	0.5040	0.4800
SDG&E	0.1550	0.0780	0.1088
SCE	0.4010	0.0000	0.1604
SoCalGas	0.0000	0.4180	0.2508

Source: CPUC CEDARS Statewide program allocation factors.

3.2 PROGRAM MEASURES AND BUILDING TYPES

Analysis of program tracking data is essential for understanding the Program's performance, measuring uptake, and selecting a representative evaluation sample. A preliminary analysis of the PY2022 CEDARS claims was performed to map projects to measure categories created by Opinion Dynamics based on the measure description. Total gas and electricity energy impact claims by measure category are provided in Table 11.

Gas tankless water heaters account for the vast majority of program claims and therm savings. There was only one electric project, a single fuel substitution heat pump water heater, as indicated by the positive gas savings and increased electricity use (negative kWh). Note that the small increase in electricity consumption (negative savings values) for the tankless water heaters, DHW boilers, and storage water heaters is because high-efficiency gas water heaters with power vents use an electric fan or blower, which increases electrical consumption. The complete list of deemed measures and the number of claims for each measure are presented by Measure Category in Table 12.

Table 11. Total Statewide Program Savings by Measure Category

Measure Category	Number of Claims	First-Year Gross Therms	Percent of First-Year Therms	First-Year Gross kWh	First-Year Gross kW	Lifecycle Gross Therms	Lifecycle Gross kWh
Tankless Water Heater	2,466	2,415,795	76%	-310,745	-39.81	48,315,901	-6,214,908
DHW Boiler	145	488,521	15%	-36,967	-3.03	9,770,420	-739,331

Storage Water Heater	411	272,719	9%	-38,338	-5.01	4,090,790	-575,073
Heat Pump Water Heater	1	603	0%	-4,570	0.00	6,030	-45,700
Total	3,023	3,177,638	100%	-390,620	-47.86	62,183,141	-7,575,012

Note: For PY2022, there was only one fuel substitution measure. The rest were gas measures, and increased electric use is due to vent fans.

Source: CPUC CEDARS PY2022 data for Program ID="*_SW_MCWH" where * is IOU.

Table 12. Deemed Measure Claims by Measure Category

Measure Category	Claims	eTRM Source Description	Measure Description
Tankless Water Heater	2,104	SWWH006-06	Tankless Water Heater <200 kBtu/hr (Small / Medium), Tier 2 (>=0.87 UEF)
Tankless Water Heater	188	SWWH006-06	TanklessWaterHeaters-Large(>=200kBtuh)-Tier3(>=96%TE)
Tankless Water Heater	128	SWWH006-06	TanklessWaterHeaters-Large(>=200kBtuh)-Tier1(>=80%TE)
Tankless Water Heater	43	SWWH006-06	TanklessWaterHeaters-Large(>=200kBtuh)-Tier2(>=90%TE)
Tankless Water Heater	3	SWWH006-06	Tankless Water Heater <200 kBtu/hr (Small / Medium), Tier 1 (>=0.81 UEF)
DHW Boiler	69	SWWH005-04	CommercialBlr-DWH-Large(>=200kBtuh)-Tier1(>=84%TE or 0.86%CE)
DHW Boiler	58	SWWH005-04	CommercialBlr-DWH-Large(>=200kBtuh)-Tier3(>=96%TE)
DHW Boiler	18	SWWH005-04	CommercialBlr-DWH-Large(>=200kBtuh)-Tier2(>=90%TE or 0.92%CE)
Storage Water Heater	279	SWWH007-04	Storage Water Heater Large Tier 3 (>75 kBtuh and TE >=96%)
Storage Water Heater	132	SWWH007-04	Storage Water Heater Large Tier 2 (>75 kBtuh and TE >= 90%)
Heat Pump Water Heater	1	SWWH027-02	Heat Pump Water Heater: 80 Gal, UEF=3.42 replacing Gas Water Heater, 75 Gal, High Draw, UEF=0.59

Note: For PY2022, there was only one electric measure; the rest are conventional gas measures.

Source: CPUC CEDARS PY2022 data for Program ID="*_SW_MCWH" where * is IOU.

Our evaluation also included a review of the building types the Program served according to CEDARS. The total first-year therm savings by building type are presented in Table 13. The “building type” accounting for the largest percent of program savings is “Commercial,” which is not an explicit building type but represents a commercial sector average. Previous DEER decisions and evaluations of other programs have recommended using explicit building types by implementers instead of the sector-level value to improve realization rate and savings claims.

Table 13. Total First-Year Therm Savings and Claims by Building Type

Building Type	Total First-Year Gross Therms	Percent of Total Program Savings	Number of Claims	Cumulative Percent of Program Savings
Commercial	1,033,708	32.5%	1318	32.5%
Lodging - Hotel	777,463	24.5%	452	57.0%
Restaurant - Sit-Down	340,066	10.7%	395	67.7%
Office - Large	263,304	8.3%	94	76.0%
Health/Medical - Hospital	147,274	4.6%	35	80.6%
Restaurant - Fast-Food	125,048	3.9%	269	84.6%
Assembly	102,298	3.2%	60	87.8%

Building Type	Total First-Year Gross Therms	Percent of Total Program Savings	Number of Claims	Cumulative Percent of Program Savings
Education - University	86,503	2.7%	63	90.5%
Health/Medical - Nursing Home	67,934	2.1%	47	92.6%
Grocery	67,190	2.1%	56	94.7%
Education - Secondary School	34,506	1.1%	21	95.8%
Lodging - Motel	31,948	1.0%	47	96.8%
Manufacturing Light Industrial	18,285	0.6%	21	97.4%
Manufacturing Biotech	17,514	0.6%	18	98.0%
Hotel Guest Room	14,958	0.5%	7	98.4%
Retail - Multistory Large	11,461	0.4%	8	98.8%
Retail - Single-Story Large	10,772	0.3%	35	99.1%
University Dormitory	9,014	0.3%	6	99.4%
Retail - Small	7,130	0.2%	29	99.6%
Office - Small	4,476	0.1%	32	99.8%
Education - Primary School	3,158	0.1%	7	99.9%
Education - Community College	2,151	0.1%	2	100.0%
Warehouse - Refrigerated	1,476	0.0%	1	100.0%
Total	3,177,638	100%	3,023	N/A

Note: PY2022 is predominantly natural gas measures; therefore, only therm savings are presented.

Source: CPUC CEDARS PY2022 data for Program ID="*_SW_MCWH" where * is IOU.

4. EVALUATION OBJECTIVES

The objectives of the PY2022 SWWH Program evaluation broadly fall under either the energy impact evaluation or the participation, innovation, and fuel substitution assessment. The objective of energy impact evaluation is to verify reported gross and net energy savings derived from PY2022 program activity. The gross impact evaluation consisted of verifying the proper application of eTRM measure package savings values in the claims filed by the programs and the proper collection of end-user information. The evaluation team applied the eTRM measure package effective for PY2022. The evaluation also focused on estimating net-to-gross (NTG) and understanding attribution issues as this represented a significant and complex challenge for the midstream delivery channel.

The participation, innovation, and fuel substitution assessment had several objectives. One objective was to evaluate the effectiveness of the delivery model based on feedback from key program stakeholders. These efforts emphasized the program’s success in implementing the innovations highlighted in the PIP and stakeholder’s experience participating in the Program. The evaluation also examined the program’s success in recruiting participation from HTR customers and those in DACs and explored the program’s potential to increase the installation of electric fuel substitution equipment.

4.1 RESEARCH QUESTIONS

Overall, the research objectives of this evaluation were to:

- Estimate the gross and net energy and demand impacts;
- Understand the effectiveness of innovative implementation processes for the midstream distribution model; and
- Understand the types of end-use customers served.

Table 14 presents the evaluation research questions and a general description of the methods used to address each question.

Table 14. Research Questions for the SWWH Program Evaluation

Research Question	Evaluation Method
Energy Impact Evaluation	
What are the ex post gross savings for evaluated measures in the third-party statewide program?	Gross savings analysis involving a desk review of program savings assumptions, application of DEER values, and most recent measure packages
Did the Program initiate any new eTRM measure packages and/or changes to existing measure packages?	Interview program staff, IOU lead, and Cal TF/eTRM staff. Check eTRM and tracking data for new measures initiated by program staff.
What are the ex post net savings for evaluated measures in the third-party statewide programs? Additional emphasis on NTG for this complex program: How much free-ridership is occurring, and can it be adequately characterized? How much are customers (contractors, end-users) selling/buying more efficient units independently?	Surveys with distributors and contractors to determine the level of free-ridership among both groups.
How effectively does the PIP Program Theory Logic Model (PTLM) describe the influence it might have on all participant types? Can it be used to evaluate the net impacts of the Program?	Program Theory and Logic Model (PTLM) review and net savings methodology
What is the evaluability of the Program, especially concerning the program operations in place to verify measures are installed on-site and capture participant contact information (across	Program staff interviews, program data and material review, PTLM review and implementation process mapping

Research Question	Evaluation Method
distributors, contractors, and customers)? Was the Program able to collect end-user/customer contact information? This is a recurring issue for the evaluability of midstream programs.	
What is the Program's evaluated cost-effectiveness, and how does it compare to what was reported?	Cost-effectiveness and total system benefit analysis
Participation, Innovation and Fuel Substitution Assessment	
Where and who are the customers that the Program reached? To what extent did it serve HTR customers and DACs?	Program staff interviews, Program data and materials review, participation assessment
To what extent are contractors and distributors satisfied with the Program?	Contractor surveys and distributor in-depth interviews
Innovation is a primary reason for moving to third-party implementation, and the implementation plan has a long list of proposed innovations: Were the innovation ideas implemented, and if so, how effective were they?	Program staff interviews, program materials reviews, innovation review, distributor in-depth interviews, and contractor surveys
Explore the future role of this program within the context of CA's decarbonization goals and the phasing out of gas incentives, as only one fuel substitution project was claimed in PY2022.	Program staff and stakeholder interviews, program performance assessment

5. METHODS

This section details this study’s research tasks and methodologies. Initially, the evaluation team also planned on conducting end-user customer surveys; however, this was contingent on the availability and completeness of end-user customer contact information. Upon reviewing program tracking data, we determined that it was unfeasible to survey end-user customers at this time due to the lack of end-user contact data such as email addresses and phone numbers. However, the end-user customer address was completely populated, which was critical to our impact evaluation efforts.

5.1 PROGRAM STAFF AND STAKEHOLDER INTERVIEWS

We completed semi-structured in-depth interviews with the program management team involved in implementing the SWWH Program, including the lead PA, the implementation team, and the third-party verification team (EcoMetric). Given that the Program was newly transitioned to a Statewide 3P program in 2021, we focused on gathering information that could be used to help inform program implementation patterns in 2022 and beyond. We also collected feedback about the Program’s processes, challenges, successes, and opportunities for improvement. Additionally, we examined the Program’s overall strategies and tactics for targeting HTR customers and DACs, barriers to increasing electric measures such as heat pump water heater participation, progress towards meeting the data tracking requirements of Resolution E-5221 and previous resolutions, and the success of all targeted program innovations listed in the SWWH Program PIP.

In addition, we solicited input from working group members involved in the viable electric alternative (VEA) efforts on how this program will progress into the future, given its current focus on gas water heater savings and the statewide efforts to phase out gas incentives in favor of VEAs. We contacted CALTF/eTRM staff to review the eTRM and data tracking for any new measures implemented by program staff. We also determined if the Program had introduced any new eTRM measure packages or made changes to existing ones. The insights from this task were included in the evaluated gross savings analysis.

5.2 PROGRAM DATA AND MATERIALS REVIEW

We requested or otherwise accessed materials such as implementation plans, M&V plans, the Program web portals, training materials, program key performance indicators (KPIs), and other collateral or application materials developed for the Program. We also requested and reviewed program tracking data to help inform future evaluation activities. Data collection and validation are key components of any midstream program, and they are important to ensure the SWWH Program’s evaluability. Under this task, we also investigated the success of the administrative process and data analytics innovations.

After reviewing the program tracking data, we addressed the long-running California evaluation issue surrounding end-user-level tracking information and examined how the implementation team addressed the issue of verifying end-user installations. Reviewing program tracking data also informed the participation assessment by exploring the extent to which the Program serves equity customers, such as those considered HTR and businesses located in DACs, as defined by CALEnviro Scores. Table 15 outlines the data sources used to assess our research objectives.

Table 15. Summary of Data Sources

Data Sources	Description
Reported program data in CEDARs	CEDARs data for savings claims in PY2022, including personally identifiable information (PII)

Data Sources	Description
Program tracking data from the PA and Implementer	Program tracking data housed by PA(s) and Implementer
Quality assurance procedures and data collected by the Implementation team	Quality assurance procedures, scripts, and verification data
Program Materials	Implementation plans, PTLM, M&V plans, application documents, and implementation process flow documents
CalEnviroScreen	Measure of economic, health, and environmental burden
Web survey & structured depth interviews	Includes surveys and in-depth interviews with two levels of participants allowed by tracking data (i.e., distributors and contractors) ^a

^a At the time of the study, end-user customer data were very limited. Due to this, the evaluation team was unable to survey end-user customers as initially planned.

5.3 PROGRAM THEORY LOGIC MODEL REVIEW AND VERIFICATION PROCESS MAPPING

It was important to reexamine the broader policy and evaluation framework for midstream programs, especially regarding the calculation of net savings, given the recent transition to a statewide third-party program model. The broader goal of this exercise was to ensure alignment of the net savings approach with the PTLM for the SWWH Program.

Primarily, we reviewed the PTLM to identify where program influence is supposed to take place in the market. Based on the PTLM review, we documented if and how the Program influences three participation targets: distributors, contractors, and end-user customers. We worked closely with program staff to understand the core theory behind the Program, including the overall goals, key activities, outputs of activities (e.g., distributor partnerships), and intended outcomes (e.g., stocking and customer adoption of higher efficiency equipment). We then recommended a net savings approach that was rooted in the PTLM as a midstream program. This net savings approach is detailed in Appendix E.

Secondarily, this task involved creating a verification process map that clearly shows how the Program verifies measure installation at the end-user customer level, noting any differences by measure grouping (i.e., boiler systems versus tankless on-demand). The process map (Section 6.2) shows the steps involved in the entire participation process and the data collected at each step. It also reveals if and how the Program verifies whether a measure has been installed at a given end-user location.

5.4 NET SAVINGS METHODOLOGY

In coordination with the CPUC, we developed an approach to estimate free ridership (FR) for the Program based on the PTLM and rooted in program theory for midstream programs. This approach incorporates existing net-to-gross method protocols and precedents for similar programs within California and nationwide. Prior to implementing the FR research, we shared the methodological memorandum through the CPUC’s Public Document Area for public comment.⁴⁰ We received no comments on the methodology.

Opinion Dynamics estimated Program FR by assessing the Program’s influence on efficient water heating sales through three pathways: distributor stocking practices, distributor upselling, and equipment price. Within each pathway, we rely on distributor feedback to characterize the Program’s influence on their stocking, upselling, and pricing practices and,

⁴⁰ https://pda.energydataweb.com/api/view/3927/CPUC%20SWWH%20Program%20NTG%20Methodology%20Memo_DRAFT%202024-02-26_pda.pdf

in turn, depend on contractor feedback to characterize the ultimate impact of these stocking, upselling, and pricing changes on market outcomes. This methodology recognizes that (1) like other midstream programs, distributors and contractors are the primary points of intervention for the Program, and (2) the Program aims to influence installations through influence on market dynamics as opposed to individual installations directly. Whether end-users understand they have received an incentive is uncertain and ultimately unnecessary for the Program to effect lasting change in the dynamics of the California commercial water heating market. Appendix E details the net savings methodology.

The results of the FR analysis were used to calculate the post-implementation net savings for the Program.

5.5 DISTRIBUTOR INTERVIEWS

We conducted semi-structured, in-depth interviews with participating distributors to understand the SWWH Program’s impact on their stocking practices and sales. We used the interviews to develop FR estimates and gather additional context and support for the Program’s overall impact on participating distributor’s pricing, upselling, and stocking. We also collected feedback from the distributors regarding their perception of the Program, including their satisfaction with the program training and processes and the associated challenges and opportunities. Additionally, we gathered information on program innovations and the successes and challenges the Program faced during its transition to statewide administration and third-party implementation.

Our interview process aimed to reach the distributors representing the highest gross savings according to program tracking data while also randomly selecting a subset of distributors with lesser program participation to ensure a well-rounded and representative sample of responses. Responses to the NTG interview questions were weighted based on the relative contribution to gross program savings. We targeted interviews of 15 participating distributors out of a total population of 39 distributors. We used email and phone outreach to schedule interviews and offered an incentive of \$100 or a donation to a charity for successfully completing an interview. In total, we interviewed 17 distributors representing 15 unique distribution companies, as shown in Table 16.

Table 16. Distributor Interview Disposition & Savings Summary

Population		Interview Completes	
Number of Unique Distribution Companies ^a	Number of Unique Distribution Companies	Percent of Population (n=39)	Percent of Savings
39	15	38%	57%

^a The number of unique distributor companies was determined by unique company or branch. Large distributors with multiple branches were considered independent distributors.

5.6 CONTRACTOR SURVEY

We fielded a web survey from April 11 to May 5, 2024, with participating contractors to understand the impact of the instant incentive and distributor stocking and upselling practices on their sales of program-qualified equipment. Given the technical nature of the questions posed to contractors in the web survey, the evaluation team included several screening questions to ensure that the correct participant responded to the survey. Although only responses to key scoring questions identified in the algorithm detailed in Appendix E directly impact FR, we included consistency checks and open-ended questions to collect additional context and support for distributors’ general level of impact on a contractor’s sales. Results of individual FR assessments were weighted based on the relative contribution to the overall gross program savings. When a contractor’s responses were incongruent with FR scoring, we followed up with dedicated open-ended questions to help resolve the apparent inconsistencies. We also explored their perceptions of the Program, including satisfaction with program training, processes, data collection, and challenges and opportunities associated with the Program.

To maximize the number of survey completes, the evaluation team used a census approach through which we attempted to contact all participating contractors. Table 17 summarizes the population, sample, and the number of surveys completed. We utilized email outreach to encourage contractor participation in the survey and offered an incentive of \$50 for a successfully completed web survey. In addition to the email outreach and incentive, we also conducted outreach via phone to a portion of the unresponsive sample to remind them of the survey and offer to complete the survey with them over the phone. Appendix D, Table 58, summarizes the outcome of these outbound calls.

Table 17. Contractor Sample Summary

Population	Sample		Survey Completes		
Number of Contractors	Number of Contractors with Contact Information	Percent of Population (n=531)	Number of Contractors	Percent of Population (n=531)	Percent of Savings
531	524	99%	31	6%	32%

The Contractor Survey achieved a response rate of 7.3%.⁴¹ Appendix D details the response rate methodology as well as the disposition summaries for the Contractor Survey.

5.7 INNOVATION REVIEW

The transition of select California ratepayer-funded energy efficiency programs to a 3P model is postulated to facilitate program design and implementation innovation. The most recent SWWH program implementation plan provides four process-focused innovations, each addressed under this evaluation. Table 18 lists the innovation categories and identifies which evaluation activities contributed to their assessment. We drew from the evaluation task listed below to explore whether the innovation ideas were implemented and, if so, how effective they were.

Table 18. Process-Related Innovations

Innovation Category	Evaluation Task(s)
Enrollment Innovation	Program staff interviews; Distributor interviews
Market Segment Innovation	Program staff interviews; Distributor interviews; Contractor interviews
Administrative Process Innovation	Program staff interviews; Program Data and Materials Review; Distributor interviews
Data Analytics Innovation	Program staff interviews; Program Data and Materials Review

5.8 GROSS SAVINGS ESTIMATES

We evaluated the therm, kWh, and kW impacts of the Program through measure package validation of a sample of PY2022 projects.⁴² Specifically, we reviewed CEDARS and the program implementer’s tracking data, designed and selected a sample of projects for desk reviews, conducted desk reviews for all sample projects, calculated project-level evaluated results and gross realization rates, and estimated program-level results through the application of realization rates to CEDARS claims. We discuss each of these in further detail below.

⁴¹ Based on the American Association for Public Opinion Research (AAPOR) Response Rate 3 (RR3)

⁴² For sampling purposes, program claims were grouped by end-user address and offering category combinations. A unique end-user address and offering category combinations are referred to as “projects” throughout the report.

DATABASE REVIEW

We reviewed both the implementer’s tracking data and CEDARS data to determine the types of measures incentivized and the total savings represented by each measure category. In the CEDARS database, the official source of reported savings, each claim from the implementer is split into four claims—one for each IOU—and does not provide the PII and other project details needed for evaluation. CEDARS was used for the sample design, but the implementer’s program tracking data were used as the primary dataset for the desk review sample and impact evaluation.

After review, we discovered discrepancies in the number of measures and total savings between the implementer’s tracking data and the CEDARS data. We found that the implementer’s tracking data savings values were not used for the final claims submitted by the PA to CEDARS. The PA had instead used the eTRM measure packages that were effective for the 2022 program year to calculate the savings claims reported to CEDARS. This is discussed further throughout Section 6.1.

SAMPLE DESIGN

We reviewed program claims data from CEDARS and the implementer to develop the sample design. CEDARS was used for the sample design, but the implementer program tracking data were used as the primary dataset for the desk review sample and impact evaluation.

MEASURE AND OFFERING CATEGORY DEFINITIONS

The sample was stratified by offering category, a dimension we created that separates each measure category into eTRM size offerings. The measure category is the technology type, and the offering category is linked to a group of offering IDs within an eTRM measure package. For example, the tankless water heater measure (SWWH006) has two offering categories: (1) “Small Instant TWH” encompasses TWH Offering ID “B” which is used for equipment with a heating capacity <200 kBtu/h and (2) “Large Instant TWH” encompasses TWH Offering IDs C/D/F which is used for equipment with a heating capacity ≥ 200 kBtu/h.

Since the TWHs were the largest contributor to program savings, we wanted to ensure our desk review sample included projects in both size categories rather than relying on a random sample to capture some of each naturally. Because the program tracking data only showed one heating capacity range for DWH boilers and storage water heaters, no further classification was needed for those measures.

Measure and offering categories are summarized in Table 19.

Table 19. Measure/Offering Categories and eTRM Measure Package-Offering ID Summary

Measure Category	Statewide Measure ID	Offering Category	Offering ID	eTRM Measure Description
DHW Boiler	SWWH005	Large DHW Boiler	C	Large commercial boiler, HW, ≥ 200 kBtu/hr, 84% TE (tier 1)
			D	Large commercial boiler, HW, ≥ 200 kBtu/hr, 90% TE (tier 2)
			E	Large commercial boiler, HW, ≥ 200 kBtu/hr, 96% TE (tier 3)
Tankless Water Heater	SWWH006	Small Instant TWH	B	Small commercial inst. heater, < 200 kBtu/hr, 0.87 UEF (tier II)
		Large Instant TWH	C	Large commercial inst. heater, ≥ 200 kBtu/hr, 80% TE (tier I)
			D	Large commercial inst. heater, ≥ 200 kBtu/hr, 90% TE (tier II)
	F	Large commercial inst. heater, ≥ 200 kBtu/hr, 96% TE (tier III)		
Storage Water Heater	SWWH007	Large Storage WH	H	Commercial stor. heater, > 75 kBtu/hr, 0.90 TE
			I	Commercial stor. heater, > 75 kBtu/hr, 0.96 TE

Note: Only a single HPWH project was reported, so it is not presented in this table. The eTRM measure ID is SWWH027.

CEDARS PROGRAM TRACKING DATA REVIEW

The CEDARS program data, which was used for the desk review sample design, shows that the Program primarily incentivized gas-fired water heating equipment, including tankless water heaters, boilers, and storage water heaters. There was also a single fuel substitution heat pump water heater. Most claims are for tankless water heaters, which account for 76% of reported therms savings in CEDARS. DHW boilers and storage water heaters account for 15% and 9% of reported therms savings, respectively.

CEDARS PY2022 reported savings, and the number of claims is summarized in Table 20.

Table 20. Reported Savings Summary by Offering Category from CEDARS Program Data

Measure Category	Offering Category	Number of Claims	First-Year Gross Therms Impacts	Percent of Program Therm Impacts	Sum of claimed gross (kWh) Impacts	Percent of Program kWh Impacts
Tankless Water Heater	Small Instant TWH	2,107	1,871,344	59%	-240,346	64%
Tankless Water Heater	Large Instant TWH	359	544,451	17%	-70,400	19%
DHW Boiler	Large DHW Boiler	145	488,521	15%	-36,967	10%
Storage Water Heater	Large Storage WH	411	272,719	9%	-38,338	10%
Heat Pump Water Heater	HPWH	1	603	0%	-4,570	1%
	Total	3,023	3,177,638	100%	-390,620	100%

Note: Number of claims is the CEDARS value divided by four to account for multiple records of the same project, one for each IOU

We designed a stratified random desk review sampling scheme based on CEDARS-reported therm savings and targeted $\pm 10\%$ relative precision at 90% confidence at the program level. The desk review sample design relied on offering category as the only stratification dimension. The sample points were not allocated proportionally across offering categories to avoid having too many small tankless water heater projects but were allocated to ensure a robust sample of projects were reviewed for every offering category. The final sample design is presented in Table 21.

Table 21. Summary of Desk Review Sample Quotas

Measure Category	Offering Category	First-Year Gross Therms	Percent of Program Therm Impacts	Desk Review Sample Point Quotas	Percent of Desk Review Sample
Tankless Water Heater	Small Instant TWH	1,871,344	59%	15	23%
Tankless Water Heater	Large Instant TWH	544,451	17%	25	38%
DHW Boiler	Large DHW Boiler	488,521	15%	15	23%
Storage Water Heater	Large Storage WH	272,719	9%	10	15%
Heat Pump Water Heater	HPWH	603	0%	-	0%
Total		3,177,638	100%	65	100%

Note: Only a single HPWH project was reported. Savings were passed through for this project.

IMPLEMENTER PROGRAM TRACKING DATA REVIEW AND SAMPLE SELECTION

The desk review sample was drawn from the implementer’s program tracking data because it contains the project details, including customer addresses and contractor contact information, needed to conduct the evaluation. Total savings from the implementer’s program tracking data are presented in Table 22. Similar to the CEDARS data, tankless water heaters account for the majority of program therm savings (81%), with 61% attributed to small instant TWHs alone. While the implementer’s final savings are similar in total and distribution across measure categories to the CEDARS values in the previous Table 21, we would expect complete alignment.

Table 22. Final Savings Summary by Offering Category for Implementer Program Data

Measure Category	Offering Category	Number of Units	First Year Gross Therms Impacts	Percent of Program Therm Impacts	First-Year Gross kWh Impacts	Percent of Program kWh Impacts
Tankless Water Heater	Small Instant TWH	2,065	1,799,340	61%	-230,251	65%
Tankless Water Heater	Large Instant TWH	325	581,178	20%	-47,145	13%
DHW Boiler	Large DHW Boiler	128	242,180	8%	-27,261	8%
Storage Water Heater	Large Storage WH	449	324,481	11%	-45,158	13%
Heat Pump Water Heater	HPWH	1	603	0%	-4,570	1%
Total		2,968	2,947,782	100%	-354,385	100%

Note: Only a single HPWH project was served. Savings were passed through for this project.

We sampled 65 projects overall, distributed across four offering categories. We defined the sample point unit as a unique combination of offering category and end-user address. Sample points have multiple records or “claims” when there are multiple water heating equipment model numbers on a single invoice or multiple invoices for a single end-user address. Total offering category savings from the implementer’s tracking data are also provided in this table for reference.

A summary of the desk review sample and projects pulled for the sample is provided in Table 23. The table includes the number of sample points, number of claims, and total therm savings for the claims.

Table 23. Engineering Desk Review Sample Counts and Implementer Final Savings Totals

Measure Category	Offering Category	Sample Point Quota	Sample Claims Count	Sample Total Therms	Program Total Claims Count	Program Total Therms
Tankless Water Heater	Small Instant TWH	15	15	57,452	2,065	1,799,340
	Large Instant TWH	25	33	152,396	325	581,178
DHW Boiler	Large DHW Boiler	15	17	84,878	128	242,180
Storage Water Heater	Large Storage WH	10	10	5,746	449	324,481
Fuel Substitution HPWH	HPWH	-	-	N/A	1	603
Totals		65	75	300,472	2,968	2,947,782

DESK REVIEWS

We reviewed and independently verified or updated the key parameters and project characteristics used for the reported claim, including the end-user address (matched to invoice and web search), the building type (i.e. retail, restaurant, multifamily, etc. from business name and web search), and the sector. We also determined if the site was existing or new construction, which was used to assess the baseline assumption for tankless water heaters. In addition, we compared the invoice information (e.g., quantities, make/model/SN) to the same information in the tracking data. Finally, we used the Air Conditioning, Heating, and Refrigeration Institute reference number (AHRI#) to validate

performance characteristics and the accuracy of the AHRI# mapping to a measure package. The desk reviews were conducted in Excel workbooks.

POPULATION-LEVEL GROSS SAVINGS

We extrapolated the findings of the desk reviews to the full program population within an offering category. The final GRRs for each offering category were multiplied by the total claimed savings for each offering category from CEDARS to calculate evaluated savings.

5.9 COST-EFFECTIVENESS AND TOTAL SYSTEM BENEFIT (TSB)

CPUC Decision 21-05-031 approved the TSB concept as the metric to value the time-varying benefits of energy efficiency.⁴³ TSB measures the Program's benefits and energy savings in dollars, based on the value provided at different times of the day.⁴⁴ For example, the value of energy savings during the peak hours of late afternoon and early evening hours is higher than during the middle of the day when solar energy is plentiful. The TSB metric seeks to maximize the energy saving, demand reduction and associated GHG reduction potential of measures and programs.

The TSB is the singular metric for evaluating energy efficiency programs in 2024; however, PAs have been required to report TSB along with kWh, kW, and therms savings since 2022. PY2022 is the first year for programs to report TSB.

We calculated the Program's cost-effectiveness and TSB based on evaluated savings results and present them alongside cost-effectiveness and TSB based on the Program's reported savings values for comparison (See Section 6.4) This analysis was conducted using the CET, available on the CEDARS website. This evaluation presents both reported and evaluated cost-effectiveness to provide stakeholders with an understanding of the Program's delivered value under the existing tests. Additionally, calculating the TSB will benefit stakeholders by providing a benchmark for the upcoming portfolio transition to TSB.

5.10 PARTICIPATION AND PROGRAM PERFORMANCE ASSESSMENT

We conducted a participation assessment that covered various aspects of the Program's impact and participant demographics. Firstly, we examined the demographic distribution of participants, including their geographic region, business size, and the CalEnviroScreen score of the area of their business location. Secondly, we assessed the involvement of HTR customers and DACs, focusing on their representation among participants, the distribution of measures installed for them compared to non-HTR/DACs, and the percentage of energy savings attributable to HTR/DAC participants.

We also evaluated the performance of the PY2022 SWWH Program by exploring various research questions related to program design and performance relative to targets. Further, we explored the future role of this program within the context of CA's decarbonization goals and the phasing out of gas incentives.

⁴³ <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M385/K864/385864616.PDF>

⁴⁴ TSB represents the combined lifecycle energy, capacity, and greenhouse gas benefits of an energy efficiency program, represented in a dollar value.

6. RESULTS

6.1 GROSS SAVINGS RESULTS

6.1.1 DATABASE REVIEW

Our primary dataset for evaluation was the implementer's program tracking data. We compared reported savings in the CEDARS data and implementer program tracking data to confirm data were complete and savings were consistent. However, the data sets were discrepant at several levels, including the number of measures and savings overall and by offering category. For example, as shown in Table 24, the implementer's total program therm savings was slightly lower than CEDARS, but the Large DHW Boiler therm savings from CEDARS is twice that reported in the implementer's tracking data (488,521 versus 242,180 terms).

Table 24. Comparison of Reported Savings from CEDARS and Implementer Program Tracking Data

Offering Category	First Year Gross Therm Impacts		CEDARS / Implementer Therms Ratio	First-Year Gross kWh Impacts		CEDARS / Implementer kWh Ratio
	CEDARS	Implementer		CEDARS	Implementer	
Small Instant TWH	1,871,344	1,799,340	4%	-240,346	-230,251	104%
Large Instant TWH	544,451	581,178	-6%	-70,400	-47,145	149%
Large DHW Boiler	488,521	242,180	102%	-36,967	-27,261	136%
Large Storage WH	272,719	324,481	-16%	-38,338	-45,158	85%
HPWH	603	603	0%	-4,570	-4,570	100%
Total	3,177,638	2,947,782	8%	-390,620	-354,385	110%

6.1.2 REPORTED SAVINGS REVIEW

In an attempt to reproduce and validate the implementer-final savings for each claim in the sample, we used project characteristics from the data to map savings to the corresponding eTRM measure package offering. For storage water heaters, we confirmed that SWWH007-04, which is the effective measure package version for PY2022, was applied correctly. For commercial boilers and large tankless water heaters, we were unable to reproduce the implementer final savings values using the reported measure package versions. However, we were able to successfully replicate the savings values using *prior* but superseded versions of the eTRM measure packages. For commercial boilers, it was evident measure package SWWH005-03 had been applied in the implementers tracking data. For large tankless water heaters, two completely different measure packages appear to have been applied: SWWH006-05 for gas savings and SWWH005-03 for electric savings.

We further investigated the discrepancies between the implementer's and CEDARS program tracking data and identified two driving factors: 1) the 2021-2022 transition to the eTRM and 2) the PA's CEDARS data processing practices.

2022 TRANSITION TO ETRM

Two of the commercial water heating measure packages used for this program were impacted by the transition to the eTRM as the deemed measure “data source of record” beginning in 2022.⁴⁵

Figure 3 shows a screen capture of the version history for the commercial boiler measure (SWWH005). There are two versions shown for the 2021-2022 time period which is when the SWWH program was relatively new and would have been selecting the deemed measure offerings for their program, specifically for PY2022. There was also one error correction version as indicated by the identical Effective Start Date and End Date (SWWH005-03-5), which was implemented prior to the -04 version which is the version effective for 2021 through 2022.

Figure 3. eTRM Commercial Boiler Measure Package (SWWH005) Version History

	VERSION ID	STATUS	CHANGE DESCRIPTION	EFFECTIVE START DATE	END DATE
P	SWWH005-06-2	CPUC Approved	Purpose: Resolution E-5221 updates of NTG ...	Jan. 01, 2024	
P	SWWH005-05-4	CPUC Approved	Purpose: Resolution E-5152 updates of DEE...	Jan. 01, 2023	Dec. 31, 2023
P	SWWH005-04-1	CPUC Approved	Purpose: Measure update in response to E-5...	Jan. 01, 2021	Dec. 31, 2022
P	SWWH005-03-5	CPUC Approved	Published version 03 of this measure for use...	Jan. 01, 2021	Jan. 01, 2021
P	SWWH005-02-7	CPUC Approved	Published version 02 of this measure for use...	Jan. 01, 2020	Dec. 31, 2020
P	SWWH005-01-15	CPUC Approved	Published version 01 of this measure for use ...	Jan. 01, 2020	Jan. 01, 2020

Source: California eTRM dashboard. Screen capture taken May 2024

Figure 4 presents the version history for the commercial tankless water heater measure, which shows three different versions over the 2021-2022 time period, including two error correction versions (-04 and -05) and a missing version (03). As with the commercial boiler measure, the version effective for PY 2022 (-06) is effective for 2021-2022.

Figure 4. eTRM Commercial Tankless Water Heater Measure Package (SWWH006) Version History

	VERSION ID	STATUS	CHANGE DESCRIPTION	START DATE	END DATE	COMMITTED	UPDATED
P	SWWH006-07-8	CPUC Approved	Purpose: Resolution ...	Jan. 01, 2023		Dec. 05, 2023	Dec. 05, 2023
P	SWWH006-06-1	CPUC Approved	Purpose: Measure up...	Jan. 01, 2021	Dec. 31, 2022	Sep. 22, 2022	Sep. 22, 2022
P	SWWH006-05-4	CPUC Approved	Published version 05...	Jan. 01, 2021	Jan. 01, 2021	Aug. 10, 2022	Aug. 10, 2022
P	SWWH006-04-5	CPUC Approved	Published version 04...	Jan. 01, 2021	Jan. 01, 2021	Sep. 13, 2021	Sep. 13, 2021
P	SWWH006-02-3	CPUC Approved	Published version 02...	May. 01, 2020	Dec. 31, 2020	Sep. 13, 2021	Sep. 13, 2021
P	SWWH006-01-12	CPUC Approved	Published version 01 ...	Jan. 01, 2020	Apr. 30, 2020	Sep. 13, 2021	Sep. 13, 2021

Source: California eTRM dashboard. Screen capture taken May 2024

⁴⁵ See <https://www.caltf.org/etrm-version-2> and the Transition Plan <https://www.caltf.org/s/eTRM-Launch-Plan-v10-final-20201211-clean.pdf> for additional details.

DATA PROCESSING FOR CEDARS

Through conversations with the PA, we learned that the implementer’s tracking data savings values were not used for the final claims submitted by the PA to CEDARS. The PA had instead used the eTRM measure packages that were effective for the 2022 program year to calculate the savings claims reported to CEDARS. This was necessary due to an automated check performed by CEDARS when claims are submitted, which compares the eTRM measure package version and date of each claim against the effective dates for the measure package in the eTRM. In addition to the date check, the process was further complicated because each implementer record was broken into a serial number-level claim, whereas the implementer’s tracking data often contained multiple serial numbers per claim.

Further review of the CEDARS data showed that the measure savings were spread to each utility by adjusting the unit energy savings (UES) value from the eTRM permutation to reflect each IOUs share, which eliminated traceability of the permutation values directly available from the measure package permutation files.⁴⁶ Finally, the issue of what date should be used for a midstream program was also raised in the discussion with the PA. The implementer’s tracking data contained four dates: Initial date submitted, invoice date, date of sale, and expected installation date. It is unclear which value was used by the PA to select the appropriate measure package, and the appropriate claims for PY2022. Notably, the implementer’s PY2022 data for “expected installation date” contained dates in 2023 and 2021, and the CEDARS data does not contain an actual date only year and quarter.

REVISED-FINAL SAVINGS FOR DESK REVIEW SAMPLE

Given the issues of data alignment described above, we developed “Revised-Final” savings for sampled projects to effectively align the basis of savings for our desk review sample with the basis of reported savings used in CEDARS data by the PA. This step was necessary to avoid double penalizing program savings for misaligned measure package assignments discovered in the implementer’s final program tracking data but not in CEDARS. These revised savings estimates were used in place of the original implementer-final savings values to calculate GRRs.

Table 25 summarizes the measure version adjustments used to develop the revised-final savings.

Table 25. eTRM Measure Package and Versions Used for Calculations Savings by Measure Category

Measure Category	eTRM Measure Package and Version Used for Impacts Claim	
	Implementer Final	Revised-Final
Tankless Water Heater	Gas: SWW006-05 Electric: SWWH005-03	SWWH006-06
Tanked Storage Water Heater	SWWH007-04	SWW007-04
DHW Boiler	SWWH005-03	SWWH005-04

Revised-final savings were calculated based on reported values for all inputs, save for the measure package. We used the implementer’s raw inputs for data parameters such as building type, climate zone, heating input capacity, and total units sold, but the data were mapped to the eTRM measure packages that were effective for 2022. We used this approach with the intent of developing GRRs at the offering category level that would be applied to the CEDARS data to calculate program-level evaluated savings. The approach is illustrated in Table 31 in section 6.1.4.

A comparison of the revised-final and original implementer savings values is provided in Table 26. The revisions significantly impacted the large instant TWH and large DHW Boiler offering categories. The measure version change did

⁴⁶ It is standard practice to distribute measure savings in CEDARS to each utility in this manner, and this practice is common for all statewide programs, yet this contributes to the need for evaluators to rely on implementer data for impact analyses.

not impact small tankless water heaters. As shown in Table 26, the same eTRM measure version was applied for implementer final savings and revised-final savings; therefore, there was no change for storage water heaters.

Table 26. Revised Final Savings Summary

Offering Category	Revised-Final Therms	Original Implementer Final Therm	Percent Difference
Large DHW Boiler	125,026	84,878	32%
Large Instant TWH	118,888	152,396	28%
Small Instant TWH	57,452	57,452	0%
Large Storage WH	5,746	5,746	0%
Total	307,112	300,472	2%

6.1.3 DESK REVIEWS

As discussed in Section 5.8, the desk reviews primarily consisted of end-user information validation, building type assessment, and AHRI# mapping. The results of each are described in detail in the following sections.

END-USER INFORMATION VALIDATION

The evaluation team reviewed invoices and, when available, project verification photos to verify the installation address for each project. Project invoices provided equipment information (make, model, serial number), the end-user's business name, and physical location. The Program also required contractors to include information on the invoice containing the program name, rebate amount, and installation address as a participation requirement. This requirement significantly improved the program's evaluability.

Nine invoices did not include the end-user address; however, seven of these were verified through job names that aligned with the end-user company name shown in the program tracking data, and the evaluation team verified the address through a web search of the end-user company name.

For the remaining two invoices, the evaluation team attempted to contact the contractor and end-user to verify the installation address. We successfully interviewed contacts for both sites. For one site, the interview verified that the end-user address from the program tracking data was correct. For the other site, the interview revealed that the address shown in the program tracking data was incorrect. The evaluation team adjusted the end-user address in the workbook; however, the address adjustment did not impact savings since the building type and climate zone did not change.

BUSINESS/BUILDING TYPE AND SECTOR ASSESSMENT

The evaluation team reviewed web search results, including maps and aerial imaging, company websites, real estate listing services, and crowdsourced review sites to assess and verify the building type of sampled projects and to determine whether incented equipment was installed in new construction or existing buildings. The evaluation team also conducted phone and email outreach to end-users and/or contractors. Based on web search and outreach results, the evaluation team matched each project site to the best-fit building type and sector from the eTRM. For claims that used "Com" we mapped to a more specific business type if available, but the commercial measure packages did not have a multifamily building type.

The most impactful building type change was updating fourteen projects from “Com” to “MFm” and applying a different measure package because the desk review showed the sites were multifamily buildings, so the commercial eTRM measure packages were not appropriate. For nine projects, we adjusted only the building type based on desk review findings.

Reported and evaluated building type changes are summarized in Table 27

Table 27. Reported and Evaluated Building Type Changes Summary for Sample

Building Type Description	Building Type	Sector	Reported Count	Evaluated Count
Assembly	Asm	Com	4	4
Commercial	Com		15	0
Education - Community College	ECC		0	1
Education - Primary School	EPr		2	2
Education - University	EUn		1	0
Grocery	Gro		2	2
Health/Medical - Hospital	Hsp		2	2
Lodging - Hotel	Htl		11	11
Health/Medical - Nursing Home	Nrs		0	1
Office - Large	OfL		9	8
Office - Small	OfS		1	0
Restaurant - Fast-Food	RFF		5	5
Restaurant - Sit-Down	RSD		16	15
Retail - Small	RtS		1	4
Storage - Unconditioned	SUn		0	1
Manufacturing Biotech	MBT	Ind	1	2
Manufacturing Light Industrial	MLI		5	3
Residential Multi-family ⁴⁷	MFm	Res	0	14

AHRI# AND OFFERING ID MAPPING VERIFICATION

The evaluation team reviewed invoices to verify the type(s) of incented equipment, make and model information, and quantity. When available, the evaluation team also used project verification photos to verify make and model information of incented equipment.

The implementer maintained a list of AHRI-rated products and used the AHRI Directory to obtain performance specifications (heating capacity and efficiency) that were used to map directly to the eTRM measure package and offering. This facilitated the Program's evaluability. We reviewed the AHRI#'s provided by the implementer and used the AHRI Certification Directory to verify that the AHRI# corresponded with the incented equipment. The evaluation team was able to verify the majority of equipment manufacturers, model numbers, efficiencies, capacities, and draw patterns (as applicable) by their AHRI#. ⁴⁸ Table 28 summarizes the measure offering definitions from the eTRM that were applied in the evaluation.

⁴⁷ The multifamily building (MFm) type was only available in the residential multifamily eTRM permutations for boilers, storage water heaters, and tankless water heaters for measure packages SWWH010, SWWH011, and SWWH013, which were applied for the evaluation.

⁴⁸ Four of the AHRI#'s provided were CEC reference numbers. The characteristics of the equipment associated with these numbers were verified using the Modernized Appliance Efficiency Database System (MAEDbS) by the California Energy Commission.

Table 28. eTRM Measure Packages and Offering IDs used for Evaluated Savings

eTRM Measure Name	Statewide Measure ID	Offering ID	eTRM Measure Description
Boiler, Commercial	SWWH005-04	B	Small/med. commercial boiler, HW, < 200 kBtu/hr, 0.87 UEF (tier 2)
		C	Large commercial boiler, HW, >= 200 kBtu/hr, 84% TE (tier 1)
		D	Large commercial boiler, HW, >= 200 kBtu/hr, 90% TE (tier 2)
		E	Large commercial boiler, HW, >= 200 kBtu/hr, 96% TE (tier 3)
Tankless Water Heater, Commercial	SWWH006-06	B	Small commercial inst. heater, < 200 kBtu/hr, 0.87 UEF (tier II)
		C	Large commercial inst. heater, >= 200 kBtu/hr, 80% TE (tier I)
		D	Large commercial inst. heater, >= 200 kBtu/hr, 90% TE (tier II)
		F	Large commercial inst. heater, >= 200 kBtu/hr, 96% TE (tier III)
Storage Water Heater, Commercial	SWWH007-04	H	Commercial stor. heater, > 75 kBtu/hr, 0.90 TE
		I	Commercial stor. heater, > 75 kBtu/hr, 0.96 TE
Boiler, Multifamily	SWWH010-01	A	MF Boiler, Hot Water, 84% TE
		B	MF Boiler, Hot Water, 90% TE
Central Storage Water Heater, Multifamily	SWWH011-01	B	Central storage water heater, tier 2 - condensing
Tankless Water Heater, Residential	SWWH013-02	I	Residential tankless water heater, <= 200 kBtu/hr, tier 3, UEF = 0.95 high draw

The verified equipment size and performance characteristics were also used to confirm mapping to the eTRM measure package and offering ID used to calculate gross savings. For four TWH projects, we adjusted only the applied eTRM measure package since desk review and/or outreach confirmed that the storage water heater baseline was not appropriate. Measure package evaluation adjustments across the desk reviews are summarized in Table 29. The rationale for all of the changes is described in the last column and varies at the measure package Offering ID level.

Table 29. Measure Package Offering ID Adjustments for the Desk Review Sample

Offering Category	Revised-Final		Evaluated		Rationale for Adjustment
	Statewide Measure ID	Offering ID	Statewide Measure ID	Offering ID	
Large DHW Boiler	SWWH005-04	C	SWWH005-04	C	No Change
		D		D	
		E		E	
		C	SWWH010-01	A	Multi-family Building
		E		B	
Large Instant TWH	SWWH006-06	C	SWWH005-04	C	Adjusted Baseline
		D		D	
		F		E	
		C	SWWH006-06	C	No Change
		D		D	
		F		F	
		C	SWWH010-01	A	Multi-family Building
F	B				
Large Storage WH	SWWH007-04	H	SWWH007-04	H	No Change
		I		I	

Offering Category	Revised-Final		Evaluated		Rationale for Adjustment
	Statewide Measure ID	Offering ID	Statewide Measure ID	Offering ID	
		I	SWWH011-01	B	Multi-family Building
Small Instant TWH	SWWH006-06	B	SWWH005-04	B	Adjusted Baseline
			SWWH006-06	B	No Change
			SWWH013-02 ⁴⁹	I	Multi-family Building

Note: Measure versions shown in the Reported Statewide Measure ID field reflect the Revised-Final update made by the evaluation team.

6.1.4 EVALUATION RESULTS AND POPULATION-LEVEL GROSS SAVINGS

After we determined the appropriate permutation to apply from the eTRM, we calculated the evaluated savings and GRR for each project. For the GRR analysis, we also made note of all discrepancies and used standard disposition codes to systematically tabulate issues. For all of the gas measures except the small residential multifamily tankless water heaters, the eTRM normalized unit for per-unit savings in the eTRM permutations was “kBtuh of input capacity”. The input heating capacity was a primary field in the implementer program data. Evaluated savings was calculated by multiplying the per-normalized-unit savings from the verified eTRM permutation by the verified input capacity (confirmed from the AHRI database) and verified quantity (confirmed by invoice review). For small residential multifamily tankless water heaters, the eTRM specified Normalized Unit is “per water heater” so unlike the other water heating measures, the evaluated savings was calculated by multiplying the per-normalized-unit savings from the verified eTRM permutation by the verified quantity.

The results of the desk review sample were used to develop GRR at the offering category level. The GRRs from the sample were then applied to total energy savings at the offering category developed for the CEDARS data, which were used to develop the overall program GRR values. Sample and program level GRRs are discussed and summarized in Section 6.1.4.

GRRs for the desk review sample and program, and adjustments made by the desk reviews that most impacted the evaluated savings are discussed below.

GROSS REALIZATION RATES

GRRs for the Desk Review Sample

GRRs for the desk review sample are presented by offering category in Table 30 and Table 31 for therms and kWh, respectively. For both tables, the GRRs use the Revised-Final savings values as described in Section 6.1.1. Small Instant TWHs were most negatively impacted by evaluation adjustments with a 64% GRR. Gas GRRs for the other offering categories were relatively mildly impacted with GRRs from 94% to 107%.

⁴⁹ For small residential tankless water heaters, the eTRM specified that the savings shown in the permutation were per water heater. The evaluation team calculated gross evaluated savings by multiplying the per-normalized-unit savings from the verified eTRM permutation by the verified quantity, confirmed by invoice review.

Table 30. Gas Savings Gross Realization Rates for Desk Review Sample by Offering Category

Offering Category	Number of Projects	Revised-Final Therms	Evaluated Therms	Therms Gross Realization Rate
Small Instant TWH	15	57,452	37,019	64%
Large Instant TWH	33	118,888	122,059	103%
Large DHW Boiler	17	125,026	117,114	94%
Large Storage WH	10	5,746	6,161	107%
Total	75	307,112	282,353	92%

Note: There was only one HPWH project in PY2022 and it was not evaluated, savings were passed-through

For electric impacts, Large DHW Boilers were most impacted by evaluation adjustments with a 9% GRR. The significant reduction is most likely due to mapping these projects to other eTRM measure packages that do not have kWh impacts. The electricity use and peak demand impacts are very small and all show increased consumption.

Table 31. Electric Savings Gross Realization Rates for Desk Review Sample by Offering Category

Offering Category	Revised-Final kWh	Evaluated kWh	kWh Gross Realization Rate	Revised Final kW	Evaluated kW	kW Gross Realization Rate
Small Instant TWH	-7,768	-7,253	93%	-1.06	-0.98	93%
Large Instant TWH	-14,919	-14,735	99%	-2.26	-2.44	108%
Large DHW Boiler	-10,653	-993	9%	-1.24	-0.05	4%
Large Storage WH	-798	-787	99%	-0.11	-0.11	97%
Total	-34,137	-23,768	70%	-4.67	-3.58	77%

Note: There was only one HPWH project in PY2022 and it was not evaluated, savings were passed-through

Program-Level GRRs

GRRs from the desk review sample were applied to CEDARS reported savings at the offering category level to develop program-level evaluated savings and GRRs. This approach was used in lieu of being able to align the implementer data with the CEDARS data, as previously discussed. Gas and electric evaluated savings and GRRs are presented in Table 32. The program-level GRRs are 79.2% for therms and 86.99% for kWh.⁵⁰ The program-level gas GRR is most impacted by the low GRR for Small Instant TWH, and the program-level kWh GRR is most impacted by the very low GRR for Large DHW Boiler.

Table 32. Population Level Electric Savings Gross Realization Rates for Desk Review Sample by Offering Category

Offering Category	Desk Review Therms Gross Realization Rates	CEDARS First Year Total Therms	Evaluated Therms	Desk Review kWh Gross Realization Rates	Evaluated kWh	CEDARS GRR Adjusted kWh
Small Instant TWH	64%	1,871,344	1,205,781	93%	-240,346	-224,416
Large Instant TWH	103%	544,451	558,971	99%	-70,400	-69,533
Large DHW Boiler	94%	488,521	457,606	9%	-36,967	-3,444
Large Storage WH	107%	272,719	292,438	99%	-38,338	-37,825
HPWH	100%	603	603	100%	-4,570	-4,570
Total	79.2%	3,177,638	2,515,399	86.99%	-390,620	-339,788

Note: There was only one HPWH project in PY2022 and it was not evaluated, savings were passed-through

⁵⁰ The evaluation achieved a relative precision of 16% and 17% for therm and kWh GRRs, respectively, at the 90% confidence level.

EVALUATION ADJUSTMENTS

Evaluation adjustments are the changes made to the underlying participant data assumptions and/or original measure package assignments used to determine and calculate a project’s energy savings. Most claims (n=46, 61%) had no change to the reported parameters or savings and therefore had a 100% GRR. In this section, we highlight the primary reasons for evaluation adjustments made across the remaining 29 claims.

Tankless water heater eTRM measure package uses a storage water heater as a baseline. The commercial TWH measure package SWWH006 is used as the default for this program. But the measure package assumes the TWH is replacing a storage water heater (SWH). However, the SWH baseline does not make sense for new construction where there is no pre-existing equipment so the correct baseline is a code-minimum efficiency TWH. Using the SWWH06 measure package may also not make sense for a midstream program where there is no intent to validate the pre-retrofit condition. The alternate measure package is SWWH005 which assumes a like-for-like equipment replacement, and this is the measure package we applied to new construction sites for our desk review. This was a major issue of investigation for the evaluation.

As part of the desk review process, we attempted end-user outreach to all TWH projects identified as existing construction projects to determine the validity of the storage water heater baseline assumption. We completed six outreach calls and of those two end-users confirmed the previous equipment was a storage water heater, one had replaced a boiler with multiple TWHs, and three were gut-rehab sites (essentially new construction). While this was a low response rate, four of the six calls confirmed a tankless water heater baseline would be the more accurate assumption. Even though this is a very small subset of the sample, the reduction due to using a TWH baseline instead of a storage water heater baseline is significant. One of these projects was very large (14 TWHs and a total of 29,945 therms), so its low realization rate (47%) likely had a significant effect on the GRR.

Multifamily buildings were mapped to the “Com” building type. Another significant element of the gas GRR is a result of using the “Com” (e.g. average commercial sector) building type and commercial water heating measures for multifamily water heating systems. Applying commercial water heating measure packages instead of multifamily-specific or individual residential unit eTRM measure packages had a significant impact on the evaluated savings.

Twelve projects (7 TWHs, 4 Boilers and 1 SWH) used the “Com” building type but were found to be large tankless water heaters serving as central water heating systems in multifamily buildings. Although multifamily building central water heating systems are often treated as commercial, there are separate multifamily measure packages in the eTRM that use a multifamily building type. In addition, we found that two small tankless water heater projects served individual apartments in multifamily buildings. For the evaluation savings, we applied the eTRM residential multifamily measure packages using the MFm building type. Because residential water heating usage is typically lower than commercial applications, this adjustment resulted in much lower realization rates for these two sites (12% and 9%).

In addition, as shown in Table 33 for the full participant population, almost a third (32.5%) of the therm savings and almost half (43.6%) of the claims use the “Com” building type. Since the majority of the “Com” sites in our desk review sample were multifamily projects, this could be a significant issue for the program.

Table 33. Use of Com Building Type in CEDARS Reported Claims

Building Type	Total Therm Savings	Percent of Therm Savings	Total Number of Claims	Percent of Claims
Com	1,033,708	32.5%	1,318	43.6%
Explicit (Not Com)	2,143,930	67.5%	1,705	56.4%
Totals	3,177,638	100%	3,023	100%

Building Type changes. For nine of the sample projects, the explicit building type (i.e. Building Type was not “Com”) was changed to reflect the evaluated business type. The GRR range for these projects was 28% (auto parts store originally identified as an industrial site) to 282% (reported restaurant changed to nursing home). Only one of these projects used the COM building type which was changed to Small Retail.

Businesses Closed. Two projects, which were both restaurants, were confirmed to be closed through the desk review process. As a result, all evaluated savings values were set to zero.

Issues impacting reported electricity kWh\kW savings and GRRs. As previously discussed, the electricity annual energy use and peak demand impacts for this program are minimal, so only high-level results are presented here but detailed results are provided in Appendix A.

6.2 PTLM REVIEW AND VERIFICATION PROCESS MAPPING

PTLM REVIEW

The evaluation team reviewed the program theory logic model (PTLM) to determine how the Program influences three participation targets: distributors, contractors, and end-user customers. We also reviewed previous studies on similar program designs and interviewed SWWH Program staff. Information gathering sought to understand the core theory behind the Program, including the overall goals, key program activities, the intended outputs (e.g., distributor partnerships), and intended outcomes (e.g., stocking and customer adoption of higher efficiency equipment). The review of the Program’s logic model and related studies, as well as program staff interviews, led to the following key takeaways:

- Like other midstream programs, distributors and contractors are the primary points of intervention for the Program.
- The Program aims to influence installations through market dynamics rather than directly influencing individual installations. Whether end-users understand they have received an incentive is uncertain and ultimately unnecessary for the Program to affect lasting change on the dynamics of the California commercial water heating market.
- The program’s influence on efficient water heating sales could be characterized through three pathways: (1) distributor stocking practices, distributor upselling, and equipment price, described in Table 34.

Table 34. Program Influence Pathways

Influence Pathways	Description
Distributor stocking practices	Program influence on purchasing decisions through the availability of high-efficiency measures, particularly when new equipment is needed
Distributor upselling	Program influence through upselling or promotion of high-efficiency measures toward contractors and end-users
Equipment price	Program influence on price through incentives or POS discounts

We used these key takeaways to develop the NTG methodology described in Appendix E.

VERIFICATION PROCESS MAP

We used our findings from program material reviews and interviews with program staff to develop a process map depicting the installation verification processes at all stages of the Program, from sales to post-installation verification. As shown in Figure 5, the first step generally involves the contractor pre-screening a customer address for eligibility with

the distributor. Then, after the contractor installs the incentivized equipment, they collect end-user customer information such as customer name, contact information, and equipment information found on the name or serial plates of incentivized measures installed and send the information to the distributor. The distributor then submits a transaction report to the implementer, which verifies end-user customer eligibility by verifying the commercial rate with IOU partners and conducting an additional review of the end-use customer property/facility through Google Maps. Once the implementer verifies the eligibility of the end-user customer property/facility, they process the incentive for the distributor.

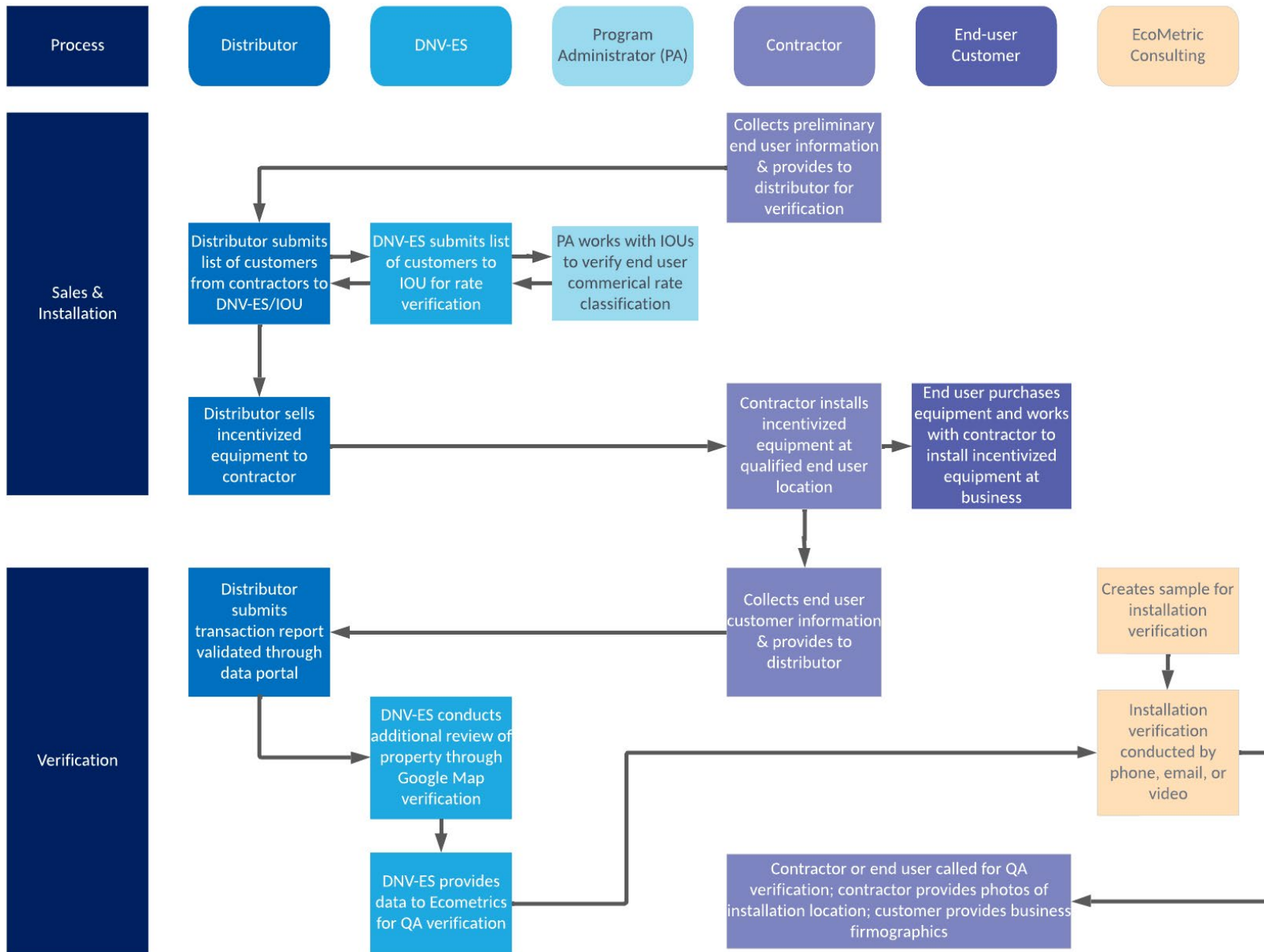
The implementer then provides data to EcoMetric Consulting for quality assurance (QA) verification of a sample of installations. EcoMetric Consulting conducts a desk review of sampled transactions to verify measure installation verification, including phone, video or photo confirmation of the installed measures. The sampling rate for the installation verification is as follows:

- 100% of water heater transactions with five or more units by a single contractor
- 50% of water heater transactions with two to four units by a single contractor
- 10% of water heater transactions with a single unit by a single contractor

A verification call is conducted with either the end-user customer or a contractor who worked with the end-user customer in maintaining their building or facility. In addition to documentation on the measure(s) installed, the end-user customer also provides firmographic information about their business, outlined in Section 6.8.

Half of the contractors reported receiving a call from EcoMetric Consulting, and the majority of them found the verification process somewhat or very easy to complete. Of those who felt that process was somewhat difficult to complete, contractors mentioned that the Program should inform contractors upfront of verification requirements (1 mention), provide contractors with a checklist of verification requirements in case they are selected for verification (1 mention), or call contractors for verification rather than email them (1 mention). The remaining contractors (n=12) did not have suggestions to improve the verification process.

Figure 5. Statewide Midstream Water Heating Program End-User Data Collection



6.3 NET IMPACT RESULTS

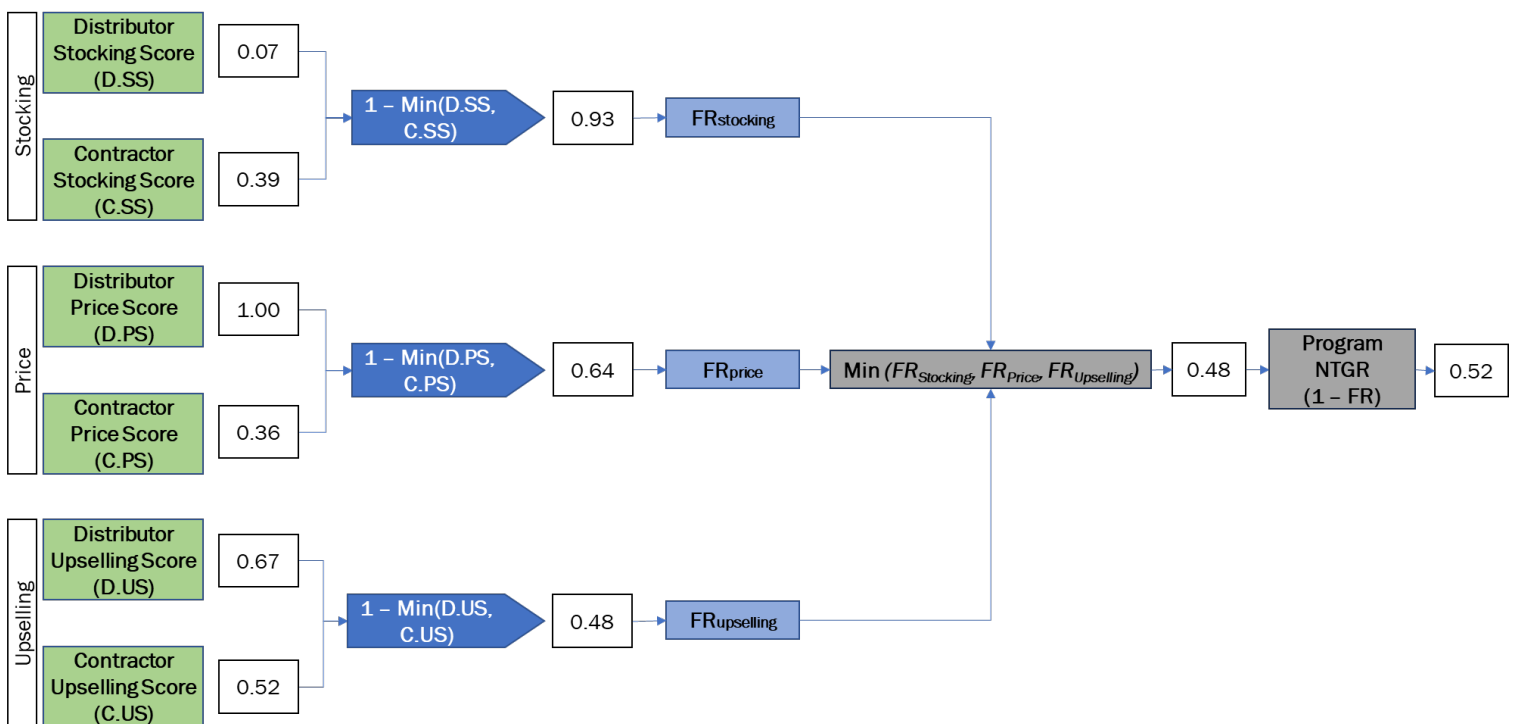
For the FR results, we derived input from the distributor interviews and the contractor survey. Responses were weighted by gross savings.⁵¹ Table 35 provides the number of distributor and contractor responses that contributed to the overall FR score and their representation of overall program savings.

Table 35. Interviewed/Surveyed Market Actor's Ex Ante Savings Representation

Market Actor	Number Interviewed/Surveyed	Population	Percent of Population Savings Represented
Distributors	15	39	57%
Contractors	31	533	32%

We estimated FR by assessing the Program's influence on efficient water heating sales through three pathways: distributor stocking practices, distributor upselling, and equipment price. As shown in Figure 6, scores are developed for contractors and distributors in each pathway. More information about the specific questions posed to develop these scores are provided in Appendix E. We calculate the Pathway FR Score as one minus the minimum of the distributor and contractor Attribution Scores. The overall Program FR is calculated as the minimum Pathway FR Score.

Figure 6. Net to Gross Results



We estimate the Program's FR at 0.48, or an NTGR of 0.52. The upselling pathway exhibited the lowest overall FR rate of 0.48, much lower than the price pathway (0.64) or the stocking pathway (0.93). Within the upselling pathway, the Program appears to have a moderate impact on distributor upselling practices (0.67 attribution score), and distributors' upselling practices have a moderate impact on contractor scores (0.52 attribution score). All distributors mentioned

⁵¹ A single contractor accounted for 86% of savings in the sample of completed surveys and was therefore treated as a certainty stratum response when estimating the program-level NTGR.

that the SWWH Program helps them increase sales of high-efficiency equipment, giving them a competitive advantage. By contrast, within the stocking pathway, the Program has a limited impact on distributor stocking practices (0.07 attribution score). Distributor stocking practices have a more limited impact on contractor purchasing decisions (0.39 attribution score). Within the price pathway, distributors are by default assigned an attributions core of 1.0, but price seems to have a more limited impact on contractor purchasing decisions (0.36 attribution score). As a point of comparison, the eTRM assumes a 0.60 NTG ratio for all measure packages included in this evaluation

We applied the Program NTGR to the evaluated first year gross savings to develop the evaluated first year net savings. The evaluated net savings were then divided by the reported net savings to calculate the net realization rate, as shown in Table 36.

Table 36. Annual First Year Net Impacts

Fuel Type	Evaluated First Year Gross Savings	NTGR	Evaluated First Year Net Savings	Reported First Year Net Savings	Net Realization Rate
Gas (therms)	2,515,399	0.52	1,305,402	1,906,824	68.5%
Electricity (kWh)	-339,788		-176,338	-236,200	74.7%

The Program fell short of its net therm savings goals and achieved 85% of established PY2022 goals. Due to predominantly gas measures being incented through the Program, it achieved negative electricity savings, as shown in Table 37.

Table 37. PY2022 Program Performance to Goals

Program Targets	2022	2022 Achieved	Percent to Target
Net Energy Savings (therms)	1,531,709	1,305,402	85%
Net Energy Savings (kWh)	2,873,720	-176,338	-6%

6.4 COST-EFFECTIVENESS AND TOTAL SYSTEM BENEFIT

The evaluation team calculated the Program’s cost-effectiveness and calculated TSB based on the evaluated GRRs and NTGR, using the Cost-Effectiveness Tool (CET) available on the CEDARS website. Table 38 shows the claimed and evaluated Total Resource Cost (TRC) ratios,⁵² Program Administrator Cost (PAC) ratios,⁵³ and TSB for the PY2022 SWWH Program.

Table 38. Cost-effectiveness and TSB Results

Component	Claimed	Evaluated
TRC Ratio	2.77	1.96
PAC Ratio	3.44	2.39
TSB	\$32,885,759	\$22,786,010

⁵² The TRC test measures the cost-effectiveness of a program, including both the participants' and the utility's costs. A TRC value of one or higher indicates the program was cost effective as evaluated under the TRC.

⁵³ The PAC test measures the cost-effectiveness of a program, including only the utility's costs. A PAC value of one or higher indicates the program was cost effective as evaluated under the PAC.

6.5 MARKETING & EDUCATION

The Program advocates for increased awareness and sales of high-efficiency equipment through various outreach activities with distributors, including visiting distributors in person to speak with purchasing contractors and ongoing communication to ensure distributors are informed about program changes or enhancements. Overall, the Program emphasizes regular communication and repetition to keep distributors informed and engaged.

Program materials and information gathered through interviews with program staff indicate that the SWWH Program engaged and educated participating distributors through various marketing, education, and outreach activities. These activities included training, regular communications, one-on-one support, and face-to-face interactions. Based on the SWWH Program's marketing plan, the Program is also marketed to contractors, developers, buyers, and property managers in participating distributors' areas of business to create awareness and encourage sales of high-efficiency water heating measures.⁵⁴ Marketing activities included cobranded print and digital materials distributed via utility-owned and paid media channels. Findings suggest that most of the Program's marketing and education activities targeted distributors rather than contractors or end-user customers.⁵⁵

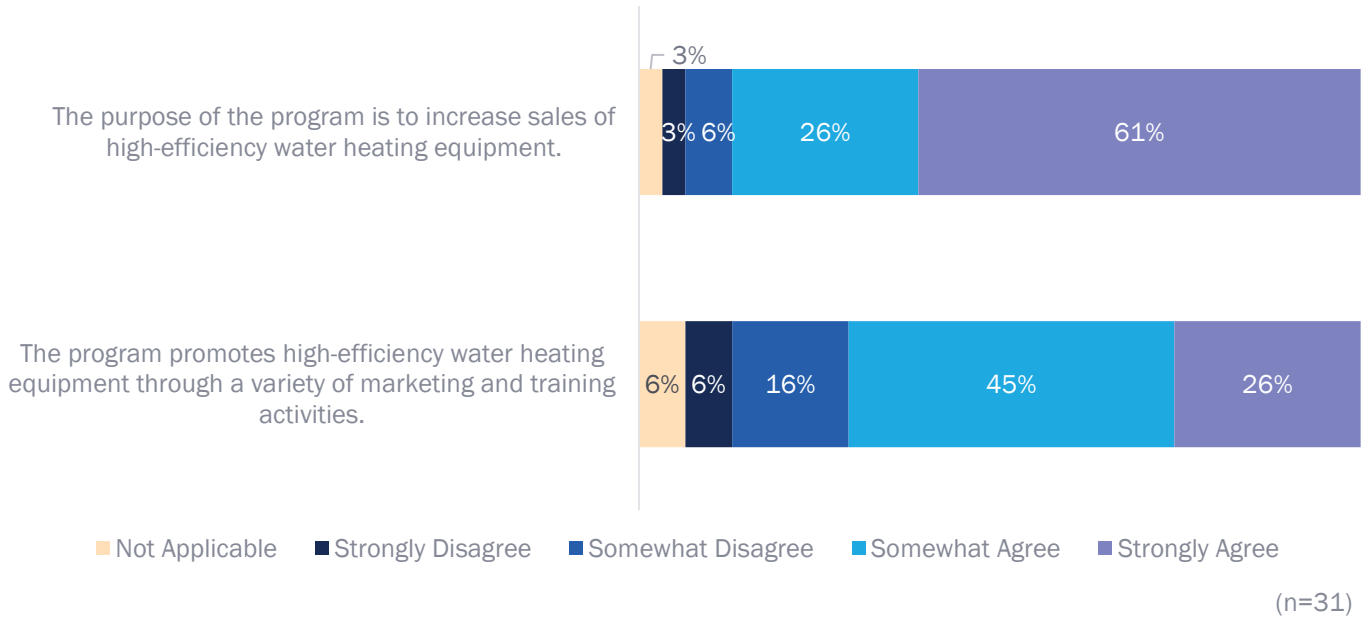
Distributors actively promote the Program to contractors through various methods. Most distributors promote the Program through marketing campaigns, such as social media campaigns, and direct advertisement channels, such as email and mailed flyers (10 mentions). Distributors also promote the SWWH Program through training sessions (10 mentions). One distributor also mentioned using newspaper ads to reach customers whose primary language is not English. A little over half of distributors also reported leveraging sales conversations to promote the Program (8 mentions), while others reported using in-store marketing (5 mentions) to promote the Program.

While contractors were generally unaware of the Program sponsor and administrators, the majority were aware of the goals and marketing activities associated with the SWWH Program. As part of outreach efforts for the contractor survey, the evaluation team followed up with half of the unresponsive sampled contractors to invite them to complete the survey via web or phone (see Appendix A for results of outreach efforts). During the phone outreach, the evaluation team observed a lack of recall of the program name and a lack of knowledge about the program sponsor, administrators, and implementers. However, the majority of contractors did indicate an understanding of the SWWH Program's goals, as 87% of contractors 'somewhat' or 'strongly' agreed that the goal of the Program is to increase the sale of high-efficiency water heating equipment (Figure 7). Contractors also broadly agreed that the SWWH Program promotes high-efficiency water heating equipment through various marketing and training activities (71%).

⁵⁴ Kelliher Samets, Ltd. "Statewide Midstream Water Heating Program 2022 Connections Plan." 2021.

⁵⁵ While end-user customers are not eligible to participate in the program directly (only indirectly through contractors), the PIP explicitly states the program implementer will "[d]evelop and implement a market engagement plan to effectively engage distributors, contractors, design firms and customers to drive savings to the measures with the highest savings potential." (page 3 of PIP).

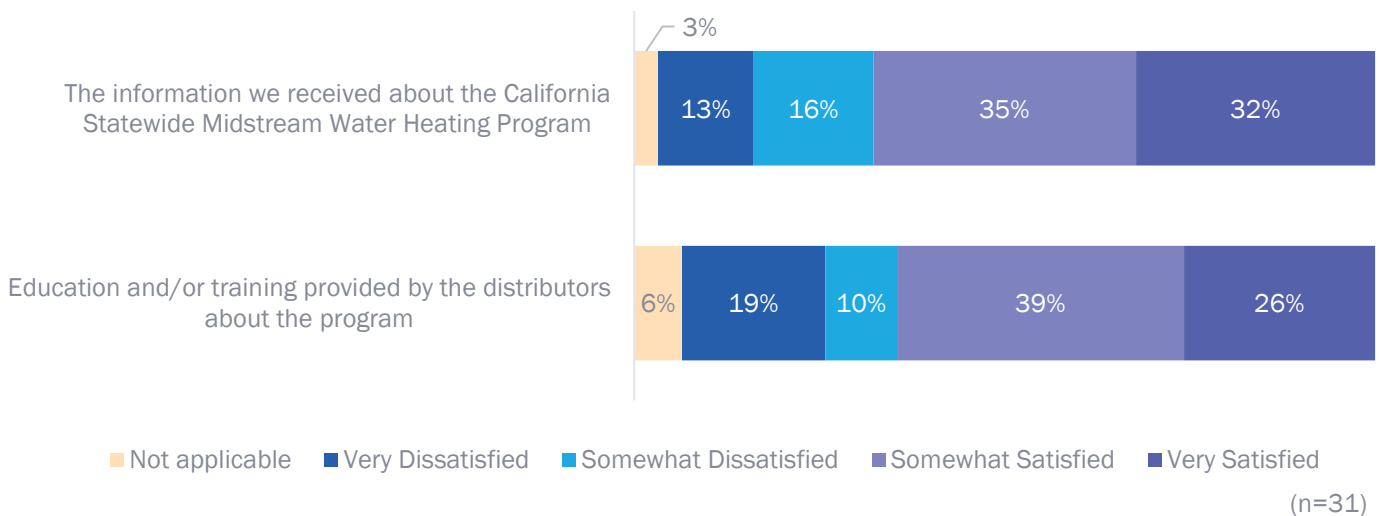
Figure 7. Contractors' Understanding of Program Goals



Most distributors host training sessions for contractors (10 of 15) through which most promote the Program. These trainings cover program participation (8 mentions), technical training related to water heating equipment, such as how appliances function, troubleshooting, repairs, and explanation of new equipment (7 mentions), and the benefits of energy efficiency (4 mentions).

Overall, contractors were satisfied with the information they received about the Program and the education and training provided by the distributors. As shown in Figure 8, 67% of contractors reported being 'somewhat' or 'very' satisfied with the program information they received, and 65% reported being very satisfied with the education and training provided by the distributor(s) about the Program. Yet, a similar proportion of contractors report being 'somewhat' or 'very dissatisfied' with the Program information they received and the education or training provided by the distributor(s) about the Program (29%, in both cases). A few contractors (n=3) indicated that these two questions do not apply to them, which suggests that they neither received Program information nor any education or training from their distributor(s) about the Program.

Figure 8. Contractor Satisfaction on Program Information Received



Contractors dissatisfied with the information they received from the Program cite a lack of program-specific information and communication from program representatives and/or distributors. More than half (n=11) of contractors who reported less satisfaction with the information they received about the Program cited the lack of information, training, or education regarding the SWWH Program as the reason for their dissatisfaction. Other reasons included the lack of communication with or from a program representative (i.e., program staff or distributor) (n=1), the lack of a point of contact for the Program (n=1), and the lack of transparency (n=1).

6.6 PARTICIPATION PROCESS

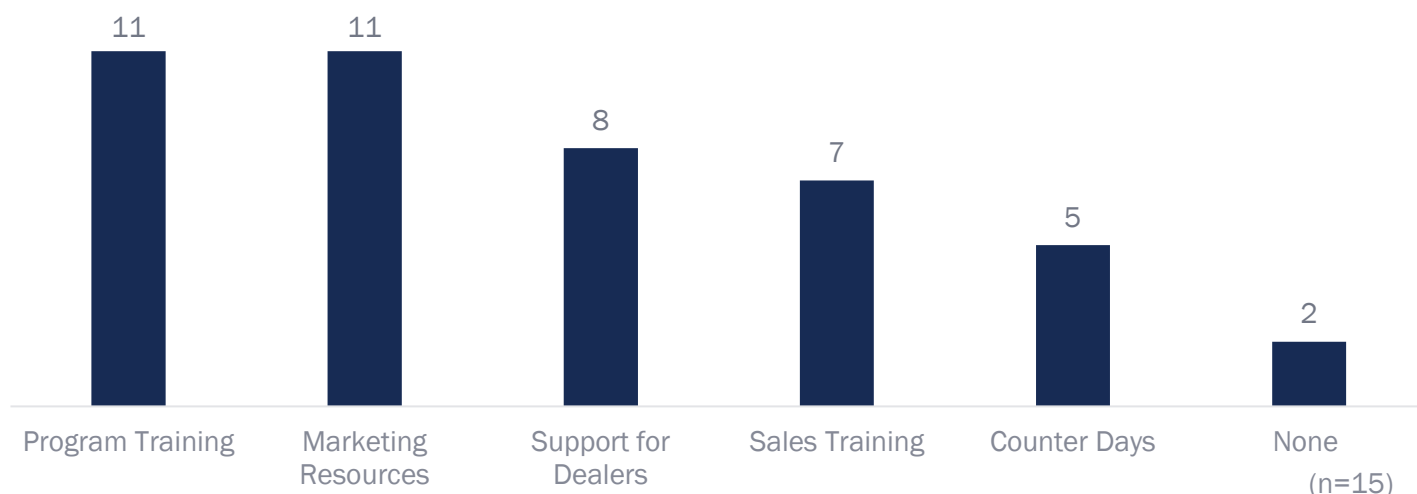
The Program requires distributors and contractors to collect and submit project and end-user information to the implementation team. To help streamline this process, the implementer created a data submission portal as part of the Administrative Process Innovation. The Administrative Process Innovation aimed to streamline the implementation process through this data submission portal by minimizing the time distributors would spend on data entry and the risk of distributor transaction rejection.

6.6.1 ONBOARDING

All distributors reported that enrolling in the SWWH Program was straightforward, and the goals were clearly communicated to them. Some distributors mentioned that it took some time to understand the Program and submission portal, but they received help and guidance from the implementer. One distributor mentioned having a difficult start with the Program, so they unenrolled for six months and re-enrolled later. Most distributors (14 out of 15) also reported that the implementer clearly explained that the Program's purpose was to incentivize more high-efficiency water heating equipment to commercial customers.

Consistent with the program plan, the majority of distributors received one-on-one support from the implementation team on a variety of issues and found it the most useful source of program support. The PIP states that providing distributors one-on-one support is core to their midstream program approach. Most distributors (13 out of 15) reported receiving one-on-one support from the implementer. The majority mentioned that this support came from program participation training (11 mentions) and marketing resources (11 mentions), as shown in Figure 9. Other types of support included support for dealers (8 mentions), sales training (7 mentions), and counter days (5 mentions). Nine out of 15 respondents found one-on-one support the most helpful type of implementer support. Additionally, two distributors cited flyers as helpful, while one distributor each mentioned counter days, program training, account management, and incentives.

Figure 9. Types of Support Received by the Program



6.6.2 DATA SUBMISSION PORTAL

The majority of distributors felt that the data submission portal generally worked well. Once they mastered the portal's logistics, they all stated it was user-friendly. Almost all distributors (13 of the 15) encountered issues when they started using the portal; however, all but one mentioned that the implementer subsequently resolved their issues. One distributor mentioned that they still send their information to the implementer to enter into the system on their behalf. Three distributors volunteered that the implementer was available and very helpful whenever they had questions.

All distributors who use the portal found it helpful that the portal automatically verifies customer zip codes and water heater equipment eligibility for program incentives. One distributor mentioned that they wished the portal also displayed incentive dollar amounts. Another noted some discrepancies between the product Excel forms provided to them and the data submission portal. They mentioned that the portal sometimes listed the same product twice, each with different incentive amounts. This made it difficult to determine the amount to enter for a given project without contacting the implementer. This distributor expressed concerns about using the incorrect incentive amount in their invoice due to the discrepancy, potentially undercharging the customer and failing to recoup the entire transaction cost. A different distributor echoed the concern that incentives for certain equipment appear to change after being added to the system, which complicates equipment pricing. One distributor mentioned dissatisfaction with the implementer's focus on the PDF invoice documentation when the same information is noted and documented in accompanying spreadsheets.

6.6.3 END-USER DATA COLLECTION

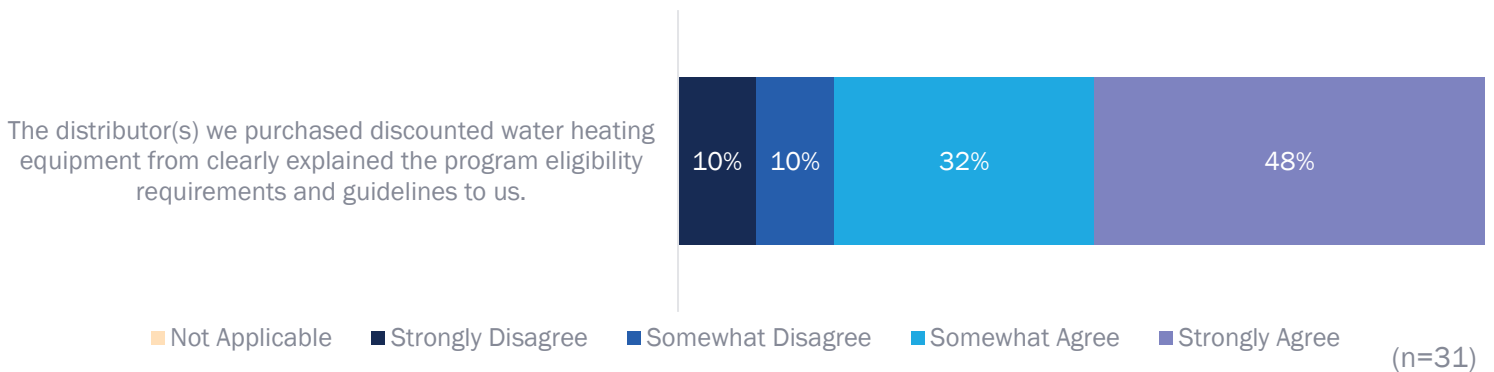
The data collected by the Program along each step of the process is critical to ensure the evaluability of the Program. Almost all desk review sites contained a valid end-user address for equipment installation enabling the evaluation team to conduct a thorough review of end-user installations. However, end-user contact details such as email and phone were predominantly filled with duplicated contractor information. Only approximately one-third of the records included valid end-user contact information.

Contractors agreed that distributors clearly explained eligibility requirements, which was in line with the training distributors reported providing contractors. When asked about the information they received from their distributor(s) regarding the SWWH Program, 81% of responding contractors indicated that the distributors who sold them program-eligible water heating equipment clearly explained program eligibility requirements and guidelines (Figure 10). However,

some contractors who disagreed with this statement suggested providing physical program collateral would better explain program requirements and guidelines (n=9).

One contractor wished that their distributor had discussed the verification process upfront rather than learning about it months after projects were completed. Another felt that the quality of the training by distributors or program staff could be better. One contractor also suggested expediting the pre-screening process for customers to ensure that they qualify for the Program.

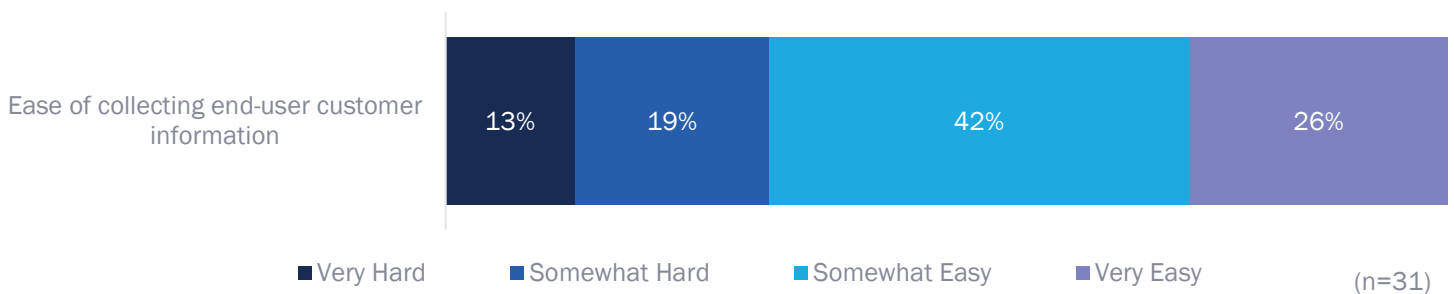
Figure 10. Distributors Explanation of Program Eligibility Requirements



Even though contractors felt that eligibility requirements were clearly explained to them, most distributors encountered difficulties with end-user data collection by contractors (9 of 15). Distributors reported that some contractors were initially reluctant to provide end-user information but stated that contractors cooperate once they understand the incentive is tied to end-user data completeness. Some distributors reported having to “chase down information” if the end-user data were incomplete. Two distributors stated that new contractors can find the data collection cumbersome when they first start participating, but it gets easier over time. One of these distributors mentioned that the implementation team started to provide them with a checklist to provide to contractors, which helped clarify what kind of information they needed to collect from the end-user. Another distributor suggested that the customer or contractor should be allowed to enter data directly into the portal and receive a code, which the distributor can then use to enter the equipment information; this would eliminate the need for the contractor to pass the information to the distributor, who then enters both the customer and the equipment data into the portal.

Contractors provided mixed feedback regarding end-user data collection. The SWWH Program also requires contractors to collect and submit end-user customer data. Two-thirds of responding contractors reported that collecting end-user customer information was somewhat easy (42%) or very easy (26%). In comparison, one-third of responding contractors reported this process as either somewhat hard (19%) or very hard (13%), as shown in Figure 11.

Figure 11. Ease of End-user Data Collection



Some contractors who found end-user data collection easy reported having no difficulty collecting end-user data (n=8), and six respondents noted that they already collect end-user data for other purposes. They also mentioned that they do

not have an issue with it, as most customers are willing to provide the data when they understand it is required for the incentive. A handful of the contractors who reported difficulty collecting end-user information mentioned dealing with multiple contacts for each customer (n=4). Other reasons included employee turnover or changes in business ownership (n=1), having difficulty collecting information after the project has been completed (n=1), lack of communication or information from the Program about end-user data collection (n=1), and the business being represented by third-party companies or a property management firm (n=1), as well as contractors' unwillingness to share end-user customer data (n=1).

Most contractors who rated end-user data collection as less than 'very easy' did not suggest how the SWWH Program could help streamline the collection of this data (70%, n=23). As shown in Table 39, contractors who found it somewhat easy to collect end-user data suggested an online form or online registration for end-users. In contrast, two contractors who had difficulty collecting end-user data suggested not collecting or requiring end-user contact information at all. Other suggestions include allowing contractors to be the point of contact for customers, asking for the property or facility point of contact instead of the business owner, or following up with contractors on required information (one mention each).

Table 39. Suggestions to Streamline End-User Data Collection

Suggestions to Streamline End-User Data Collection	Number of Respondents (n=7) ^a
Somewhat Easy (n=3)	
Online form or registration	2
Ask for property/facility point-of-contact rather than the property/facility/business owner	1
Somewhat Hard to Very Hard (n=4)	
Not to collect customer contact information	2
Allow contractors who maintain the property/facility to be the point-of-contact	1
Follow-up with contractors on data needed	1

^a This table excludes 16 respondents who had no suggestions to streamline data collection of end-user data. The remaining 8 contractors found data collection 'very easy' and were not asked this question.

6.6.4 STATEWIDE IMPLEMENTATION

The Program targets and offers incentives to all customers with a non-residential rate structure served by one of the four IOUs—SoCalGas, PG&E, SCE, and SDG&E. As part of the transition to the statewide implementation model, the Program is offered consistently across all IOU territories.

All distributors found that the reimbursement requests were processed in a timely manner. Five stated they received the reimbursements as quickly as one week. In contrast, others stated that reimbursements took up to one month, especially if the equipment claimed went through further verification by the implementation team. Two distributors mentioned that the reimbursement timing varied and expressed a desire for itemized reimbursement for incentivized equipment. However, 13 of 15 distributors stated that the reimbursement process posed no issues for their business.

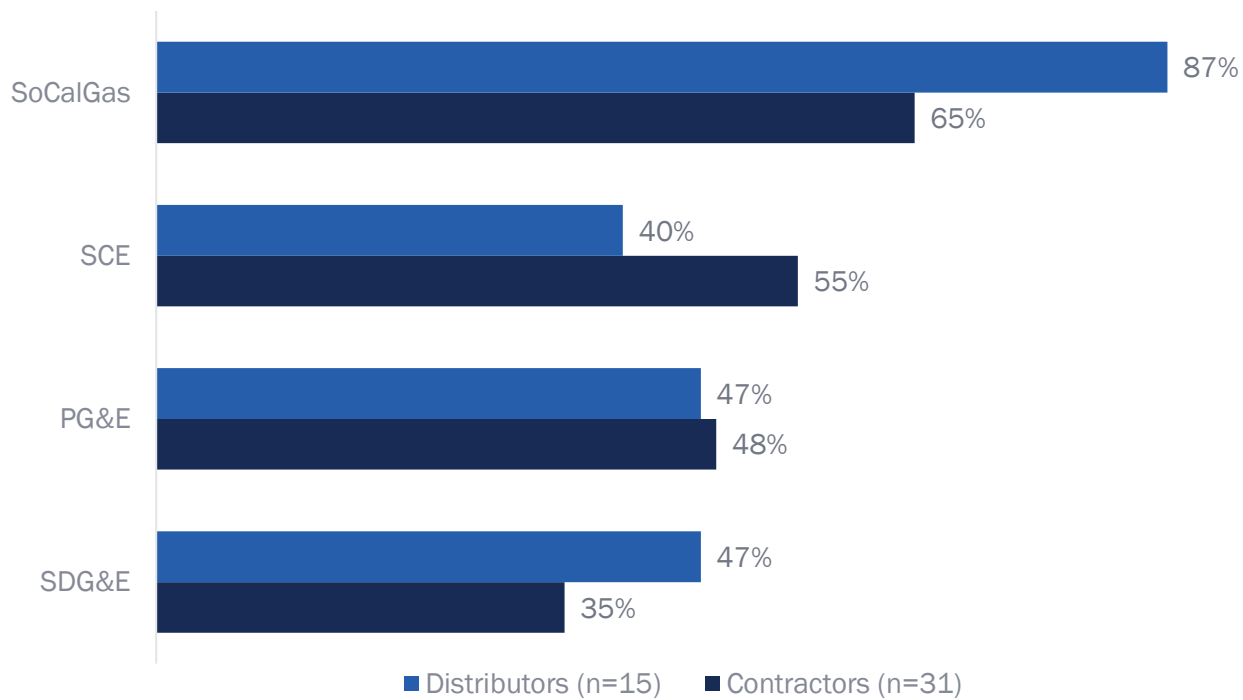
Seven of the eight distributors who reported selling equipment in multiple IOU service territories mentioned that project approval times do not vary across service territories. One distributor mentioned that approvals for projects in PG&E's territory took slightly longer than those in SoCal Gas' service territory. They mentioned that the longest they had to wait for approval in SoCal Gas' territory was a week compared to a week and a half in PG&E's territory.

Distributors reported that the SWWH Program is easier to participate in than other incentive programs in which they have participated. Most distributors (9 out of 15) participated in IOU programs before the SWWH Program. They stated

that the SWWH Program is easy to work with, has a better data submission portal, has a broader QPL, and offers better incentives than past programs.

Figure 12 shows the service territories served by the contractors and distributors. The majority of both distributors (87%) and contractors (65%) serve the SoCalGas territory. Notably, a little over half of distributors (53%) and contractors (55%) provide services in more than one service territory, while the remaining distributors and contractors provide services in one IOU service territory.

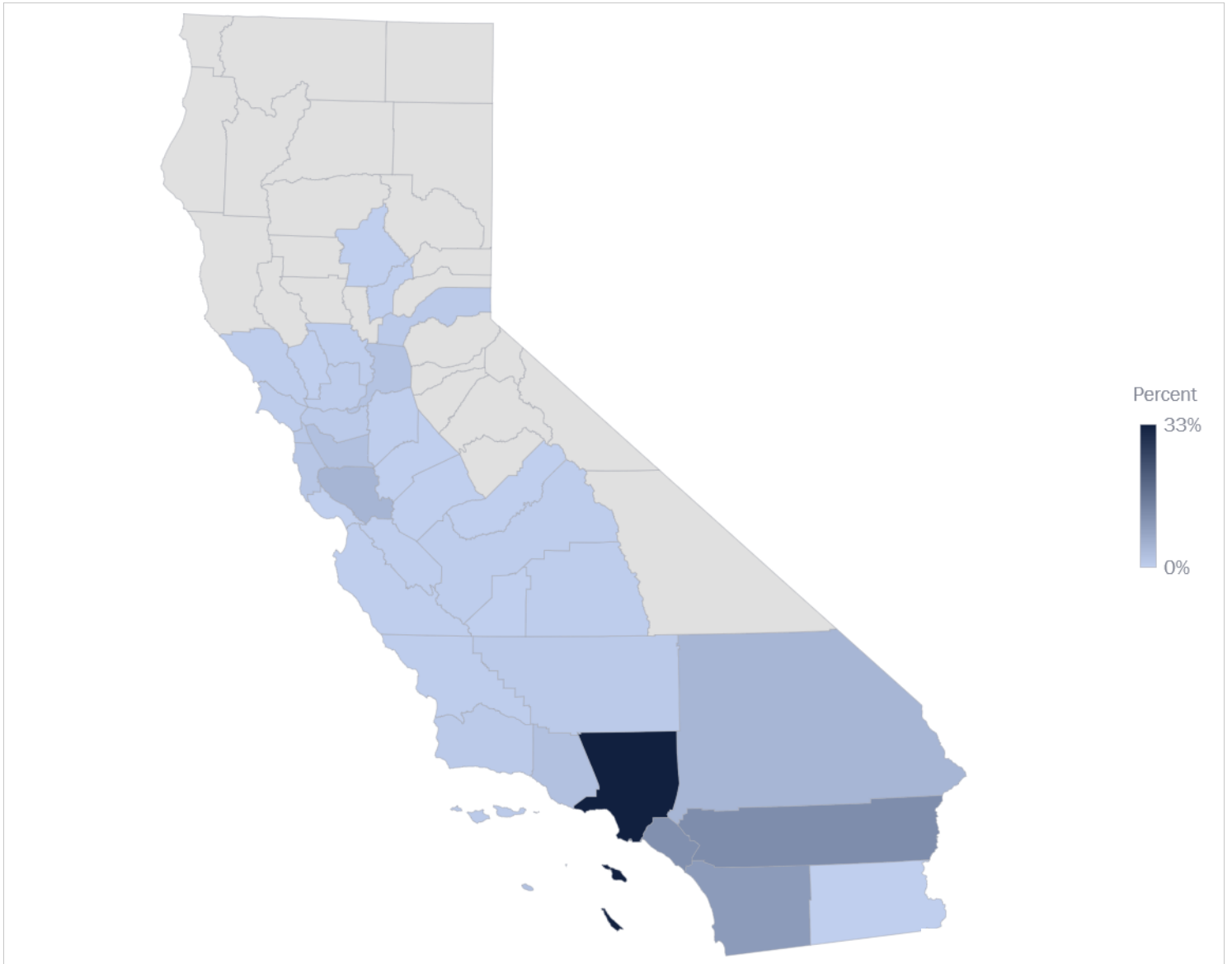
Figure 12. IOU Territories Served by Distributors and Contractors



Note: The total sums up to over 100% due to respondents with multiple responses.

Participating distributors and contractors are primarily located in Southern California, and correspondingly, the majority of commercial customers are also located in Southern California. Most participating businesses were located in Southern California counties, as shown in Figure 13. This aligns with expectations, considering the program's origins within a Southern California IOU, which transitioned to statewide implementation in 2021. The PIP also notes that the implementer's strategic approach was to prioritize distributors already enrolled in SoCalGas' legacy program to establish credibility within the distributor community. By building trust within these networks, the program aims to capitalize on this foundation to attract more distributors. Establishing a distributor network is a process that requires time but given the progress that the implementation team made in 2022 to serve Northern California counties, we anticipate participation to expand across California in the forthcoming implementation years.

Figure 13. Percent of End-Users by County



6.7 EQUIPMENT OFFERINGS

The Program offers equipment incentives for natural gas and electric water heating equipment for commercial applications. The implementation team regularly updates the QPL with new measures and adjusts savings as per CPUC decisions. Additionally, the Program actively addresses requests from distributors and manufacturers regarding QPL updates, following a thorough vetting process to ensure validity.

The majority of distributors stock both natural gas and electric water heating equipment; however, two exclusively sell natural gas equipment. On average, 80% of distributors' sales are natural gas equipment, while the remaining 20% are electric equipment. Most distributors stock tankless water heaters, followed by commercial boilers and tank water heaters. About two-thirds of distributors stock HPWHs, as shown in Table 40.

Table 40. Types of Equipment Stocked and Sold by Distributors

Type of Equipment	Percent of Distributors that Sell Equipment (n=15)
Tankless Water Heaters	93%
Commercial Boilers	87%
Tank Water Heaters	87%
HPWH	67%

6.7.1 CONTRACTOR COUPONS

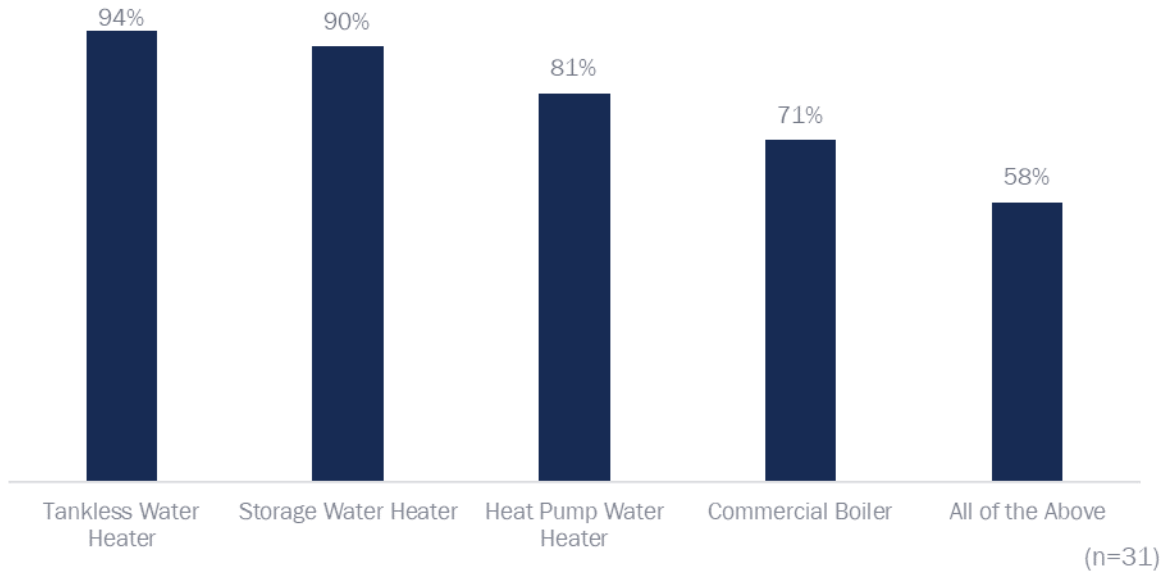
The majority of contractors did not shop at big box stores or know about the online coupon tool provided by the Program. Additionally, no contractors reported using the coupon tool. The transition of select California ratepayer-funded energy efficiency programs to a statewide 3P model is postulated to facilitate program design and implementation innovation. One of the ways that the Program planned to demonstrate innovation was through Market Segment Innovation, wherein the Program implemented an online coupon tool through which contractors could generate mobile-friendly coupons that they could use to purchase equipment from big box stores like Home Depot and Lowe’s. When asked whether they purchased equipment from big box stores in 2022, 19% of the 31 responding contractors reported shopping at big box stores. Of the 31 responding contractors, four, or 13%, indicated they were aware of the online coupon tool. However, none of the responding contractors used the coupons provided by the Program to purchase program-eligible equipment from big box stores in 2022.

6.7.2 QUALIFIED PRODUCTS LIST

The vast majority of distributors indicated satisfaction with the comprehensiveness of the QPL, with no notable omissions reported. Only one distributor reported that additional types of equipment should be added to the QPL, including hydronic systems without domestic hot water applications. Additionally, a little over half of the distributors worked with the implementation team to add new products to the QPL. All of them reported that adding new types of equipment was relatively seamless and easy, although two mentioned that it took longer than they anticipated.

A little over half of contractors reported selling and installing all types of water heating equipment offered by the program. All contractors reported installing gas water heating equipment and 81% of contractors reported installing electric water heating equipment. As shown in Figure 14, contractors primarily reported installing tankless (94%) and storage water heaters (90%). However, most contractors also reported installing heat pump water heaters (81%) and commercial boilers (71%). A little over half of contractors (58%) reported selling all four types of water heating equipment categories incentivized through the Program.

Figure 14. Water Heating Products Installed by Contractors Overall



Note: The total sums up to over 100% due to respondents with multiple responses.

6.7.3 BARRIERS TO INCREASING SALES OF ALL-ELECTRIC EQUIPMENT

This section describes the barriers inhibiting the increased adoption of all-electric water heating equipment among commercial customers and highlights insights from participating contractors and distributors.

Despite the majority of distributors stocking both electric and gas water heating equipment, only one electric HPWH project was completed in PY2022. As shown above in Table 40, most distributors stock all equipment types offered through the Program, including HPWHs (67%). However, on average HPWHs only accounted for 8% of distributor’s commercial water heating equipment sales. Distributors also reported that approximately 80% of their commercial sales consist of gas equipment, and the remaining 20% consist of electric equipment. Two distributors reported only selling gas equipment, while the remainder reported selling a mixture of gas and electric commercial water heating equipment.

Labor costs, panel upgrades, and fuel switching were identified as the primary barriers to installing HPWHs in commercial applications by contractors. Other barriers to installing HPWHs include a lack of customer awareness and contractors’ lack of knowledge and experience in installing and maintaining them, as shown in Table 41.

Table 41. Barriers to Increasing Installations of HPWHs

Barriers to Increasing Installations of HPWHs	Percentage (n=31) ^a
Cost of installing/replacing equipment (including labor costs)	52%
Need for panel or electrical upgrades at the site	52%
Existing equipment is not electric	42%
Equipment cost	42%
Equipment compatibility with other customer equipment or site conditions	42%
Lack of customer awareness of HPWHs	35%
Lack of knowledge/experience of how to install/maintain HPWHs	29%

Barriers to Increasing Installations of HPWHs	Percentage (n=31) ^a
Lack of supply of desired HPWH equipment	13%
Increasing/high electric utility costs	6%
Lack of reliability	3%
Lack of end-user customer demand for HPWH	3%
No barriers	3%

^a The total sums up to over 100% due to respondents with multiple responses.

To help increase HPWH sales, responding contractors suggested increasing marketing, education, and outreach (ME&O) and training activities to increase contractor and end-user customer awareness. Contractors also felt that increased equipment rebates or incentives would help increase the sale of HPWHs. Other suggestions include streamlining program participation processes, improving the equipment or technology, and decreasing electric costs (Table 42).

Table 42. Suggestions for Increasing Sales of HPWHs

Ways Program Can Help Sell More HPWHs	Percentage (n=31) ^a
Increase ME&O and training to increase contractor and customer awareness	35%
Increase rebate/incentive amounts	19%
Streamlining participation process	6%
Improving technology/equipment	6%
Decreasing electric costs	3%
Promote other HPWH rebates alongside midstream incentives	3%
No suggestions	19%
Don't know	13%

^a The total sums up to over 100% due to respondents with multiple responses.

As a point of comparison to the barriers to installing HPWHs, contractors reported that fuel switching, panel upgrades, equipment costs, and labor costs were the primary barriers to installing electric resistance water heaters. The majority of contractors (68%) reported that existing fuel sources are a major barrier to installing more electric equipment. They also cited the need for panel or electrical upgrades, equipment cost, and the cost of installing or replacing equipment (including labor costs) as key barriers to increasing the installation of electric resistance water heaters. A few respondents also mentioned that the increasing or high cost of electricity is also a barrier to installing electric water heating equipment (Table 43).

Table 43. Barriers to Increasing Electric Resistance Water Heaters

Barriers to Increasing Installations of Electric Resistance Water Heaters	Percentage (n=31) ^a
Existing equipment is not electric	68%
Need for panel or electrical upgrades at the site	65%
Equipment cost	58%

Barriers to Increasing Installations of Electric Resistance Water Heaters	Percentage (n=31) ^a
Cost of installing/replacing equipment (including labor costs)	52%
Equipment compatibility with other customer equipment or site conditions	35%
Lack of customer awareness of electric resistance water heaters	32%
Lack of supply of desired electric resistance water heating equipment	23%
Lack of knowledge of how to install electric resistance water heaters	10%
Increasing/high electric utility costs	9%

^a The total sums up to over 100% due to respondents with multiple responses.

Looking forward, we interviewed a member of the VEA on the potential impact of that initiative on the SWWH Program. This member of the VEA working group noted that the VEA policy currently only affects new construction commercial equipment, which likely represents a minor portion of SWWH Program savings, but the CPUC will likely expand this policy in the future. Given that the general purpose of VEA policy is to encourage electrification of end-uses where viable electric alternative equipment exists, future efforts will likely more directly impact the SWWH Program.

The program appears to be preparing for an increased emphasis on fuel substitution. Members of the California Technical Forum (CaTF) noted the SWWH Program implementer was among the first to submit a new measure through the online Measure Proposal Form, and submitted several new measures in 2020, including a heat pump water heater. Also, according to the eTRM Measure Development Report available on the eTRM dashboard, there are numerous proposed revisions to existing measure packages currently under review, including several for HPWH equipment including SWWH033-03-3, SWWH031-04-1, SWWH027-05-1, SWWH028-04-3).⁵⁶

Finally, according to the SCG PY2023 Energy Efficiency Annual Report, by the end of 2023, the SWWH Program was primarily offering HPWHs⁵⁷, although a review of 2023 CEDARS claims indicated program installations in 2023 were still dominated by TWHs.

6.8 PARTICIPATION ASSESSMENT

According to tracking program data provided by the implementation team⁵⁸, the Program served 1,074 unique commercial customers by address in PY2022. The majority of commercial customers received a TWH (70%), followed by SWH (25%) as shown in Table 44.

Table 44. PY2022 Implementer Data Total Measures Installed and End-Users Served

Product Type	Total Units Sold	Unique Addresses Served	Percent of Addresses
Tankless Water Heater	2,390	750	70%
Tanked Storage Water Heater	449	267	25%
Commercial Boiler	128	70	7%
Heat Pump Water Heater	1	1	0.1%

⁵⁶ <https://www.caetrm.com/cpuc-status-report/development>

⁵⁷ Southern California Gas Company (U 904 G) Energy Efficiency Programs 2023 Annual Report. May 1, 2024

⁵⁸ The evaluation team was unable to replicate the total number of units in the CEDARs database. This table shows the total number of units installed at end-user commercial customer addresses according to the implementer's database. More information about this difference is provided in Section 6.1.1 Database Review.

When a project undergoes third-party quality assurance verification, end-users are asked questions about their business to determine their HTR status, including the number of employees, the primary language spoken, and whether they own or rent their facility, as shown in Table 45. Details regarding the QA sampling methodology that the Program uses is provided in Section 6.2

Table 45. Quality Assurance Verification Business Firmographics

Firmographic Information	Number of Businesses (n=189)	Percent of Participants
Number of Employees		
0-10 Employees	43	23%
10+ Employees	145	77%
Don't know	1	1%
Primary Language Spoken		
English	163	86%
Spanish	10	5%
English Mix	8	4%
Korean	5	3%
Other	2	1%
Don't Know	1	1%
Ownership Status		
Own	119	63%
Rent	69	37%
Don't Know	1	1%

6.8.1 DAC AND HTR COMMUNITIES

One of the program's objectives is to increase the adoption of high-efficiency equipment among HTR businesses and businesses located in DACs.⁵⁹ The program defined HTR communities as falling into one of the following criteria:

1. The business must have fewer than ten employees, operate in a leased space, and English is the staff's second language or,
2. The business is in a DAC and meets at least one criterion from item 1 or,
3. The business is located outside of specified counties and meets one criterion from item 1.⁶⁰

In PY2022, the SWWH Program served businesses in 512 zip codes, with 238 in a DAC (46%). As a point of comparison, of California's 1,765 active zip codes, 495 are categorized as located in a DAC census tract (Table 46).⁶¹

⁵⁹ CalEnviroScreen 4.0 Scores were utilized to identify the projects located in Disadvantaged Community (DAC) areas.

⁶⁰ Counties included Contra Costa, Marin, Napa, San Benito, San Francisco, San Mateo, Santa Clara, Santa Cruz, Sonoma, Solano, Nevada, Placer, Sacramento, San Joaquin, Sutter, Yolo Yuba, Orange, San Bernardino, Riverside, Ventura, San Diego, and Los Angeles.

⁶¹ Note that not all California zip codes are eligible to participate in the SWWH Program because installations are required to occur within an IOU service territory.

Table 46. Number of DAC Zip Codes Served by Program

	Total	Served by Program	Percent Served
All Zip Codes	1,765	512	29%
DAC Zip Codes	495	238	46%

Based on the implementation team’s definition of HTR businesses, the evaluation team determined the number of measures installed in HTR communities (Table 47). Additionally, we determined the number of businesses that fell into a DAC community based on census tract and zip code. The DAC analysis was conducted with the entire population since the data provided included addresses for all end-users.

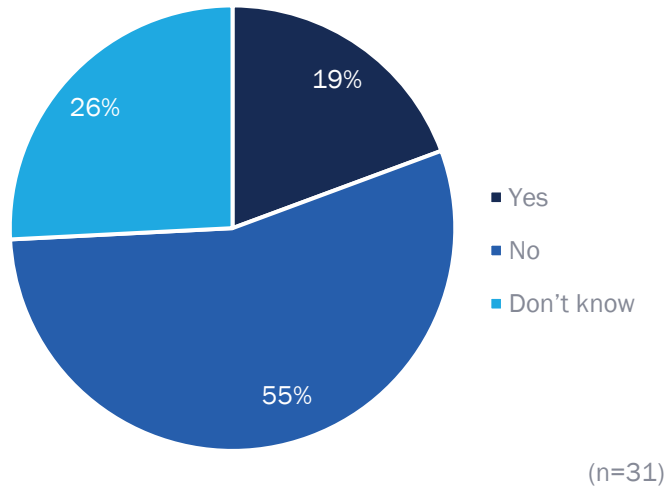
Table 47. Number of Measures Installed in HTRs/DACs

Type of Measure	Number of DAC/ HTR Participating Businesses	Total Number of Measures Installed	Number of Measures Installed in HTR/DAC Business'	Percent of Measures
HTR Definition (n=189)				
Tankless Water Heater	51	1,067	151	14%
Tanked Storage Water Heater	5	65	13	20%
Commercial Boiler	1	2	1	50%
Heat Pump Water Heater	0	0	0	0%
DAC Definition (n=1,074)				
Tankless Water Heater	359	1,419	971	41%
Tanked Storage Water Heater	115	449	188	42%
Commercial Boiler	28	128	36	28%
Heat Pump Water Heater	0	1	0	0%

6.8.2 SERVING DAC AND HTR CUSTOMERS

One way to ensure that the Program reaches HTR customers and DACs is to ensure the participation of distributors and contractors who serve those areas. Most contractors reported that they did not operate in an HTR area or DACs or were unaware if they operated within an HTR area or a DAC. Slightly less than one-fifth of contractors reported serving DACs or areas with HTR customers (Figure 15).

Figure 15. Contractors Serving DACs or HTR Customers



The barriers to increased adoption of high-efficiency water heating equipment among HTR and small businesses that contractors reported are similar to the barriers contractors reported to increased electric equipment adoption. Barriers to increasing adoption of high-efficiency water heating equipment among HTR and small business customers and businesses in DACs include the cost of labor to install or replace water heating equipment, equipment cost, and the lack of awareness of high-efficiency water heating equipment (Table 48). Contractors also mentioned that the lack of customer demand for high-efficiency water heating equipment and insufficient discounts on program-eligible equipment are barriers to increasing the adoption of such equipment among HTR customers and DACs.

Table 48. Barriers to Increasing Adoption of High-Efficiency Water Heating Equipment Among DACs

Barriers to Increasing Adoption of High-Efficiency Water Heating Equipment	Percentage (n=31) ^a
Cost of labor to install/replace equipment	68%
Equipment cost	58%
Lack of customer awareness of high-efficiency water heating equipment	45%
Lack of customer desire to purchase high-efficiency water heating equipment	39%
Insufficient discounts on program-eligible high-efficiency equipment	29%
Other	10%

^a The total sums up to over 100% due to respondents with multiple responses.

6.9 SATISFACTION

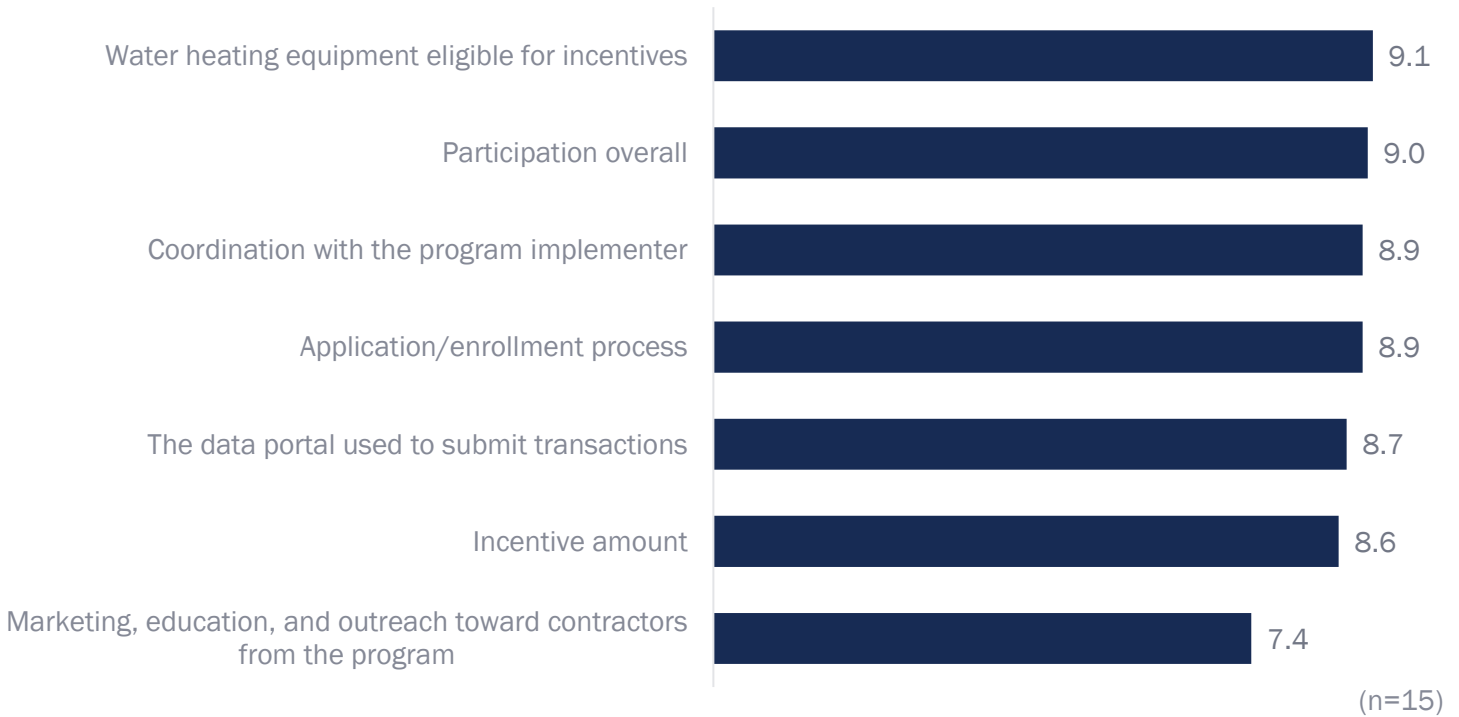
Distributors and contractors both report high levels of satisfaction with the SWWH Program. We present detailed findings on both in the sections below.

6.9.1 DISTRIBUTOR

Distributor satisfaction with program components was consistently high across program components. Distributors are very satisfied overall with the types of equipment listed in the QPL, coordination with the implementation team, and

their participation as shown in Figure 16 below. The majority of distributors (12 out of 15) mentioned they would recommend the Program to other distributors. The remaining three stated that it was a good program that gave them a competitive advantage, which is why they would hesitate to recommend it to their competition.

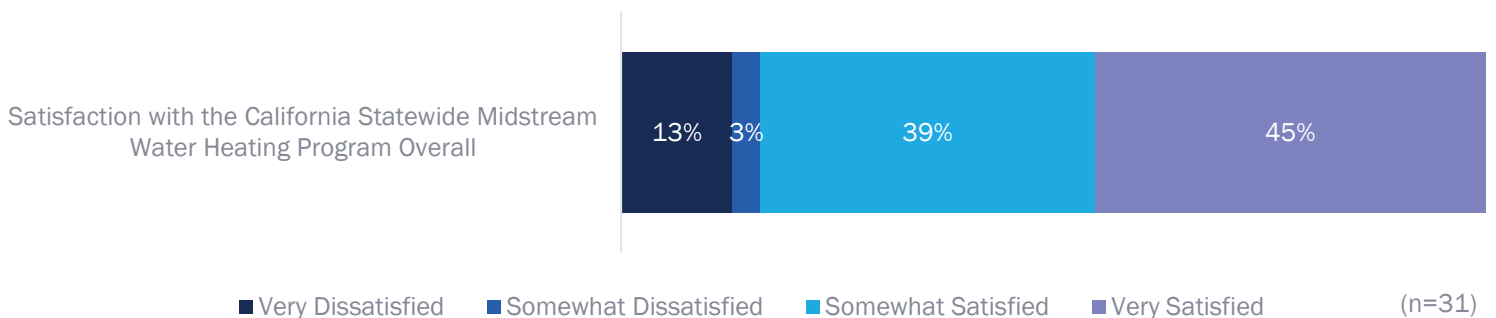
Figure 16. Distributor Satisfaction with Program Components



6.9.2 CONTRACTOR

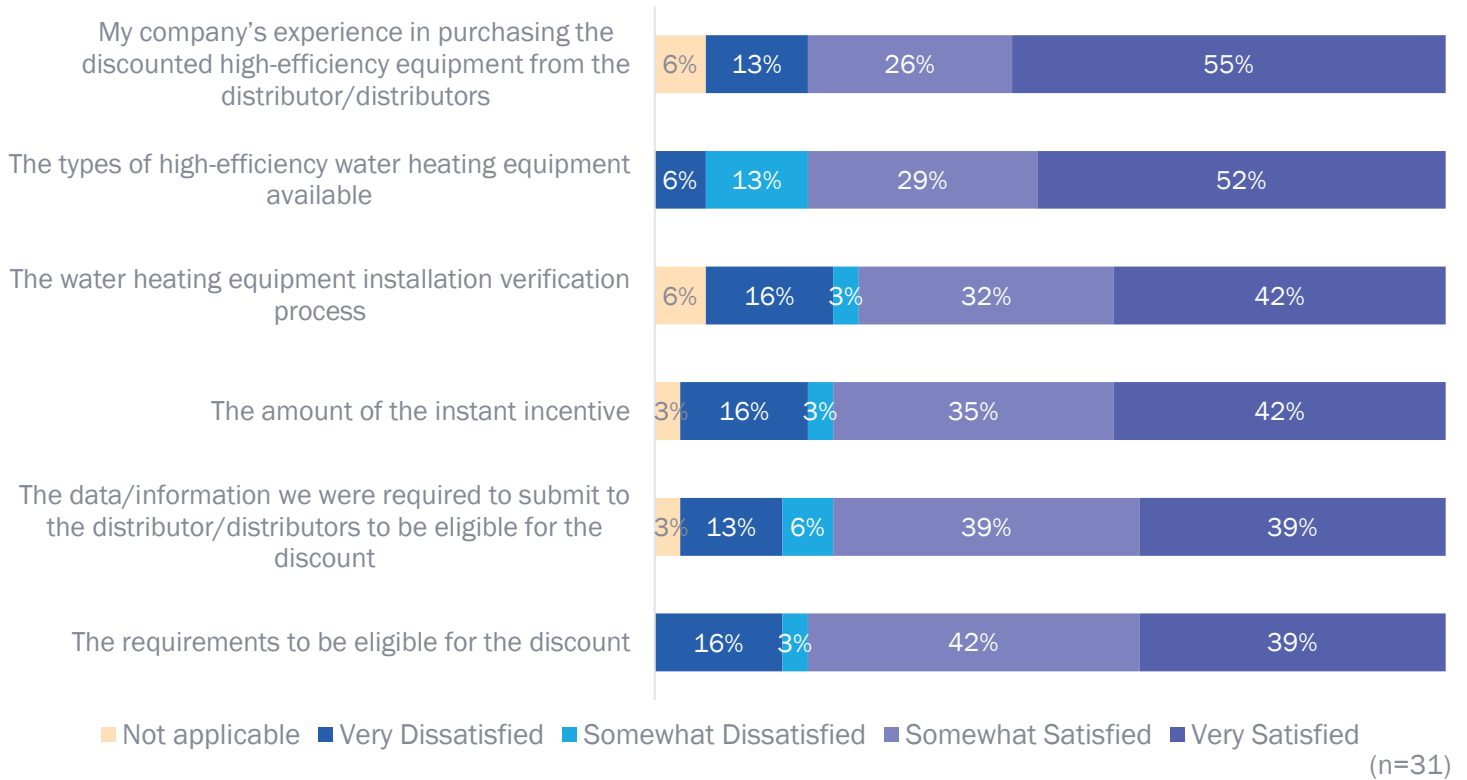
The majority (84%) of responding contractors reported being satisfied with the Program overall. In comparison, 13% were very dissatisfied with the Program, as shown in Figure 17.

Figure 17. Contractor Satisfaction with Program Overall



More than two-thirds of the contractors reported being satisfied with all the program components, including their company's experience purchasing water heating equipment from participating distributors, the types of water heating equipment offered, and the verification process (Figure 18). This finding suggests that contractors had a positive and perhaps even relatively hassle-free experience participating in the Program.

Figure 18. Contractor Satisfaction with Program Components



Five out of eleven contractors who reported being less than 'somewhat satisfied' with the types of water heating equipment available through the Program reported that they felt the QPL was not inclusive enough. Other reasons mentioned included a lack of information, training, and distributor knowledge regarding the equipment (n=3), equipment cost (n=1), lack of incentive/rebate (n=1), and lack of transparency (n=1). To improve the Program, 16% of the 31 responding contractors suggested increasing ME&O activities. Other suggestions include allowing contractors to participate directly (3%), allowing end-user customers to apply for the rebate/discount (3%), hiring third-party implementers within the State of California (3%), increasing rebates/incentives (3%), lowering equipment costs for end-user customers (3%), and training third-party implementers (3%). The rest of the respondents had no suggestions (68%).

7. CONCLUSION AND RECOMMENDATIONS

Key Finding	Recipient	Recommendation
Impact-Related Findings		
Final savings in the program implementer’s tracking data did not align with the eTRM measure package versions effective for PY2022 for large tankless water heaters (TWH) and commercial domestic hot water (DHW) boilers. The program tracking data only indicates the basic measure and offering ID (e.g., SWWH005E, SWWH006C)	Implementer	<ul style="list-style-type: none"> Implement QA/QC procedures to ensure final implementer savings use eTRM measure package versions effective for the program year. In the program tracking data, clearly indicate the version of the eTRM measure package used to develop savings. If possible, also include the actual eTRM permutation file used.
Almost a third of the PY2022 therm savings come from claims using a “Com” building type, and most “Com” projects in the desk review sample were multifamily sites. For water heating equipment installed in multifamily buildings, the Program used commercial eTRM measures and the “Com” (commercial sector average) building type instead of a multifamily building type. Another minor issue that was documented in the desk review process was the mischaracterization of building types, such as a nursing home that was mischaracterized as a restaurant (8 of 75 claims).	Implementer	<ul style="list-style-type: none"> If residential multifamily applications continue to be valid for this program, use multifamily-specific eTRM measure packages and permutations to develop reported savings instead of the commercial measure packages, which do not include a multifamily building type. Quality assurance processes should be reviewed or established to validate the building type assigned to end-users.
The SWWH Program used the eTRM TWH measure package, which assumes a SWH baseline. However, this assumption does not make sense for newly constructed buildings and is also not applicable if the incentivized TWH is replacing an existing, failed TWH or boiler. Six completed end-user surveys to investigate this issue found that only half of the projects replaced an SWH.	Implementer	<ul style="list-style-type: none"> Conduct a more robust baseline study to determine the mixture of SWHs and TWHs replaced by incentivized TWHs in existing buildings. For TWHs installed in new construction buildings or replacing existing TWHs, apply the small/medium (<200 kBtuh) commercial boiler measure package (SWWH005), which uses code-minimum efficiency equipment as the baseline. Do not use the commercial TWH measure package (SWWH006) for midstream programs since the SWH baseline cannot be validated. The program implementation team should use a code-minimum TWH as the baseline.
The evaluation team was unable to match up the records in the implementer’s program tracking data with the records in the CEDARS database. The evaluation team was unable to recreate the savings in the CEDARS database, in part, because of its complex nature. The database records four entries (one for each IOU) for each record in the implementer data. Further, the PA did not rely on implementer final savings for CEDARS claims, but calculated final savings claims based on a subset of implementer tracking data.	Implementer / PA	<ul style="list-style-type: none"> Provide a clear and transparent process to trace CEDARS data to the original savings record in the implementer’s program tracking data at a record level. The PA should fully document the process of translating final implementer data into reported CEDARS claims.
A valid end-user address for the equipment installation was provided for almost all desk review sites and is fully populated in the program tracking data. End-user contact information (e.g., email and phone) was primarily populated with duplicated contractor information. Only about a third of the claims contained end-user contact information.	Implementer	<ul style="list-style-type: none"> Business name and address are often sufficient to verify the business type and location of an end-user for an impact evaluation. However, verifying the replaced equipment, building information, and/or primary or secondary configurations often requires the input of the end-user or installing

Key Finding	Recipient	Recommendation
		contractor. Therefore, the implementation team should improve the collection of end-user phone and email contact information to facilitate end-user research and evaluation.
The implementer provided invoices for all sampled projects and included specific data requirements on invoices in addition to the typical items (i.e., equipment make, model, quantity, etc.) that greatly facilitated evaluability, including end-user address, serial numbers, program name, and incentive amount.	Implementer	<ul style="list-style-type: none"> No Recommendation
The implementer maintained a QPL from certified sources to validate equipment program eligibility, track key equipment performance characteristics (i.e., product type, heating capacity, and efficiency) and used these values to map to the correct eTRM Measure Package. The QPL accuracy was also verified for the desk review sample. The QPL with eTRM measure package mapping was integral to the savings development process.	Implementer	<ul style="list-style-type: none"> Consider making the QPL, including the eTRM measure package matching, an integral part of the program tracking data for future evaluations.
Process-Related Findings		
One-on-one support provided by the Program's implementation team was highly valued by distributors and instrumental in their successful participation.	Implementer	<ul style="list-style-type: none"> No Recommendation
While contractors generally found eligibility requirements clear, distributors faced challenges with contractor end-user data collection, with some contractors initially hesitant to provide information.	Implementer	<ul style="list-style-type: none"> Enhance communication and streamline processes between distributors and contractors to improve end-user data collection. Provide comprehensive training and resources to distributors to assist in training contractors to ensure they understand the importance of data completeness for program incentives. Provide contractors with standardized checklists and regular communication of Program protocols to facilitate efficient and accurate data collection processes.
The majority of contractors did not shop at big box stores or utilize the Program's online coupon tool, with only 13% aware of the tool and none using it to purchase program-eligible equipment.	Implementer	<ul style="list-style-type: none"> To increase the effectiveness and adoption of the online coupon tool, the Program implementer should enhance awareness and promotion of the tool among contractors. This could include targeted communication campaigns, training sessions on how to use the tool, and demonstrating the benefits and ease of purchasing equipment from big box stores using the coupons.
The Program is successfully working with participating distributors to incentivize efficient water heating equipment, but most participating businesses and contractors are concentrated in Southern California. The PIP highlights the implementer's strategy of prioritizing distributors from SoCalGas' legacy program to establish credibility, aiming to leverage this trust to attract additional distributors. Yet, given that the program launched in May of 2021 we would expect participation to be more dispersed across the state by 2022.	Implementer	<ul style="list-style-type: none"> The Program implementer should target outreach efforts and support to distributors and contractors in other parts of the state beyond southern California. This could include tailored marketing campaigns, incentives, and training programs to increase awareness and participation statewide.

Key Finding	Recipient	Recommendation
Based on our desk reviews, the program likely incentivized some in-unit water heating measures, which would only be valid if the multifamily building in which they were installed is master metered. Further, the process of verifying the eligibility of multifamily installations was described as ad hoc in program staff interviews.	Implementer / PA	<ul style="list-style-type: none"> ▪ The Program administrator and implementer should formalize a process of verifying the eligibility of multifamily installations to ensure equipment is only installed on non-residential/commercial rate meters.
Distributors are largely satisfied with the comprehensiveness of the QPL, with no significant omissions reported. Over half of the distributors worked with the implementation team to add new products, finding the process relatively seamless.	Implementer	<ul style="list-style-type: none"> ▪ No Recommendation

APPENDIX A. DATA STANDARDIZED HIGH-LEVEL SAVINGS

GROSS AND NET FIRST YEAR SAVINGS

The following tables share the gross and net CEDARS program first year savings.

Table 49. Gross and Net First Year CEDARS Program Therm Savings

Offering Category	Reported Gross Therms	Gross Realization Rate Therms	Evaluated Gross Therms	Net to Gross Ratio	Evaluated Net Therms
Small Instant TWH	1,871,344	64%	1,205,781	0.52	627,006
Large Instant TWH	544,451	103%	558,971	0.52	290,665
Large DHW Boiler	488,521	94%	457,606	0.52	237,955
Large Storage WH	272,719	107%	292,438	0.52	152,068
HPWH	603	100%	603	0.52	314
Totals	3,177,638	79%	2,515,399	0.52	1,308,007

Table 50. Gross and Net First Year CEDARS Program kWh Savings

Offering Category	Revised Final Gross kWh	Gross Realization Rate kWh	Evaluated Gross kWh	Net to Gross Ratio	Evaluated Net kWh
Small Instant TWH	-240,346	93%	-224,416	0.52	-116,696
Large Instant TWH	-70,400	99%	-69,533	0.52	-36,157
Large DHW Boiler	-36,967	9%	-3,444	0.52	-1,791
Large Storage WH	-38,338	99%	-37,825	0.52	-19,669
HPWH	-4,570	100%	-4,570	0.52	-2,376
Totals	-390,620	87%	-339,788	0.52	-176,690

Table 51. Gross and Net First Year CEDARS Program kW Savings

Offering Category	Revised Final Gross kW	Gross Realization Rate kW	Evaluated Gross kW	Net to Gross Ratio	Evaluated Net kW
Small Instant TWH	-32	93%	-30	0.52	-15
Large Instant TWH	-8	108%	-8	0.52	-4
Large DHW Boiler	-3	4%	-0.13	0.52	-0.068
Large Storage WH	-5	97%	-5	0.52	-3
HPWH	0	100%	0	0.52	0
Totals	-48	90%	-43	0.52	-22

GROSS AND NET LIFECYCLE SAVINGS

The following tables share the gross and net CEDARS program lifecycle savings.

Table 52. Gross and Net Lifecycle CEDARS Program Therm Savings

Offering Category	Revised Final Gross Therms	Gross Realization Rate Therms	Evaluated Gross Therms	Net to Gross Ratio	Evaluated Net Therms
Small Instant TWH	37,426,875	64%	24,115,613	0.52	12,540,119
Large Instant TWH	10,889,026	103%	11,179,427	0.52	5,813,302
Large DHW Boiler	9,770,420	94%	9,152,123	0.52	4,759,104
Large Storage WH	4,090,790	107%	4,386,567	0.52	2,281,015
HPWH	6,030	100%	6,030	0.52	3,136
Totals	62,183,141	79%	48,839,760	0.52	25,396,675

Table 53. Gross and Net Lifecycle CEDARS Program kWh Savings

Offering Category	Revised Final Gross kWh	Gross Realization Rate kWh	Evaluated Gross kWh	Net to Gross Ratio	Evaluated Net kWh
Small Instant TWH	-4,806,915	93%	-4,488,311	0.52	-2,333,922
Large Instant TWH	-1,407,993	99%	-1,390,656	0.52	-723,141
Large DHW Boiler	-739,331	9%	-68,888	0.52	-35,822
Large Storage WH	-575,073	99%	-567,373	0.52	-295,034
HPWH	-45,700	100%	-45,700	0.52	-23,764
Totals	-7,575,012	87%	-6,560,929	0.52	-3,411,683

GROSS AND NET LIFECYCLE SAVINGS BY IOU

The following tables share the gross and net CEDARS program lifecycle savings by IOU.

Table 54. Total Statewide Program Savings Distributed by IOU

IOU	Claims	First Year kW		First Year kWh		Lifecycle Net kWh	First Year Therms		Lifecycle Net Therms
		Gross	Net	Gross	Net		Gross	Net	
PG&E	3,023	-21.25	-12.75	-173,435	-104,873	-2,026,100	1,601,530	961,039	18,805,398
SCE	3,023	-19.19	-11.51	-156,639	-94,716	-1,829,878	0	0	0
SoCalGas	3,023	0.00	0.00	0	0	0	1,328,253	797,053	15,596,541
SDG&E	3,023	-7.42	-4.45	-60,546	-36,611	-707,310	247,856	148,732	2,910,359
Total	12,092	-47.86	-28.71	-390,620	-236,200	-4,563,288	3,177,638	1,906,824	37,312,298

Note: For PY2022, there was only one fuel substitution measure claim, and the remainder were gas measures.

APPENDIX B. RESPONSE TO RECOMMENDATION

Rec #	Program or Database	Key Finding	Recipient	Recommendation	Affected Workpaper or DEER
Impact-Related Findings					
1	Statewide Third-Party Midstream Commercial Water Heating Program	Final savings in the program implementer's tracking data did not align with the eTRM measure package versions effective for PY2022 for large tankless water heaters (TWH) and commercial domestic hot water (DHW) boilers. The program tracking data only indicates the basic measure and offering ID (e.g., SWWH005E, SWWH006C)	Implementer	<ul style="list-style-type: none"> Implement QA/QC procedures to ensure final implementer savings use eTRM measure package versions effective for the program year. In the program tracking data, clearly indicate the version of the eTRM measure package used to develop savings. If possible, also include the actual eTRM permutation file used. 	<ul style="list-style-type: none"> All Measures
2	Statewide Third-Party Midstream Commercial Water Heating Program	Almost a third of the PY2022 therm savings come from claims using a "Com" building type, and most "Com" projects in the desk review sample were multifamily sites. For water heating equipment installed in multifamily buildings, the Program used commercial eTRM measures and the "Com" (commercial sector average) building type instead of a multifamily building type. Another minor issue that was documented in the desk review process was the mischaracterization of building types, such as a nursing home that was mischaracterized as a restaurant (8 of 75 claims).	Implementer	<ul style="list-style-type: none"> If residential multifamily applications continue to be valid for this program, use multifamily-specific eTRM measure packages and permutations to develop reported savings instead of the commercial measure packages, which do not include a multifamily building type. Quality assurance processes should be reviewed or established to validate the building type assigned to end-users. 	<ul style="list-style-type: none"> All Measures
3	Statewide Third-Party Midstream Commercial Water Heating Program	The SWWH Program used the eTRM TWH measure package, which assumes a SWH baseline. However, this assumption does not make sense for newly constructed buildings and is also not applicable if the incentivized TWH is replacing an existing, failed TWH or boiler. Six completed end-user surveys to investigate this issue found that only half of the projects replaced an SWH.	Implementer	<ul style="list-style-type: none"> Conduct a more robust baseline study to determine the mixture of SWHs and TWHs replaced by incentivized TWHs in existing buildings. For TWHs installed in new construction buildings or replacing existing TWHs, apply the small/medium (<200 kBtuh) commercial boiler measure package (SWWH005), which uses code-minimum efficiency equipment as the baseline. Do not use the commercial TWH measure package (SWWH006) for midstream programs since the SWH baseline cannot be validated. The 	<ul style="list-style-type: none"> SWWH006

Rec #	Program or Database	Key Finding	Recipient	Recommendation	Affected Workpaper or DEER
				program implementation team should use a code-minimum TWH as the baseline.	
4	Statewide Third-Party Midstream Commercial Water Heating Program	The evaluation team was unable to match up the records in the implementer's program tracking data with the records in the CEDARS database. The evaluation team was unable to recreate the savings in the CEDARS database, in part, because of its complex nature. The database records four entries (one for each IOU) for each record in the implementer data. Further, the PA did not rely on implementer final savings for CEDARS claims, but calculated final savings claims based on a subset of implementer tracking data.	Implementer / PA	<ul style="list-style-type: none"> Provide a clear and transparent process to trace CEDARS data to the original savings record in the implementer's program tracking data at a record level. The PA should fully document the process of translating final implementer data into reported CEDARS claims. 	<ul style="list-style-type: none"> All Measures
5	Statewide Third-Party Midstream Commercial Water Heating Program	A valid end-user address for the equipment installation was provided for almost all desk review sites and is fully populated in the program tracking data. End-user contact information (e.g., email and phone) was primarily populated with duplicated contractor information. Only about a third of the claims contained end-user contact information.	Implementer	<ul style="list-style-type: none"> Business name and address are often sufficient to verify the business type and location of an end-user for an impact evaluation. However, verifying the replaced equipment, building information, and/or primary or secondary configurations often requires the input of the end-user or installing contractor. Therefore, the implementation team should improve the collection of end-user phone and email contact information to facilitate end-user research and evaluation. 	<ul style="list-style-type: none"> All Measures
6	Statewide Third-Party Midstream Commercial Water Heating Program	The implementer maintained a QPL from certified sources to validate equipment program eligibility, track key equipment performance characteristics (i.e., product type, heating capacity, and efficiency) and used these values to map to the correct eTRM Measure Package. The QPL accuracy was also verified for the desk review sample. The QPL with eTRM measure package mapping was integral to the savings development process.	Implementer	<ul style="list-style-type: none"> Consider making the QPL, including the eTRM measure package matching, an integral part of the program tracking data for future evaluations. 	<ul style="list-style-type: none"> All Measures
Process-Related Findings					
7	Statewide Third-Party Midstream Commercial	While contractors generally found eligibility requirements clear, distributors faced challenges with contractor end-user data collection, with some contractors initially hesitant to provide information.	Implementer	<ul style="list-style-type: none"> Enhance communication and streamline processes between distributors and contractors to improve end-user data collection. Provide comprehensive training and resources 	<ul style="list-style-type: none"> All Measures

Rec #	Program or Database	Key Finding	Recipient	Recommendation	Affected Workpaper or DEER
	Water Heating Program			to distributors to assist in training contractors to ensure they understand the importance of data completeness for program incentives. Provide contractors with standardized checklists and regular communication of Program protocols to facilitate efficient and accurate data collection processes.	
8	Statewide Third-Party Midstream Commercial Water Heating Program	The majority of contractors did not shop at big box stores or utilize the Program's online coupon tool, with only 13% aware of the tool and none using it to purchase program-eligible equipment.	Implementer	<ul style="list-style-type: none"> To increase the effectiveness and adoption of the online coupon tool, the Program implementer should enhance awareness and promotion of the tool among contractors. This could include targeted communication campaigns, training sessions on how to use the tool, and demonstrating the benefits and ease of purchasing equipment from big box stores using the coupons. 	<ul style="list-style-type: none"> All Measures
9	Statewide Third-Party Midstream Commercial Water Heating Program	The Program is successfully working with participating distributors to incentivize efficient water heating equipment, but most participating businesses and contractors are concentrated in Southern California. The PIP highlights the implementer's strategy of prioritizing distributors from SoCalGas' legacy program to establish credibility, aiming to leverage this trust to attract additional distributors. Yet, given that the program launched in May of 2021 we would expect participation to be more dispersed across the state by 2022.	Implementer	<ul style="list-style-type: none"> The Program implementer should target outreach efforts and support to distributors and contractors in other parts of the state beyond southern California. This could include tailored marketing campaigns, incentives, and training programs to increase awareness and participation statewide. 	<ul style="list-style-type: none"> All Measures
10	Statewide Third-Party Midstream Commercial Water Heating Program	Based on our desk reviews, the program likely incentivized some in-unit water heating measures, which would only be valid if the multifamily building in which they were installed is master metered. Further, the process of verifying the eligibility of multifamily installations was described as ad hoc in program staff interviews.	Implementer / PA	<ul style="list-style-type: none"> The Program administrator and implementer should formalize a process of verifying the eligibility of multifamily installations to ensure equipment is only installed on non-residential/commercial rate meters. 	<ul style="list-style-type: none"> All Measures

APPENDIX C. DATA COLLECTION INSTRUMENTS

This appendix includes the data collection instruments used for the Distributor In-Depth Interviews and Contractor Survey.

DISTRIBUTOR IN-DEPTH INTERVIEW GUIDE



2022 SW3PWH
Distributor Interview

CONTRACTOR WEB SURVEY INSTRUMENT



2022 SW3PWH
Contractor Survey FI

APPENDIX D. RESPONSE RATE AND OUTREACH DISPOSITION SUMMARIES

This appendix summarizes the disposition or outcome of outreach conducted for the Distributor In-Depth Interviews and Contractor Survey.⁶²

DISTRIBUTOR IN-DEPTH INTERVIEWS

We recruited distributors to participate in interviews from April to May of 2024. Outreach was conducted via email and phone. Distributors were contacted up to five times beginning with an email invitation and followed up by phone call and email reminders.

Table 55. Distributor Disposition Summary

Disposition	Number of Sample Points
Completes	15
Partial Completes	1
Refusals	5
No Response	20
Total	47

CONTRACTOR SURVEY

CONTRACTOR SURVEY DISPOSITION SUMMARY

We fielded one web survey from April 11 to May 5, 2024. Initial outreach was primarily conducted via email with one formal invite and two reminders. However, to help increase the survey response rate, the evaluation team sent additional email reminders and conducted outbound phone calls to follow up and/or offer to conduct the survey by phone with contractors included in the sample.

Table 56 provides a summary of the survey dispositions for the web survey.

Table 56. Contractor Survey Disposition Summary

Disposition	Number of Sample Points
Completes	31
Partial Completes	0
Refusals/Break-Offs	47
Non-Contacts	343
Others	32
Break-Offs (with eligibility)	0
Unknown If Eligible For Survey	47
Unknown If Eligible For Survey, Other	0
Unknown If Eligible Household/Business/Respondent	343
Unknown If Eligible Household/Business/Respondent, Other	32

⁶² Dispositions are the results for each potential response to a survey, these could include survey bounce-backs, ineligible respondents, or respondents who may end the survey prior to completion. Each of these dispositions are used to calculate response rates for surveys.

Disposition	Number of Sample Points
Unused Sample	0
Ineligible for Survey	2
Ineligible Household/Business/Respondent	0
Ineligible Sample Units	69

Table 57 and Table 58 summarize the final dispositions from outreach done via email and outbound calls, respectively. For the outbound follow-up calls, the evaluation team excluded contractors who had completed the survey before the evaluation team began outbound calls and contractors who were included in the engineering sample.

Table 57. Email Outreach Final Disposition Summary

Final Disposition	Number of Sample Points	Percent (n= 215)
No response	91	42%
Undeliverable email	64	30%
Complete	31	14%
Screen-out	27	13%
Terminate	2	1%
Grand Total	215	

Table 58. Phone Outreach Final Disposition Summary

Final Disposition	Number of Sample Points	Percent (n=309)
No response	155	50%
Answering machine	95	31%
Hard refusal	10	3%
Soft refusal	6	2%
Not in service	5	2%
Opt-out	4	1%
Callback	2	1%
Other	32	10%
Grand Total	309	

RESPONSE RATE CALCULATIONS

The evaluation team used the American Association for Public Opinion Research (AAPOR) Response Rate 3 (RR3), which excludes partial completes but includes eligibility criteria. Equation 1 presents the formula used to calculate AAPOR RR3. The definitions of the letters used in the formula are listed below.

Equation 1. AAPOR RR3 Formula

$$I \div [(I+P) + (R1) + (e1 \times ((UH1+UO1) + (e2 \times (UH2+UO2)) + (e3 \times UH3)))]$$

Where:

I = Completes

P = Partial completes

R = Refusals/Break-offs

NC = Non-contacts

O = Others

R1 = Break-offs (with eligibility)

UH1 = Unknown if eligible for survey

UO1 = Unknown if eligible for survey, other

UH2 = Unknown if eligible household/business/respondent

UO2 = Unknown if eligible household/business/respondent, other

UH3 = Unused sample

X1 = Ineligible for survey

X2 = Ineligible household/business/respondent

X3 = Ineligible sample units

e1: Estimated % of sample that is eligible to complete survey = $(I+P+R1) / (I+P+R1+X1)$

e1inverse: % of sample that is ineligible to complete survey = $100\% - e1$

e2: Estimated % of sample that is eligible HH/BUS/R = $(I+P+R1+UH1+UO1+X1) / (I+P+R1+UH1+UO1+X1+X2)$

e2inverse: % of sample that is ineligible HH/BUS/R = $100\% - e2$

e3: Estimated % of sample that is an eligible sample unit = $(I+P+R1+UH1+UO1+UH2+UO2+X1+X2) / (I+P+R1+UH1+UO1+UH2+UO2+X1+X2+X3)$

e3inverse: Estimated % of sample that is an ineligible sample unit = $100\% - e3$

APPENDIX E. NET SAVINGS METHODOLOGY

The methodology draws heavily from historical FR evaluations of midstream commercial HVAC equipment in California. The evaluation team also considered other methodologies from California, Illinois, Missouri, and Connecticut. In addition, we conducted a comprehensive review of program theory and incorporated insights from initial interviews with program managers and implementers to adapt the algorithm for the SWWH Program.

Opinion Dynamics estimated Program FR by assessing the Program's influence on efficient water heating sales through three pathways: distributor stocking practices, distributor upselling, and equipment price.

We calculated the Program FR as the minimum of the FR Stocking Score (SS), FR Upselling Score (US), and FR Price Score (PS), as shown in Equation 2.

Equation 2. FR Score Combination

$$FR = \text{Min}(FR_{SS}, FR_{US}, FR_{PS})$$

FR stocking, upselling, and price scores were derived from distributor interviews and contractor survey responses and then weighted based on the savings associated with each distributor and contractor, respectively.

STOCKING

Figure 19 presents a diagram of the FR algorithm we will use to calculate the Program's influence on contractor installations via distributor stocking changes, including references to question numbers.

Figure 19. FR Stocking Score

Stocking

Distributor

D.S1. What proportion of your stock is program-eligible equipment? [0-100%]

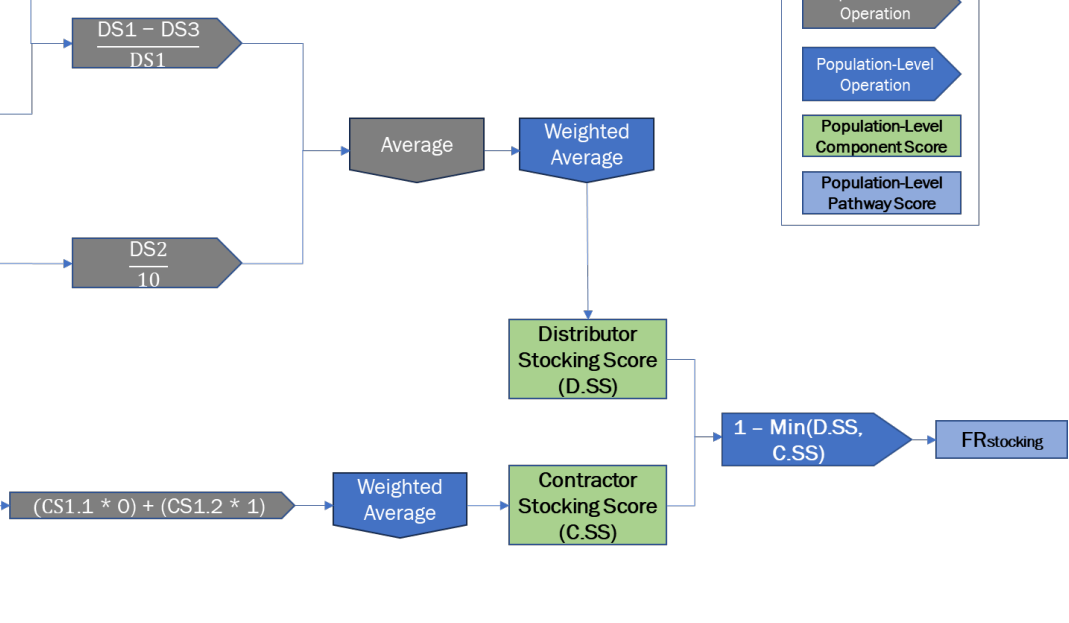
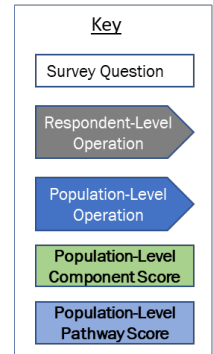
D.S3. If the program training, marketing, and per unit incentive were not available, what proportion of your stock would still be program-eligible equipment? [0-100%]

D.S2: How influential was the SWWH Program on your stocking decisions related to program-eligible equipment? [0-10]

Contractor

C.S1: When you are looking to install high-efficiency equipment for a project, and it is not in stock at the distributor or otherwise available on a reasonable timeline, what percent of the time would you:

1. Delay your project
2. Select lower-efficiency model



DISTRIBUTOR STOCKING SCORE

The Distributor Stocking Score (DSS) was calculated based on responses to three questions:

- D.S1.** What proportion of your stock is program-eligible equipment? [0%–100%]
- D.S2:** How influential was the Program on your stocking decisions related to program-eligible equipment? [0–10]
- D.S3.** If the program training, marketing, and per-unit incentive were not available, what proportion of your stock would still be program-eligible equipment? [0%–100%]

The respondent-level DSS was calculated as the average of two sub-components: one that estimates any increased stocking of high-efficiency water heating equipment attributable to program intervention and one that estimates program influence on distributor stocking decisions related to program-eligible equipment. The score was then extrapolated to the population level based on a savings-weighted average across distributors. Equation 3 shows the DSS calculation:

Equation 3. Distributor Stocking Score

$$DSS = \frac{\sum Average \left(\frac{DS1_i - DS3_i}{DS1_i}, \frac{DS2_i}{10} \right) w_i}{\sum w_i}$$

CONTRACTOR STOCKING SCORE

The Contractor Stocking Score (CSS) was calculated based on responses to the question:

C.S1: When you are looking to install high-efficiency equipment for a project, and it is not in stock at the distributor or otherwise available on a reasonable timeline, what percent of the time would you:

1. Delay your project [0%–100%]
2. Select a lower-efficiency model [0%–100%]

Responses to the two C.S1 components were required to sum to 100%. The respondent-level CSS was computed based on the percentage of the time a contractor chose a lower-efficiency model that is immediately available when their preferred high-efficiency equipment is not. In these situations, the Program has a positive impact on high-efficiency water heating equipment installations by ensuring the distributor is adequately stocked with high-efficiency equipment. If a contractor delays the project and waits for the high-efficiency equipment, program-induced increases in high-efficiency water heating equipment stock ultimately have no impact on equipment installations. The score was then extrapolated to the population level based on a savings-weighted average across contractors. Equation 4 shows the CSS calculation:

Equation 4. Contractor Stocking Score

$$CSS = \frac{\sum((CS1.1_i * 0) + (CS1.2_i * 1))w_i}{\sum w_i}$$

FR STOCKING SCORE

After the scores were extrapolated to the population level using the savings weights of each respective distributor and contractor, the scores were combined using the following calculation:

Equation 5. FR Stocking Score

$$FR_{Stocking\ Score} = 1 - Min(D.SS, C.SS)$$

The DSS and CSS represent the respective influence the Program had on distributors' program-qualifying equipment stock and how much of an impact distributor stocking habits had on contractor installations. We then took the minimum value of the DSS and CSS to calculate the amount of program influence passed on from the distributor to the contractor at a population level.

UPSELLING

Figure 20 is a diagram of the algorithm we will use to calculate the influence of the Program on contractor installations via distributor upselling changes, including references to question numbers.

Figure 20. FR Upselling Score

Upselling

Distributor

D.UP1: How influential were the following factors of the SWWH Program on your ability to upsell program-qualified equipment to contractors? [0-10]

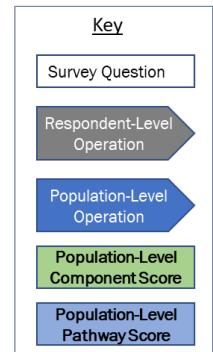
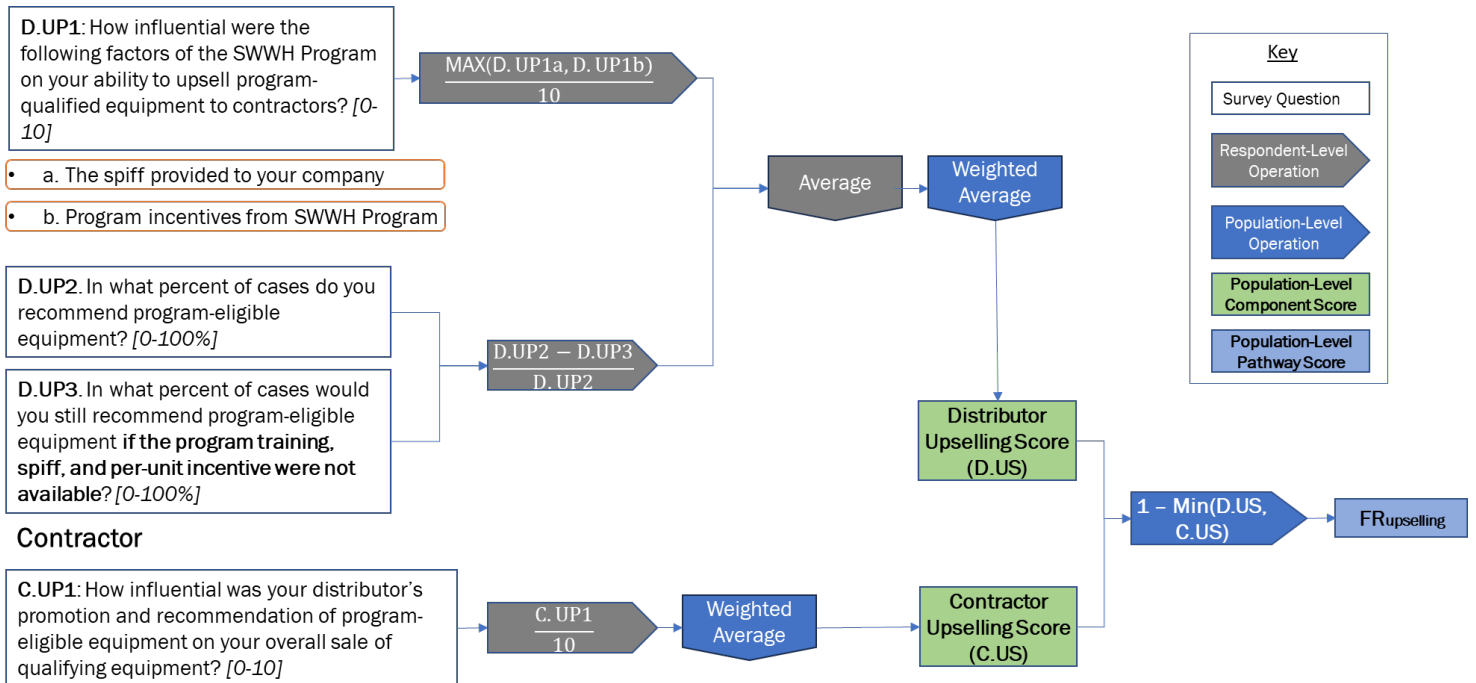
- a. The spiff provided to your company
- b. Program incentives from SWWH Program

D.UP2: In what percent of cases do you recommend program-eligible equipment? [0-100%]

D.UP3: In what percent of cases would you still recommend program-eligible equipment if the program training, spiff, and per-unit incentive were not available? [0-100%]

Contractor

C.UP1: How influential was your distributor's promotion and recommendation of program-eligible equipment on your overall sale of qualifying equipment? [0-10]



DISTRIBUTOR UPSELLING SCORE

The Distributor Upselling Score (DUS) was calculated based on responses to three questions:

D.UP1. How influential were the following factors of the Program on your ability to upsell program-qualified equipment to contractors? [0–10]

- A. The spiff provided to your company
- B. Program incentives from the Program

D.UP2: In what percent of cases do you recommend program-eligible equipment? [0%–100%]

D.UP3. In what percent of cases would you still recommend program-eligible equipment if the program training, spiff, and per-unit incentive were not available? [0%–100%]

We focused distributor upselling questions on the spiff since this was the primary motivation for the distributor to upsell program-eligible equipment. This decision stemmed from a review of the program design and discussions with implementation staff. Program intervention primarily centered on enhancing awareness of program incentives and operational alterations among distributors rather than conducting specialized training sessions to promote program-eligible equipment to contractors (for distributors) or end-users (for contractors).

The respondent-level DUS was calculated as the average on two sub-components: one estimating any increased incidence of upselling high-efficiency water heating equipment attributable to program intervention and one estimating the Program's influence on a distributor's ability to upsell high-efficiency water heating equipment effectively. The score was then extrapolated to the population level based on a savings-weighted average across distributors. Equation 6 shows the DUS calculation:

Equation 6. Distributor Upselling Score

$$DUS = \frac{\sum \text{Average} \left(\frac{\max(DUP1a_i, DUP1b_i)}{10}, \frac{DUP2_i - DUP3_i}{DUP2_i} \right) w_i}{\sum w_i}$$

CONTRACTOR UPSELLING SCORE

The Contractor Upselling Score (CUS) was calculated based on responses to the question:

C.UP1: How influential was your distributor’s promotion and recommendation of program-eligible equipment on your overall sale of qualifying equipment? [0–10]

The respondent-level CUS was calculated as the influence score divided by ten. The score was then extrapolated to the population level based on a savings-weighted average across contractors. Equation 7 shows the CUS calculation:

Equation 7. Contractor Upselling Score

$$CUS = \frac{\sum \left(\frac{CUS1_i}{10} \right) w_i}{\sum w_i}$$

FR UPSELLING SCORE

After the scores were extrapolated to the population level using the savings weights of each respective distributor and contractor, the scores were then combined using the following calculation:

Equation 8. FR Upselling Score

$$FR_{Upselling\ Score} = 1 - \text{Min}(D.US, C.US)$$

The DUS and CUS represent the respective influence that the Program had on distributors’ upselling of program-qualifying equipment and how much of an impact distributor upselling had on contractor installations. We then took the minimum value of the DUS and the CUS to calculate the amount of program influence passed on from the distributor to the contractor at a population level.

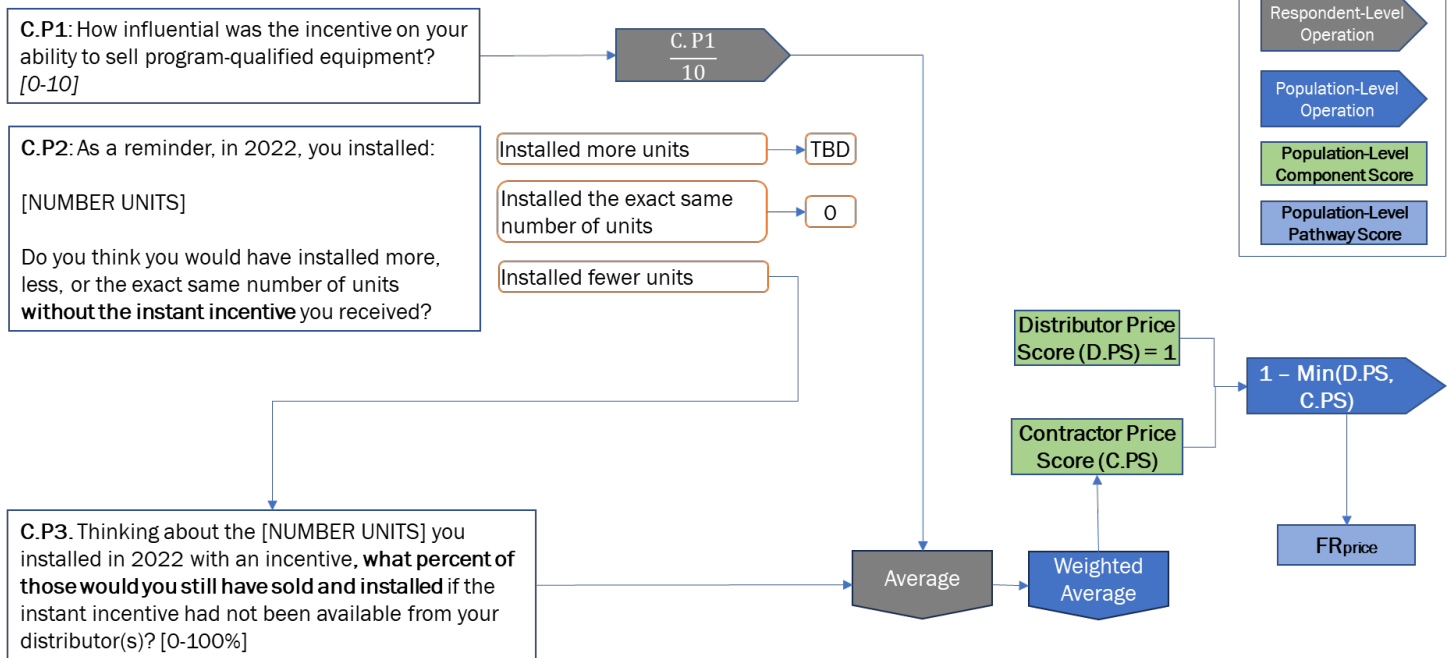
PRICE

Figure 21 shows a diagram of the algorithm we used to calculate the influence of the Program on contractor installations via distributor instant POS incentives, including references to question numbers.

Figure 21. FR Price Score

Price

Contractor



DISTRIBUTOR PRICE SCORE

The Distributor Price Score (DPS) is deemed at one, or 100% program attribution, based on program design. The Program offers a POS instant incentive; therefore, without program intervention, the price contractors pay would be higher. Equation 9 shows the calculation of the DPS.

Equation 9. Distributor Price Score

$$DPS = 1$$

CONTRACTOR PRICE SCORE

The Contractor Price Score (CPS) was calculated based on responses to the questions:

C.P1: How influential was the incentive on your ability to sell program-qualified equipment? [0–10]

C.P2: As a reminder, in 2022, you installed [NUMBER UNITS]

Do you think you would have installed more, less, or the exact same number of units without the instant incentive you received?

C.P3. Thinking about the [NUMBER UNITS] you installed in 2022 with an incentive, what percent of those would you still have sold and installed if the instant incentive had not been available from your distributor(s)? [0%–100%]

The first question, CP.1, estimated how influential the program incentive was on the contractors' ability to sell program-qualified equipment to end-users. The next two questions estimated the proportion of a contractor's 2022 sales of high-efficiency equipment attributable to the program incentive. Program tracking data were used to read sales information from PY2022 to minimize recall bias. Using this information, the evaluation team asked contractors to estimate if their

sales of program-qualifying units would have been more, less, or the same if the instant incentive had not been available. Contractors who reported that their sales would have been the same were assigned a zero score, indicating that the Program had no impact on their sales. Those who reported that their sales of high-efficiency equipment would have been greater without the program incentive were asked a follow-up open-ended question to contextualize their response. Based on this open-ended response, it was clear the respondents misunderstood the question, and therefore we assigned a score based on the average of the valid responses to CP3. Finally, if the contractor reported that they would have installed fewer units had the program incentive not been available, they were asked C.P3 to provide a more granular estimation of the proportion of units they would have sold had the program incentive not been available.

As shown in Equation 10, the responses were averaged and weighted based on contractor savings to extrapolate to the population level.

Equation 10. Contractor Price Score

$$CPS = \frac{\sum Average \left(\frac{CP1_i}{10}, CP3 \right) w_i}{\sum w_i}$$

FR PRICE SCORE

After the scores were extrapolated to the population level using the savings weights of each respective distributor and contractor, the scores were combined using the following calculation:

Equation 11. FR Price Score

$$FR_{price\ score} = 1 - Min(D.PS, C.PS)$$

The DPS and CPS represent the respective influence the Program had on the price distributors sell program-qualifying equipment and how much of an impact the availability of the instant incentive (i.e., reduced price) had on contractor sales. The minimum value of the DPS and the CPS was then taken to calculate the amount of program influence passed on from the distributor to the contractor at a population level.



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