EM&V GROUP A

Regional Energy Networks, Program Year 2022

California Public Utilities Commission
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Abbreviations and acronyms

3C-REN – Tri-County Regional Energy Network

3CE – Central Coast Community Energy

ABAG – Association of Bay Area Governments

ABAL – Annual budgetary advice letters

ACS – American Community Survey

AIA – American Institute of Architects

AMI – Advanced metering infrastructure

ATA – Apply to administer

AVCE – Apple Valley Choice Energy

BayREN – Bay Area Regional Energy Network

BPI – Building Performance Institute

C&S – Codes and standards

CalEPA – California Environmental Protection Agency

CARE – California Alternate Rates for Energy

CBO – Community-based organization

CBSA – Core-based statistical area

CCA – Community choice aggregator

CEC – California Energy Commission

CEDARS – California Energy Data and Reporting System

CIS – Customer information systems

CPA – Clean Power Alliance

CPSF – CleanPowerSF

CPUC – California Public Utility Commission

CZ – Climate zone

DAC – Disadvantaged community

DAW – Disadvantaged worker

DCE – Desert Community Energy

DEER – Database for Energy Efficiency Resources

DER – Distributed energy resource

DOE – U.S. Department of Energy

DR – Demand response

DSM – Demand-side management

EBCE – East Bay Community Energy

EECBG – Energy Efficiency and Conservation Block Grant

EJC – Environmental justice community

EM&V – Evaluation, measurement, and verification

EPIC – Energy for Palmdale's Independent Choice

ESA-CAM – Energy Savings Assistance – Common Area Measures

ESL – English as a second language

ETA – Elect to administer

FERA – Family Electric Rate Assistance Program

GHG – greenhouse gas

GRR – Gross realization rate

GSA – Gross savings adjustment

HERS – Home Energy Rating System

HES – Home Energy Score

HOA – Homeowners association

HPWH – Heat pump water heater

HTR – Hard to reach

HVAC – Heating ventilation and air conditioning

I-REN – Inland Regional Energy Network

IDI – In-depth interview

IEET – Integrated Energy Education and Training

IOU – Investor-owned utility

JCM – Joint cooperation memorandum

LCE – Lancaster Energy

LGSEC – Local Government Sustainable Energy Coalition

M&V – Measurement and verification

MCE – Marin Clean Energy

MESP – Multifamily Energy Savings Program

NAC – Normalized annual consumption

NATE – North American Technician Excellence

NMEC – Normalized metering energy consumption

NOAA – National Oceanic and Atmospheric Administration

NRE – Non-routine event

NTG – Net-to-gross

NTGR – Net-to-gross ratio

OCPA – Orange County Power Authority

OMB – U.S. Office of Management and Budget

P4P – Pay-for-performance

PA – Program Administrator

PCE – Peninsula Clean Energy

PG&E – Pacific Gas & Electric

PIP – program implementation plan

PLA – Plug and Load Appliances

PRIME – Pico Rivera Innovative Municipal Energy

PY – Program Year

PY2022 – Program Year 2022

R-REN – Rural Regional Energy Network

REN – Regional energy network

RMEA – Rancho Mirage Energy Authority

RUCA – Rural-Urban Commuting Area

SBCE – Santa Barbara Clean Energy

SCE – Southern California Edison

SCG – Southern California Gas

SCP – Sonoma Clean Power

SEM – Strategic energy management

SoCalREN – Southern California Regional Energy Network

SJCE – San Jose Clean Energy

SJP – San Jacinto Power

SMB – Small- and medium-size business

SVCE – Silicon Valley Clean Energy

TECH – Technology and Equipment for Clean Heating

TMY – Typical meteorological year

TOWT – Time of the week temperature

USDA – U.S. Department of Agriculture

VSD – Variable speed drive

WE&T – Workforce education and training

ZNE – Zero net energy

Glossary of key terms

California Database for Energy Efficiency Resources (DEER) – Refers to the Database for Energy Efficient Resources. This database contains information on energy-efficient technologies and measures. DEER estimates the energy savings potential for these technologies in residential and non-residential applications. DEER is used by California energy efficiency Program Administrators (PAs), private sector implementers, and the energy efficiency industry across the country to develop and design energy efficiency programs.[1] Available at eTRM: https://www.caetrm.com/.

California Energy Data and Reporting System (CEDARS) – Refers to the database that securely manages California Energy Efficiency Program data reported to the California Public Utilities Commission (CPUC) by investor-owned utilities (IOUs), regional energy networks (RENs), and certain community choice aggregators (CCAs).[2]

California Public Utility Commission (CPUC)[3] – A state agency created by constitutional amendment in 1911 to regulate the rates and services of privately owned utilities and transportation companies. The CPUC is an administrative agency that exercises legislative and judicial powers; its decisions and orders may be appealed only to the California Supreme Court. The primary duties of the CPUC are to regulate privately owned utilities and secure adequate service to the public at rates that are just and reasonable to customers and shareholders of the utilities, including rates for electricity transmission lines and natural gas pipelines. The CPUC also provides electricity and natural gas forecasting, analysis, and planning of energy supply and resources. Its headquarters are in San Francisco.

Community choice aggregator (CCA) – Local government entities that procure power for residents opting to receive this service in their areas (e.g., MCE).

Contractor – A commercial entity that installs the measures offered by energy efficiency programs.

Demand response (DR) – Demand response is a way for customers to manage their electricity demand by shifting or reducing usage during periods of peak demand.

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1 CPUC. "Resolution E-5152." deerresources.com, August 5, 2021. http://www.deeresources.com/files/DEER2023/Resolution%20E-5152%20DEER2023%20Complete.pdf

2 California Energy Data and Reporting System (CEDARS). "Welcome to CEDARS." cedars.sound-data.com. https://cedars.sound-data.com/

3 CPUC. "California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals." April 2006. (PDF) California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals (researchgate.net)

Demand side management (DSM) – DSM encompasses a range of plans and technologies strategically used to manage and alter energy consumption levels and patterns among customers.

Direct install program – An energy efficiency program where a contractor installs energy-saving technologies or upgrades in participating customer homes for no or low cost.

Disadvantaged community (DAC) – Refers to the areas throughout California that most suffer from a combination of economic, health, and environmental burdens.[4]

Disadvantaged worker – An individual that meets at least one of the following criteria: lives in a household where total income is below 50 percent of Area Median Income; is a recipient of public assistance; lacks a high school diploma or GED; has previous history of incarceration lasting one year or more following a conviction under the criminal justice system; is a custodial single parent; is chronically unemployed; has been aged out or emancipated from the foster care system; has limited English proficiency; or lives in a high unemployment ZIP code that is in the top 25 percent of only the unemployment indicator of the CalEnviroScreen Tool.[5]**End user** – A program participant who benefits directly from the energy efficiency program.

Energy Efficiency – Activities or programs that encourage customers to invest in more efficient equipment or controls that reduce energy use while maintaining a comparable level of service.

Energy efficiency measures – A technology or equipment whose installation and operation at a customer's premise reduces energy use.

Free-ridership – Program participants who would have installed the program measure or equipment in the absence of the program.

Gross realization rate (GRR) – the ratio of evaluated savings to claimed savings, without any adjustments for program influence.

Gross savings – Gross savings count the energy savings from installed energy efficiency measures (EEMs) irrespective of whether those savings are from free-riders, i.e., those customers who would have installed the measure(s) even without the financial incentives offered under the program.

Hard-to-reach (HTR) customer – HTR customers in the residential sector must meet one geographic and at least one of three non-geographic criteria or all three non-geographic criteria. Geographic criteria include being located in a DAC or outside metro areas, while non-geographic criteria include language, income, and rental status. HTR commercial customers must meet business size and lease status requirements instead of income and rental status..[6]

Heating, ventilation, and air conditioning (HVAC) system – The equipment, distribution network, and terminals that provide either collectively or individually the processes of heating, ventilating, or air conditioning to a building.[7]

Implementer – A program implementer is a third-party entity contracted by a program administrator (PA) to design, implement, and deliver third-party programs.

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4 CPUC. "Disadvantaged Communities." cpuc.gov, 2021. https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/disadvantaged-communities

5 D.18-10-008 (October 11, 2018), "Decision Addressing Workforce Requirements and Third Party Contract Terms & Conditions", p.79, Ordering Paragraph 9.

6 Specific details can be found here: Statewide Deemed Workpaper Rulebook

7 CPUC. "California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals." April 2006. (PDF) California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals (researchgate.net)

Investor-owned utilities (IOUs) – A private company that provides a utility, such as water, natural gas, or electricity, to a specific service area. California investor-owned utilities are regulated by the CPUC.[8]

Measure – A technology or equipment whose installation and operation at a customer's premise reduces energy use.

MMBtu – The sum of kWh and therm savings converted to a common unit of measure.

Net-to-gross ratio (NTGR) – A ratio or percentage of net program savings divided by gross or total impacts. Net-to-gross ratios are used to estimate and describe the free-ridership that may be occurring within energy efficiency programs.

Net savings – Refers to the savings realized when free-ridership is accounted for. Net savings are calculated by multiplying the gross savings by the net-to-gross ratio.

Program Administrator (PA) – An entity tasked with the functions of portfolio management of energy efficiency programs and program choice.

Regional energy network (REN) – Local government entities that administer energy efficiency programs for residents, businesses, and institutions in their jurisdictions (e.g., BayREN, SoCalREN).

Split incentives – Occur when the party paying for the energy efficiency improvements is not the one receiving the benefits. With the landlord-tenant split incentive, the landlords pay for the capital improvements that yield energy savings, but the tenants are the ones who receive the benefits of the reduced utility costs. Therefore, property owners are not incentivized to make these capital improvements.

Stratified sampling – Stratified sampling is a type of sampling approach in which the total population is divided into smaller subgroups, or strata, to complete the sampling process. The strata are formed based on some common characteristics in the population data. After dividing the population into strata, samples are chosen randomly from each stratum in a way that is proportional to the stratum's size within the total population.

8 CPUC. "California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals." April 2006. (PDF) California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals (researchgate.net)

1 EXECUTIVE SUMMARY

On behalf of the California Public Utilities Commission (CPUC), DNV conducted an evaluation of all Regional Energy Network (REN) programs that were active in program year (PY) 2022 to gain insight into how they are meeting their program savings and non-savings goals.

In 2007, the Local Government Sustainable Energy Coalition (LGSEC) developed the concept and advocated for the establishment of RENs to engage with local governments and citizens to develop and deliver energy efficiency programs to customers that investor-owned utilities (IOUs) had been unable to reach. In 2012, CPUC Decision (D.) 12-05-015 encouraged local governments to submit proposals for regional pilot programs. The initial mission of the RENs was to provide centralized energy efficiency program management, administration, and technical resources to increase project implementation. The CPUC developed program goals and objectives[9] requiring that REN activities must demonstrate new and unique value towards California's energy, climate, and equity goals through one or more of the following objectives:

- Offer activities that utilities or community choice aggregators (CCAs)[10] cannot or do not intend to undertake.
- Pilot activities where there is no current utility or CCA program offering, and where there is potential for scalability to a broader geographic reach, if successful.
- Serve hard-to-reach (HTR)[11] markets, whether or not there is another utility or CCA program that may overlap.

1.1 Background

DNV evaluated 18 active REN resource and non-resource programs[12] in PY2022, run by Bay Area Regional Energy Network (BayREN), Southern California Regional Energy Network (SoCalREN), and Tri-County Regional Energy Network (3C-REN). For the impact evaluation, we focused on three REN resource programs with claimed savings in PY2022. The process evaluation included all 18 programs, which we organized into three categories: residential, public agency and commercial, and workforce education and training (WE&T) and codes and standards (C&S).

1.1.1 Residential

There are six residential programs included in our evaluation. BayREN had two residentials programs (one single-family and one multifamily). SoCalREN managed two residential programs (one multifamily and one Kits for Kids program that included third and fourth grade participants from all both single-family and multifamily households). 3C-REN also managed two residential programs (one single-family and one multifamily). REN residential programs targeted underserved groups and either limited participation to them or offered them opportunities for enhanced incentives. Residential programs also tackled nuanced issues such as lack of technical knowledge, split incentives[13], renter equity[14], and socioeconomic factors through customized approaches. All residential programs addressed a lack of awareness and technical expertise using dedicated advocates, educators, and assistants.

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[9] As defined in D.12-11-015 (and later updated by D.19-12-021).

[10] Local (city or county), not-for-profit public agencies within the IOU service areas, which purchase and/or generate electricity for their residents and businesses. CPUC D.19-12-021 added the requirement to coordinate with CCAs regarding REN programs goals and objectives.

[11] Hard to reach (HTR): The criteria for residential HTR customers are the combination of a geographic prerequisite plus at least one of the following criteria: primary language, income, or housing type. Commercial HTR customers are defined by a combination of a geographic requirement plus at least one of the following criteria: primary language, business size, or leased or rented facility. Specific details can be found in Table 6 of the Statewide Deemed Workpaper Rulebook. Also note that Tribes were not included in the HTR definition until D.23-06-055 in June 2023.

[12] Resource programs generate energy savings that are quantified and tracked by program administrators. Non-resource programs are designed to promote activities that indirectly reduce energy usage (e.g., marketing, education, and outreach programs).

[13] A split incentive refers to any situation where the benefits of a transaction do not accrue to the actor who pays for the transaction. For multifamily rental properties, property owners may be reluctant to invest in energy-efficient upgrades because the tenants, who pay the utility bills, would reap the benefits of reduced energy costs.

[14] Renter equity in the context of energy efficiency programs refers to ensuring that renters, particularly those in low-income households, have fair and equitable access to the benefits of energy-saving initiatives.

1.1.2 Public agency and commercial

There are seven public agency and commercial programs included in our evaluation. BayREN managed one public agency program (Water Upgrades Save) and one small and medium-size business (SMB) commercial program. SoCalREN managed five public agency programs. REN public and commercial programs targeted a diverse range of participants to reduce the sector's carbon footprint and achieve long-term savings through energy efficiency initiatives. The REN programs provide education and mentorship and facilitate timely and straightforward access to funding. The programs' flexible incentive structures and eligibility requirements enable entities who may not otherwise be eligible for alternative programs to participate. These programs provide a "one-stop-shop" for resource-constrained agencies and provide technical and administrative assistance from initiation through implementation and project close-out including project management, procurement, and construction support services.

1.1.3 WE&T and C&S

There are three WE&T and two C&S programs included in our evaluation. BayREN implemented a C&S as well as a Green Labeling program that trained real estate professionals to understand the benefits of an energy-efficient home. SoCalREN implemented one WE&T program that provided training, tools, and opportunities for minority participants residing in disadvantaged communities (DACs)[15] to pursue careers in energy and water efficiency. 3C-REN managed one WE&T program that provided access to in-person and on-demand trainings and mentorship opportunities and one C&S program that provided trainings, forums, and expert assistance for public- and private-sector building staff. WE&T and C&S programs focused on activities that ensure there is a well-trained workforce (e.g., contractors, building and real estate professionals, and government staff) equipped to navigate energy efficiency practices and technologies. The programs provided training, tools, and career opportunities, focusing on electrification to increase the size, skill level, and diversity of the energy-efficiency labor force in the regions they serve.

1.2 Research objectives

The research objectives of the PY2022 REN evaluation include:

- Conducting a process evaluation to:
  - Address gaps in energy efficiency services, particularly in the multifamily sector.
  - Assess how REN program services and activities complement or overlap with existing programs run by utilities and CCAs (other program administrators ([PAs]).
  - Describe how RENs coordinate with other PAs within their service region.
  - Identify the REN programs' unique values and contributions to California's energy, climate, and equity goals.
  - Assess REN program outreach activities, including outreach to HTR customers and DACs.
  - Assess customer participation and experiences, including among HTR and DAC customers.
  - Identify REN participant perceived/self-reported program benefits and barriers.
- Estimating the energy savings associated with PY2022 REN single family and multifamily programs.
- Estimating the proportion of program installations that would have occurred without the REN single-family and multifamily programs.

[15] Disadvantaged communities refer to the areas throughout California that most suffer from a combination of economic, health, and environmental burdens. See the CPUC's definition of disadvantaged communities for more information.

1.3 Study approach

Process evaluation. DNV conducted a process evaluation through a multi-source approach that included program documentation review, program tracking data[16] review, residential customer surveys, non-residential participant in-depth interviews (IDIs), and program staff IDIs. We conducted targeted IDIs among non-residential program participants via telephone with up to five participants per program. The purpose of the IDIs was to understand how participants learned about the program, gather information about participant characteristics and demographics, determine participant perception of program benefits, and assess program satisfaction and barriers to participation.

Our approach consisted of evaluating REN program objectives and requirements, comparing REN program offerings to those offered by utilities and CCAs, examining coordination activities between RENs and other PAs, assessing RENs' unique value, reviewing marketing and outreach strategies, and determining how well REN programs are serving HTR customers and DACs**.**

Single- and multifamily program impacts. We used energy consumption data analysis to assess the energy impact of the PY2022 REN single-family program with deemed[17] claims (BAYREN08). This approach quantifies changes in energy consumption over time as a proxy for program impacts based on statistical models. The models estimate energy consumption changes at the whole-home level, which we disaggregated into fuel substitution[18] and other energy efficiency technology-related changes. To evaluate the impact of the REN multifamily programs with whole-building claims (SCR-RES-A1, BAYREN02 / BAYREN02-A), we conducted engineering desktop reviews of measure[19] savings and installation verification. We reviewed the appropriate application of measure package values for deemed[20] savings claims and the calculations for custom savings claims provided in project documents. To verify installation, we conducted property manager surveys and site visits. Table 1-1 presents the population and sample sizes of our survey efforts. Based on the survey responses, we calculated net-to-gross ratios (NTGRs),[21] which we applied to the gross savings[22] estimates to get the net savings attributable to the program.

Table 1-1. Survey efforts and sample size summary

Surveys	Mode	Population	Sample size	Completed surveys	Response rates
Residential participant	Web	5,799	5,328	676	13%
Residential property manager	Phone	77	77	30	39%

1.4 Key findings

1.4.1 Process evaluation findings

This section provides DNV's findings from our process evaluation activities. Based on our research objectives listed in Section 1.2, we identified overarching trends that span multiple energy efficiency programs. These trends include the impact of the push towards electrification, addressing multifamily renter equity and split incentives, the relationships RENs have with

16 Tracking data provides information that PAs track and file with regulators about energy efficiency activities including the type and quantities of technologies delivered and associated savings.

17 Measure packages contain estimates on energy savings of different technologies used in residential and non-residential settings. Database for Energy Efficient Resources (DEER) available at eTRM: https://www.caetrm.com/login/?next=/ provides deemed savings and other measure package information.

18 Fuel substitution involves projects where all or part of the existing energy consumption shifts from one CPUC-regulated fuel to another CPUC-regulated fuel (for example, from gas to electric). The program's fuel substitution measures included space and water heater heat pumps, induction cooktops, and heat pump clothes dryers. These technologies replaced existing gas equipment.

19 Measures are energy-saving technologies or upgrades installed by programs.

20 Deemed refers to researched, vetted, and predictable savings for EE technologies and services with well-established properties. This contrasts with custom savings for EE technologies and services that require unique calculations and do not use predefined values. Project files often provide custom calculation processes and values that programs use for as the basis for their claimed savings.

21 Net savings are the savings attributable to an energy efficiency program. NTGRs are used to estimate and describe the "free ridership" that may be occurring within energy efficiency programs. NTGR is the degree to which participating customers would have installed the technology or equipment without the program benefits.

22 Gross savings are a measure of change in energy use due to energy efficiency programs, regardless of why customers participated. Gross savings are multiplied by the NTGR to arrive at net savings.

utilities, the effectiveness of outreach methods, hands-on support to program participants, and the lingering effects of the pandemic. Below, we have provided more detail about these findings.

Key finding	**REN programs engaged in activities that contribute to decarbonizing through electrification and encountered similar issues and challenges related to this effort.**
Related research objectives	• Identify the REN programs' unique values and contributions to California's energy, climate, and equity goals. • Address gaps in energy efficiency services, particularly in the multifamily sector.

The RENs' push towards electrification was driven by a commitment to sustainability, reducing greenhouse gas (GHG) emissions, and improving indoor air quality.[23] DNV heard from the RENs that contractors' limited knowledge, high equipment cost, and long manufacturing and delivery time for equipment were barriers to electrification. Residential and public agency/commercial programs promoted measures and/or developed program activities designed to support electrification efforts but were faced with challenges:

- Potential customers and in some cases, contractors, often had little knowledge of electrification measures.
- Electrification measures were often more expensive, had complicated and lengthy logistics and have long lead times and complicated coordination, which adds supply chain and funding challenges.

Program staff mitigated these challenges by:

- Developing outreach and education approaches to increase awareness about electrification
- Giving higher incentives for electrification and fuel substitution measures
- Helping participants find additional sources of funding and financial assistance
- Finding creative ways to alleviate supply chain issues for equipment that requires long manufacturing/delivery times, such as heat pumps (e.g., bulk purchasing equipment for multifamily properties)

Multifamily residential programs faced more resistance to electrification measures, as property owners are more reluctant to embrace high-cost and complicated equipment installation. BayREN's Multifamily Residential program (BAMBE) created a subprogram (BAMBE Electrification Pathway) that provided no-cost technical assistance to multifamily property owners specifically to increase participant knowledge about electrification measures, assist with complicated coordination, and help get the most out of available incentives and rebates.

In PY2022, WE&T and C&S programs worked to increase the overall knowledge base and skill level of local government building staff and energy efficiency workforce with a particular focus on electrification. For example, BayREN's Green Labeling program worked to advance the energy literacy of real estate professionals by using tools such as its "electrification checklist," developed to train the current workforce on modern electrification technologies and to determine the suitability of a house for transitioning from gas to electric appliances.

23 These were precipitated by California Senate Bill 350 (SB 350), Assembly Bill 137 (AB 137), and Senate Bill 100 (SB 100) which set requirements to foster a transition to a clean energy economy.

Key finding	**All three multifamily programs included in DNV's evaluation catered to the unique needs of multifamily customers by allowing for greater customization and flexibility with measure requirements and eligibility and directly confronting the issues of split incentives and renter equity.**
Related research objectives	• Identify the REN programs' unique values and contributions to California's energy, climate, and equity goals. • Address gaps in energy efficiency services, particularly in the multifamily sector. • Assess customer participation and experiences, including among HTR and DAC customers. • Identify REN participant perceived/self-reported program benefits.

Multifamily programs sought to address renter equity and split incentives by encouraging in-unit measures and increasing benefits for property owners. Renter equity in energy efficiency programs means that renters should have fair access to the benefits gained through energy efficiency upgrades, particularly for low-income renters facing the challenges of high rents, high energy costs, and climate change risks. Energy efficiency upgrades help alleviate these challenges. However, property owners lack the incentives to invest in improvements that benefit tenants. Solutions that address the split incentives by providing benefits for both renters and property owners are crucial for addressing renter equity and advancing energy efficiency goals for multifamily programs.

One way that multifamily programs addressed renter equity is to encourage property owners to install in-unit energy efficiency upgrades such as heat pump water heaters, heat pump HVAC, laundry dryers, electric cooking, insulation, and lighting. These upgrades are particularly advantageous for renters because they directly affect renter's energy bills by lowering costs, enhancing comfort and well-being, and contributing to a healthier and more pleasant living environment. REN multifamily program designs all encouraged in-unit and multiple-measure upgrades in PY2022. For example, BayREN's Multifamily program offered additional incentives for property owners to switch from gas-fueled space heating, water heating, and cooking appliances to cleaner, highly efficient electric alternative projects. To qualify for the additional incentives, projects had to install at least three measures. And when installing in-unit measures, they had to be installed in at least 75% of units.

Similarly, SoCalREN's Multifamily program provided several approaches to encouraging multiple and in-unit upgrade measures. The program offered the only dual-fuel option for multifamily property owners in the service area. SoCalREN coordinated closely with SCE and SCG, which enabled the program to complete all gas and electric upgrades in a single project. Furthermore, this program required comprehensive upgrades and did not allow for single measures. The program offered tiered incentives to encourage multi-measure upgrades. The program uniquely allowed for incremental installation phases where multiple measures could be installed over time for a whole building approach.

Besides encouraging in-unit measures, another way that the multifamily programs helped address split incentives was by increasing benefits for property owners. 3C-REN's Multifamily program provided sizable incentives directly to property owners and managers, particularly to motivate HTR buildings that would not make energy-efficiency upgrades otherwise. Multifamily programs also sought to alleviate property manager burdens by leading many administrative and logistical tasks, providing technical assistance, and conducting financial analysis.

For example, the BayREN Multifamily program tried to identify small business owners by requesting applicants to report if their properties were independently owned. The purpose of identifying these property owners was to provide more comprehensive support to these historically underserved property types. Participants received no-cost energy consulting services and technical assistance that covers the entire project lifecycle. The technical assistance provided in REN multifamily programs encompassed several valuable services including energy bill analysis, project scope development, and identification of additional incentive programs.

The result of providing this elevated level of service was to increase the number of project completions and to make upgrades more financially feasible for multifamily property owners who may not have the required time, technical knowledge, or staff. SoCalREN's Multifamily program provided added value to property owners through customized measure recommendations to tackle the lack of in-house technical expertise and financial analysis of payback for all measures. 3C-REN's multifamily program conducted building energy assessments, developed personalized scopes of work, and provided technical support from the initial consultation through project completion.

Key finding	**REN programs provided hands-on support and technical assistance tailored to the specific needs of their participants not available through other PA programs, particularly in the multifamily and public sectors.**
Related research objectives	• Identify the REN programs' unique values and contributions to California's energy, climate, and equity goals. • Address gaps in energy efficiency services. • Identify REN participant perceived/self-reported program benefits.

Our review of program documentation indicated that RENs offered hands-on support and technical assistance to (1) provide the types of services not available to participants in their service territories, (2) ensure that projects move forward efficiently, (3) promote cost-effective measures, (4) make the participation process smooth, and more. Our primary and secondary research confirmed that the programs effectively implemented this elevated level of support.

For multifamily programs, staff provided administrative and logistical support to alleviate tenant disruption, contractor coordination, and permitting. They also developed personalized scopes of work and provided technical support from initial consultation through project completion, for example:

- 3C-REN's Multifamily program embedded staff within the community to provide participants with close support. Program staff referred to their role as a "boots on the ground" partner that can provide multifamily properties with local technical assistance to scope projects and identify funding sources.
- SoCalREN's Multifamily program provided clear and directive measure recommendations to tackle the lack of in-house technical expertise and financial payback analysis for all measures to address split incentives.

Public and commercial program support mechanisms offered customized training, project management, and technical assistance that may be lacking in the public sector or small businesses due to resource constraints. Programs provided tailored support through design and procurement, agency approval, construction, and project close-out. When asked to identify helpful aspects of program services and support, SoCalREN's public agency program participants remarked on the extent of support that they received:

- Some participants reflected that they would not have been able to complete projects in the absence of the public agency programs' support.
- Interviewees underscored the value of the public agency programs' willingness to dive into details on bids, measure specifications, applications for incentives and financing, and more.

Key finding	**The joint cooperation memos (JCMs) did not accurately reflect the depth or cadence of coordination between the RENs and the utilities (particularly for specific programs) and do not address or define third-party implementer roles and responsibilities in the coordination efforts between RENs and utilities.**
Related research objectives	• Assess how REN program services and activities complement or overlap with existing programs run by utilities and CCAs. • Describe how RENs coordinate with other PAs within their service region.

The evaluation team used program documentation (JCMs, annual reports, and program implementation plans [PIPs]) as well as PA/implementer IDIs to assess how each of the three RENs coordinated with utilities and CCAs to decrease any perceived customer confusion, leverage existing partnerships, and work together to enhance participation and program performance in PY2022. To this end, the JCMs describe coordination efforts between program staff by program type (residential, public agency and commercial, and WE&T / C&S). According to the JCMs, the respective REN or utility program teams meet with each other on a monthly or quarterly basis.

For some programs, the level of coordination and cooperation that was required and was occurring is much greater and more often than was captured in the JCMs. The JCMs described how coordination meetings occur monthly or quarterly. However, based on our PA/Implementer IDIs, we found that all three RENs communicate much more frequently with utilities and CCAs through email, phone calls, and smaller, ad hoc meetings. The breadth and depth of that day-to-day communication and coordination was not fully captured in the JCMs. Several of the REN programs could benefit from enhanced and more active participation from the utilities to provide services and support for specific programs. Some of these programs depend on utility incentives or rely on utility data to verify savings for incentive payments, for example:

- SoCalREN relies on SCE incentives for approximately 60% of its public agency projects. However, in PY2022, SCE had extreme processing delays. The PDP program manager recalled observing customer dissatisfaction due to conflating SCE's process with SoCalREN's. The interviewee believed that the SCE delays resulted in slow or no responses and failure to renew contracts with technical reviewers.
- BayREN SMB Commercial, SoCalREN Public Agency NMEC, and 3C-REN Single Family NMEC programs rely on data from the utilities to determine program savings and incentive payments. A major challenge in PY2022 for 3C-REN was having to navigate complex conversations around data access with the three utilities in its region, PG&E, SCE, and SCG.[24]

The JCMs did not address the role or impact of third-party implementers on coordination efforts between RENs and utilities. Third-party implementers managed a large majority of both REN and utility programs (e.g., third-party implementers managed 14 of the 18 programs included in our evaluation). Given that third-party implementation was so prevalent, the JCMs should have included more explanation and guidelines for coordinating with third parties in lieu of REN or utility program staff. There was a variance in attendance by IOUs at regular coordination meetings. Often, neither utility nor REN staff attended the regular coordination meetings. SoCalREN noted that coordinating directly with third-party program implementers had been more resource intensive, presumably because it took longer and additional effort to communicate with the utilities directly because they had to go through the implementers first. SoCalREN also noted that third-party implementers regarded the RENs more as competition instead of an ally, particularly regarding multifamily programs. The competitive environment was due, in part, to the performance-based contracts that third-party implementers have with the utilities, but also because multifamily programs are costly to run, and REN programs are not required to be cost effective.

[24] As of March 2024, access to utility data has continued to be a barrier for 3C-REN's Single Family Flex Market program. The process is underway to establish agreements for data access, but this process is time intensive. Once this process is established and data is obtained, 3C-REN will be able to true-up forecasted savings in CPUC reporting and pay incentives based on realized savings.

Key finding	**RENs found direct outreach (e.g., targeted emails and mail campaigns) or strategic partnerships (with organizations closely associated with their target market) to be successful outreach methods, including among underserved and HTR communities and DACs.**
Related research objectives	• Assess REN program outreach activities, including outreach to HTR customers and DACs.

While outreach activities differed by program sector, particular REN-reported outreach methods were effective. In the residential sector, RENs found direct outreach approaches and partnerships to be successful in acquiring participants, for example:

- The BayREN multifamily program staff noted that direct mailers were generally the most effective way of reaching property owners, accounting for roughly half of the new program leads in PY2022.
- The 3C-REN multifamily program staff indicated that the most effective outreach in PY2022 was a direct mailer that resulted in 115 leads (out of the 118 for the year mentioned in the annual report).

Public agency programs found only partnerships with various organizations that resulted in "warm" leads to be effective, for example:

- Of the 214 public agencies that SoCalREN served in PY2022, 13 were new to public agency programs. SoCalREN enrolled seven of these new agencies through collaboration with regional partners.
- BayREN's Water Upgrades Save program staff collaborated with local governments to promote the program and arrange introductory meetings with municipal water utilities.

WE&T and C&S programs also reported outreach success based on partnerships with local organizations and direct outreach leveraging their extensive email lists, for example:

- BayREN's Codes and Standards (BAYREN03) program manager indicated email outreach to be likely the most successful method for both Regional Forum and online regional training enrollments, followed by word of mouth.
- 3C-REN's WE&T (TCR-WET-001) program manager highlighted that partnering with schools in low-income, Spanish-speaking communities, and supply houses for Spanish-speaking construction workers was most effective in reaching participants.

Programs focused on increasing participation of underserved and HTR/DAC communities by customizing their successful outreach approaches. For example, residential multifamily programs partnered with rental housing associations and property management companies, commonly used by HTR property managers, to increase the participation of "mom-and-pop" property managers. WE&T programs also tailored their partnerships to reach trainees in underserved communities. For example, they partnered with suppliers catering to building professionals and Title 1 schools[25] to reach youth (16 to 24-year-olds) disconnected from school or work.

1.4.2 Gross and net savings impacts

Overall, the RENs achieved higher savings than claimed for the single-family program and most of the savings claimed for the multifamily programs. The net-to-gross values for the multifamily programs indicate that the programs reached populations that benefited from their interventions significantly, but the single-family program had lower influence. Table 1-2 provides the total gross claimed and achieved (evaluated) electric savings for the three REN single and multifamily resource programs with claims in PY2022. These residential programs achieved total gross electric savings of 13.9 GWh or 111% of the gross claimed

[25] A Title 1 school is a school that receives federal funds designated to support students in low-income communities. Programs use CA Department of Education data to identify such schools.

electric savings (gross realization rate [GRR]). The electric savings gross realization rate for the single-family program was high at 142%. Most of the savings came from fuel substitution technologies installed by approximately a quarter of the program's participants. The evaluated savings (like the claimed savings) reflected the combination of the gas reductions converted to kWh and the electric load increase associated with fuel substitution installations.

Multifamily program GRRs reflected generally sound custom calculations and their application based on our engineering desktop reviews, the appropriate application of measure package values, and high in-service rates (ISR)[26] determined by DNV through site visits. In a few cases, evaluated savings differed from claimed savings due to unclear measure characterizations in the project documents or differences between project document calculations and tracking-reported savings. In the former case, the measures received no evaluated savings. In the latter case, DNV revised tracking-reported savings to reflect the correct calculations in the project documents. Most measures were still installed and operating during site visits. However, during our site visits we observed small measures such as faucet aerators, showerheads, and smart power strips had the lowest in-service rates due to tenant removal.

The single-family program influenced a lower percentage of gross electric savings (58%) than claimed but similar gross gas savings (49%) as claimed. The program's claimed electric NTGR is high because of fuel substitution measures, which have deemed NTGRs of 100%. While these measures were responsible for most of the program's savings, they influenced a lower fraction of claimed savings than claimed. The multifamily programs influenced almost all gross electric and gas savings, indicating they reached populations that benefited from their interventions.

Table 1-2. REN gross and net electric savings by program, PY2022

Program	Customer segment	Total gross claimed savings (kWh)	Total gross evaluated savings (kWh)	GRR	Claimed NTGR	Evaluated NTGR	Total net evaluated savings (kWh)
BAYREN08	Single Family	4,331,840	6,136,396	142%	97%	58%	3,559,110
BAYREN02/02A	Multifamily	1,234,506	1,003,757	81%	84%	75%	752,818
SCR-RES-A1	Multifamily	7,033,773	6,809,763	97%	76%	96%	6,537,372
All	**All**	**12,600,119**	**13,949,916**	**111%**	**84%**	**78%**	**10,849,300**

Table 1-3 provides the total gross claimed and evaluated gas savings by REN residential programs. The programs achieved 319,379 therms of gross gas savings, or 96% of gross claimed savings (GRR). Like the electric case, the gross evaluated gas savings for one of the multifamily programs were notably lower than claimed due to unclear measure characterizations and low in-service rates for some measures. Additionally, as in the electric case, multifamily program attribution was high and above claimed levels, indicating that the programs succeeded in serving the right population segments.

Table 1-3. REN gross and net gas savings by program, PY2022

Program	Customer segment	Total gross claimed savings (therm)	Total gross evaluated savings (therm)	GRR	Claimed NTGR	Evaluated NTGR	Total net evaluated savings (therm)
BAYREN08	Single Family	168,539	176,036	104%	47%	49%	86,247
BAYREN02/02A	Multifamily	62,407	43,355	69%	75%	92%	39,887
SCR-RES-A1	Multifamily	100,164	99,988	100%	75%	97%	96,988
All	**All**	**331,110**	**319,379**	**96%**	**61%**	**70%**	**223,123**

[26] In-service rates represent the portion of measures still installed and in service. Multifamily program measures were determined to still be in place and operational through site visits. Site visits indicated in-service rates ranging from 88-94% at the program level.

1.5 Recommendations and considerations

Table 1-4 summarizes DNV's key findings, implications, and recommendations for this evaluation.

Table 1-4. Key findings and recommendations

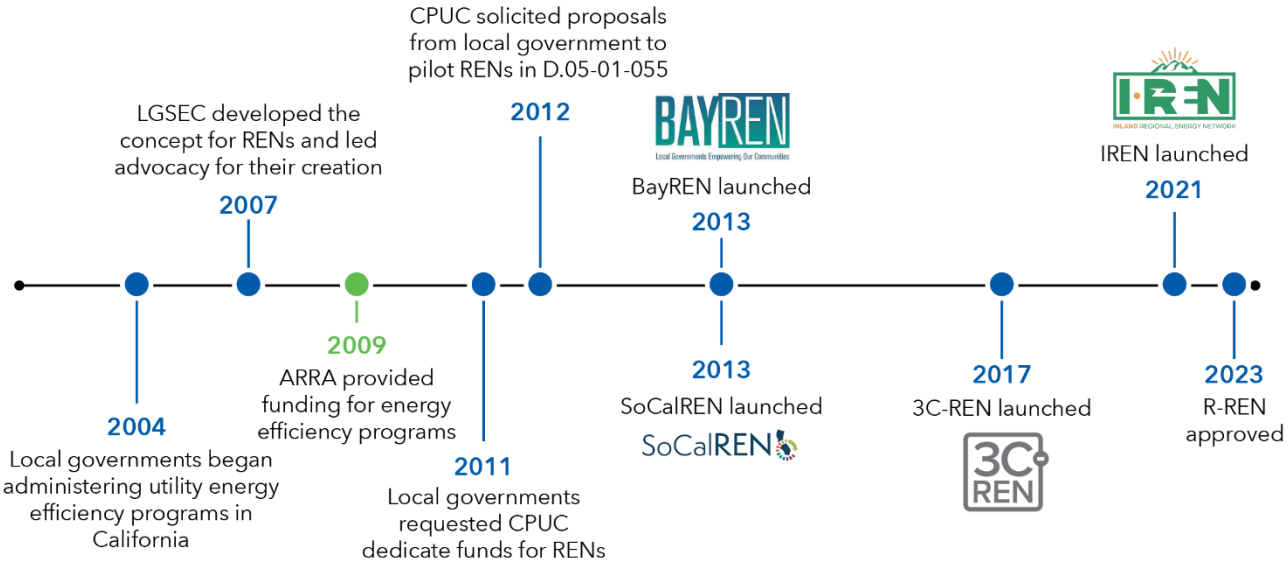
Key findings	Implications and recommendations
DNV process evaluators found that all REN programs approached decarbonizing through electrification to contribute to state GHG reduction goals. As a result, they encountered similar issues and challenges related to electrification such as a lack of understanding about electrification and fuel-substitution measures among program participants and contractors, low incentives relative to the high equipment and installation costs, and complicated coordination.	RENs are in the unique position of being able to support more effectively CPUC policies and California's larger decarbonization goals through innovative solutions and scalable activities. For this reason, RENs should consider increasing efforts to create a pathway to electrification such as higher incentives and rebates, varying levels of incentives, and equity-focused multipliers that target low-income participants, DACs, and environmental justice areas.
The REN multifamily programs catered to the unique needs of their customers by allowing for greater customization and flexibility with measure and eligibility requirements. The programs also confronted split incentives by increasing benefits for property owners and helping achieve renter equity by requiring certain core measures or providing larger incentives for projects that included in-unit measures.	Given their mandate to pilot activities where there is no current utility or CCA program offering, specifically where there is potential for scalability to a broader geographic reach, we recommend that the RENs consider sharing their successes serving the multifamily sector (including best practices for addressing split incentives and renter equity) during their coordination meetings with utilities. This type of sharing could expand useful approaches beyond the RENs.
Providing additional hands-on support addressed unique challenges faced by multifamily property owners and public agencies, such as lack of in-house technical expertise and administrative burdens associated with energy efficiency upgrades. The RENs embedded staff to provide services such as project management, procurement, financial, and construction management.	We recommend that the RENs collaborate with the utilities and other stakeholders to share best practices and lessons learned from their experience and to identify opportunities for coordination and alignment of programs and incentives, particularly for programs that traditionally experience challenges serving the multifamily sector.
In accordance with their JCMs, RENs coordinated with utilities and CCAs for most of their programs. However, third-party implementers managed a majority of both REN and utility programs and the JCMs did not mention the role that third-party implementers should play in coordination efforts. DNV found there was a variance in attendance by IOUs at regular coordination meetings but relied on the third-party implementers to attend the meetings in their place. As third-party implementers have performance-based contracts with the PAs, their interests may not always align with the need to	DNV recommends that the PAs (utilities, RENs, and CCAs) and/or their representatives (e.g., technical and regulatory consultants) continue or begin to attend all official coordination meetings as defined in the JCMs even when third-party implementers manage the programs. The PAs should attend the coordination meetings and then direct the program implementers to follow through with any necessary actions identified during the meetings. The PAs should consider including a RACI (responsible, accountable, consulted, informed) chart in the JCMs and PIPs that defines the role of PAs, implementers, and any other stakeholders. A RACI chart would help clarify who

Key findings	Implications and recommendations
coordinate or cooperate directly with other PAs or implementers.	needs to attend the coordination meetings, define their role, and help eliminate any confusion related to coordination efforts. The RACI chart should be a living document and an updated version of the RACI could be included with both the JCM and PIP documentation. DNV also recommends that attendance at the meetings be documented and made available to future evaluators.
The BayREN single-family program achieved gross savings at or above claimed levels. Program interventions included several electrification measures that contributed to achieving gross savings. However, while the program intended to benefit low- to moderate-income households (with the assumption that these households need the program), the attribution results indicate that the program served a relatively high proportion of households that would have installed the measures without program support.	The program should continue its successful effort to electrify and achieve realistic and ambitious single-family energy consumption reductions. However, the program should target more underserved populations that would not undertake similar upgrades without program support. To reach such customers, the program could increase incentives for populations unlikely to install expensive fuel substitution technologies without program support.

2 INTRODUCTION

This report provides DNV's impact and process evaluation of all active PY2022 Regional Energy Network (REN) programs on behalf of the California Public Utilities Commission (CPUC). In 2007, the Local Government Sustainable Energy Coalition (LGSEC) proposed the creation of Regional Energy Networks (RENs) to collaborate with local governments and communities to develop and deliver energy efficiency programs to customers that investor-owned utilities (IOUs) had been unable to reach. In 2012, CPUC Decision (D.) 12-05-015 encouraged local governments to propose regional pilot programs. RENs initially focused on managing, administering, and providing technical support for energy efficiency projects. In subsequent years, they became fully-fledged PAs providing energy efficiency programs to customers in their service territories. In 2013, the first two RENs, SoCalREN and BayREN, launched based on the success of their proposals to the CPUC. Ventura, Santa Barbara, and San Luis Obispo counties successfully filed to become 3C-REN in 2017. A fourth REN, Inland REN (I-REN), led by Western Riverside Council of Governments and partners was approved in 2021, and a fifth REN serving rural areas (R-REN) was approved by the CPUC in May 2023. See Figure 2-1 for a timeline of major milestones in the development of RENs.

Figure 2-1. Timeline of REN development



REN activities must meet program goals outlined by the CPUC,[27] which require that they demonstrate unique value to meet California's energy, climate, and equity objectives through one or more of the following ways:

- Offer activities that utilities or community choice aggregators (CCAs)[28] cannot or do not intend to undertake.
- Pilot activities where there is no current utility or CCA program offering, and where there is potential for scalability to a broader geographic reach, if successful.
- Serve hard-to-reach (HTR)[29] markets, whether or not there is another utility or CCA program that may overlap.

[27] Defined in D.12-11-015 (and later updated by D.19-12-021).

[28] Community Choice Aggregation was created in California by AB 117 (2002), which gave local governments the authority to purchase electricity on behalf of their residents and businesses.

[29] Hard to reach (HTR): The criteria for residential HTR customers are the combination of a geographic prerequisite plus at least one of the following criteria: primary language, income, or housing type. Commercial HTR customers are defined by a combination of a geographic requirement plus at least one of the following criteria: primary language, business size, or leased or rented facility. Specific details can be found in Table 6 of the Statewide Deemed Workpaper Rulebook. Also note that Tribes were not included in the HTR definition until D.23-06-055 in June 2023.

While not a primary focus of this evaluation, CCAs also provide energy efficiency programs in regions served by RENs and utilities. CCAs are local (city or county), not-for-profit public agencies that purchase or generate electricity for residents and businesses in their service areas. Because of the recent increase in CCAs and the geographic overlap between CCAs, RENs, and utilities, CPUC D.19-12-021 required the RENs to coordinate program activities with utilities and CCAs. Given the CPUC's authorization for RENs to offer complementary or overlapping services and its allowance for RENs, IOUs, and CCAs to operate in the same geographical areas, the decision reflects the additional importance placed on cooperation, communication, and coordination among these separate entities.

Currently, 25 CCAs operate within California, and 19 operate within the same territories as the three RENs included in this evaluation. CCAs that provide energy efficiency programs using ratepayer funds have two options. They can "elect to administer" (ETA) energy efficiency programs for their own customers and follow the requirements under General Order 96-B,[30] meet the standard in the Public Utilities Code (PUC) Section 381,[31] and be subject to financial audits. They can also "apply to administer" (ATA) energy efficiency programs for their own customers and those customers that have opted out of a CCA and be subject to the rules that apply to IOU programs These rules include being cost-effective, passing the Total Resources Cost Test, and being subject to evaluation, measurement, and validation (EM&V) review. CCAs may also operate energy efficiency programs without using ratepayer funds. In PY2022, MCE was the only CCA with reported savings. It was also the only CCA represented in a joint cooperation memo (JCM).[32] MCE was also the first CCA to ETA and ATA energy efficiency programs.

2.1 RENs included in evaluation

Three of the five existing RENs had active programs in PY2022: Bay Area Regional Energy Network (BayREN), Southern California Regional Energy Network (SoCalREN), and Tri-County Regional Energy Network (3C-REN).[33]

2.1.1 Bay Area Regional Energy Network

BayREN collaborates with nine counties to implement regional energy savings programs for single-family and multifamily homeowners and small-and medium-sized businesses (SMBs). Single-family homeowners receive rebates and financing for heat pumps, induction cooktops, insulation, air and duct sealing, energy efficient heating ventilation and air-conditioning (HVAC) equipment, and water efficiency upgrades. Multifamily property owners qualify for building improvements and water efficiency upgrades. BayREN also includes non-energy saving programs such as Codes and Standards, Water Upgrades Save, and Green Labeling.

BayREN serves Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties and overlaps with the Pacific Gas & Energy (PG&E) service territory. BayREN also overlaps with the following CCAs: MCE, CleanPowerSF (CPSF), East Bay Community Energy (EBCE),[34] Peninsula Clean Energy (PCE), San Jose Clean Energy (SJCE), Silicon Valley Clean Energy (SVCE), and Sonoma Clean Power (SCP). All of the CCAs in this list, except for SVCE, are listed in CEDARS, administer energy efficiency programs, and use ratepayer funds.[35]

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[30] General Order 96-B is the Commission order that contains the various rules that govern Advice Letter submittals.

[31] PUC Section 381 was created by Assembly Bill (AB) 1890 in September 1996 and established a Public Goods Charge (PGC) that consumers pay on electricity consumption for cost-effective energy efficiency, renewable technologies, and public interest research.

[32] A Joint Cooperation Memo is a document that outlines collaboration and coordination between utilities, RENs, and some CCAs.

[33] A fourth REN, Inland REN (I-REN), led by Western Riverside Council of Governments and partners was approved by the CPUC in 2021, and a fifth REN serving rural areas (R-REN) was approved by the CPUC in May 2023.

[34] East Bay Community Energy was renamed Ava Community Energy in October 2023.

[35] The CPUC established the terms ETA (Elect to Administer) and ATA (Apply to Administer) to describe the regulatory requirements related to CCA registration, implementation, and expansion. Under ETA, a CCA provides energy efficiency programs exclusively for its own customers. CCAs choosing ATA can provide energy efficiency programs to both their CCA customers and customers who have opted out of participating in CCA services.

2.1.2 Southern California Regional Energy Network

SoCalREN provides energy efficiency resources and programs for residential customers (single-family and multifamily property owners), businesses, and public agencies throughout the Southern California Edison (SCE) and SoCalGas (SCG) service territories. SoCalREN serves the following counties: Imperial, Inyo, Kern (partial), Kings (partial), Los Angeles, Mono, Orange (partial), Riverside, San Bernardino, Tulare (partial), Santa Barbara (partial), and Ventura counties. The SoCalREN program also overlaps with the following CCAs: Apple Valley Choice Energy (AVCE), Clean Power Alliance (CPA), Desert Community Energy (DCE), Energy for Palmdale's Independent Choice (EPIC), Lancaster Energy (LCE), Orange County Power Authority (OCPA), Pico Rivera Innovative Municipal Energy (PRIME), Pomona Choice Energy, Rancho Mirage Energy Authority (RMEA), and San Jacinto Power (SJP). From this list, only LCE uses an ETA to provide energy efficiency programs using ratepayer funds.

2.1.3 Tri-County Regional Energy Network

3C-REN is a joint initiative involving the San Luis Obispo, Santa Barbara, and Ventura counties. This REN is dedicated to delivering energy efficiency programs and education to reduce energy use, bolster the local economy, and contribute to meeting climate goals. Presently, 3C-REN caters to single-family residents and multifamily property owners with a focus on HTR, DAC, and underserved communities. This REN program also provides capacity-building services such as workforce development training and technical support for upholding energy codes and standards. 3C-REN overlaps with PG&E, SCE, and SCG service territories and three CCAs: Central Coast Community Energy (3CE), Santa Barbara Clean Energy (SBCE), and Clean Power Alliance. None of the CCAs administer energy efficiency programs that use ratepayer funds.

2.2 Evaluated programs

DNV evaluated all active PY2022 REN programs. Table 2-1 lists the 18 programs included in this evaluation by program ID and name and the name DNV uses to reference each program throughout this report.

Table 2-1. Names of evaluated programs

Program ID	Program name	DNV name
BAYREN02	Multifamily Residential Energy Efficiency Program	BayREN MF
BAYREN02-A[36]	BAMBE Electrification	BayREN MF Electrification
BayREN03	Codes and Standards	BayREN C&S
BayREN04	Water Upgrades Save	BayREN WUSave
BAYREN06	SMB Commercial Program	BayREN SMB
BayREN07	Green Labeling	BayREN Green Labeling
BAYREN08	Single Family Residential Energy Efficiency Program	BayREN SF
SCR-FIN-C1	Public Agency Revolving Loan Fund	SoCalREN RLF
SCR-PUBL-B1	Energy Efficiency Project Delivery Program	SoCalREN EE PDP
SCR-PUBL-B2	Distributed Energy Resource Disadvantaged Communities Program	SoCalREN DER DAC
SCR-PUBL-B3	Public Agency NMEC Program	SoCalREN PA NMEC

[36] BAYREN02-A is a subprogram under BAYREN02, and we have referred to them as one program in other sections of this report but broke them out here because BayREN reports the savings claims separately.

Program ID	Program name	DNV name
SCR-PUBL-B4	Streamlined Savings Program	SoCalREN PA SSP
SCR-RES-A1	Multifamily Program	SoCalREN MF
SCR-RES-A4	Residential Kits4Kids	SoCalREN Kits for Kids
SCR-WET-D1	Workforce Education & Training Program	SoCalREN WE&T
TCR-WET-001	Building Performance Training	3C-REN WE&T
TCR-CS-001	Energy Code Connect	3C-REN C&S
TCR-Res-002	Multifamily	3C-REN MF
TCR-Res-003	Single Family NMEC	3C-REN SF NMEC

The impact evaluation focused on three active REN programs with claimed savings in PY2022 (indicated by an * in Table 2-2 below), while the process evaluation included an assessment of all 18 REN programs that were active that year. Because there are so many common elements within each program type (e.g., target customers, outreach strategies, types of measures and services/support offered, etc.), we have organized the evaluation for these 18 programs by category (residential, public agency and commercial, and workforce education and training [WE&T] and codes and standards [C&S]).

2.2.1 Residential single family and multifamily

Table 2-2 provides a summary of the six residential programs included in our evaluation.

Table 2-2. Residential single family and multifamily program summaries

Program	Program summary
BayREN MF / BayREN MF Electrification *	Offered no-cost technical assistance and rebates for energy saving and electrification technologies to all multifamily property owners, while prioritizing small and independently owned properties.
BayREN SF *	Provided a variety of service offerings to underserved single-family homeowners and renters including rebates, an online energy evaluation, no-cost energy efficiency kits, in-home education, and direct install services.
SoCalREN MF *	Provided an energy and green building consultant to identify cost-effective upgrades and applicable incentives to improve the efficiency of multifamily buildings, primarily properties classified as HTR or located in DACs.
SoCalREN Kits for Kids	Introduced third- and fourth-grade students from participating schools within SoCalREN's territory to energy efficiency and how it can help their families save money and improve their comfort and safety at home.
3C-REN MF	Provided owners of existing multifamily properties with a no-cost energy assessment and rebates for whole building upgrades and high energy-saving measures, including heat pumps, with an emphasis on affordable housing, HTR, DAC, and underserved communities.
3C-REN SF NMEC	Offered contractor incentives for energy saving projects in single-family homes, using a normalized metering energy consumption (NMEC) program design, with an emphasis on HTR and underserved communities.

* Programs included in our impact evaluation.

REN residential programs targeted underserved groups and either limited participation to them or offered them opportunities for enhanced incentives. REN residential programs also tackled nuanced issues such as lack of technical knowledge, split incentives, renter equity, and socioeconomic factors using dedicated advocates, educators, and assistants who provided

hands-on support. Most residential programs experienced similar barriers and program challenges related to supply chain problems, limited supply of contractors, and multiple aspects of electrification. Electrification-related challenges included high upfront costs, low incentives, complicated logistics, and a lack of customer and contractor knowledge. For more detail about program challenges and barriers, see Appendix D: Program challenges and barriers.

2.2.2 Public and commercial programs

Table 2-3 provides a summary of the seven public agency and commercial programs included in our evaluation.

Table 2-3. Public agency and commercial program summaries

Program	Program summary
BayREN WUSave	Partnered with water utilities to deliver water efficiency improvements to residential and commercial customers. Allowed certain cost-effective energy measures to be installed and paid back through the water bill surcharge mechanism.
BayREN SMB	Used multiple energy efficiency contractors to offer rebates to small- and medium-size businesses with a focus on HTR and DACs.
SoCalREN RLF	Supported energy efficiency upgrades of public agency facilities by providing no-interest financing for customers enrolled in the SoCalREN DER DAC program. (see SCR-PUBL-B2 below).
SoCalREN EE PDP	Non-resource program that offered free services for public agencies including high-level technical assistance, objective third-party expertise, access to project funding and financing, and project management for all stages of an energy efficiency project. The program channeled projects to other resource programs offered by SoCalREN, IOUs, or other programs partners, as applicable, to provide a robust array of service offerings while also improving cost-effectiveness across programs and avoiding duplication of efforts.[37]
SoCalREN DER DAC	Supported public agencies on a path towards zero net energy (ZNE), which means producing all the energy needed on-site. Maximized energy efficiency opportunities for low-income, rural, and DACs while driving the integration of distributed energy resources (DERs).
SoCalREN PA NMEC	Provided core energy efficiency services including audit and technical services, financing support, simplified procurement, and incentive application support. Determined energy savings using site-level NMEC approaches.[38]
SoCalREN PA SSP	Offered expedited cash incentives for energy efficiency upgrades that have energy savings calculations pre-approved by the CPUC (i.e., deemed measures).

REN public and commercial programs targeted diverse participants to reduce the sector's carbon footprint and achieve long-term savings through energy efficiency initiatives. The REN programs play a role in the energy efficiency landscape by bridging gaps through education, and mentorship, and facilitating timely and straightforward access to funding for program implementation and development. The public and commercial programs' flexibility in terms of incentive structures and eligibility requirements enable entities who may not otherwise be eligible for alternative programs to participate. The REN public and commercial programs offer customized project management and technical assistance that may be lacking in the public sector or in small businesses due to resource constraints. Such support allows the participating entities to build capacity, which is not possible through a one-time intervention.

[37] Resource programs generate energy savings that are quantified and tracked by program administrators. Non-resource programs are designed to promote activities that indirectly reduce energy usage (e.g., marketing, education, and outreach programs).

[38] The NMEC Rulebook 2.0 provides the following definition for site-level NMEC approaches. Savings are determined on a site-by-site basis and claimed at the level of the individual site or project. The method used to estimate savings is developed based on building and/or site-specific characteristics and reflect the unique drivers of savings at the site or project. The method may include adjustments for site-specific non-routine events (NREs) that occurred at the site during the baseline, reporting, or installation period.

2.2.3 WE&T and C&S programs

Table 2-4 provides a summary of the three WE&T and two C&S programs included in our evaluation.

Table 2-4. WE&T and C&S program summaries

Program	Program summary
BayREN C&S	Gathered, developed, and promoted best practices and facilitated data sharing between jurisdictions to promote compliance with energy codes and green building standards through trainings and workshops with local government building department staff.
BayREN Green Labeling	Trained real estate professionals to understand the benefits of an energy efficient home so they can effectively market and communicate with their clients about the benefits of energy efficient upgrades. Used the DOE's Home Energy Score (HEScore) to estimate home energy use and associated costs and provide cost-effective energy solutions.
SoCalREN WE&T	Provided training, tools, and opportunities for youth and contractors in disadvantaged communities to pursue careers in energy and water efficiency.
3C-REN WE&T	Offered career pathways and enrichment by providing access to in-person, on-demand, and technical training, mentorship opportunities, soft skills development (e.g., resume writing and interview preparation), and energy efficiency certifications. Engaged HTR and disadvantaged workers and workers in DACs.
3C-REN C&S	Offered local, in-person, and online person-to-person training, regional forums, and an energy code coach service that provides in-person, over-the-phone, texting, and online expert assistance for public- and private-sector building professionals.

WE&T and C&S programs focused on activities that ensure a well-trained workforce (e.g., contractors, building and real-estate professionals, government staff) equipped to navigate energy efficiency practices and technologies. The programs provided training, tools, and career opportunities to increase the size, skill level, and diversity of the energy efficiency labor force in the regions they serve. WE&T and C&S programs relied on local knowledge and presence to provide a custom approach designed to be more hands-on and regionally relevant than IOU approaches.

2.2.4 Reported gross and net savings

Table 2-5 summarizes the claimed savings of each PY2022 REN program that DNV evaluated in the impact assessment. We evaluated the gross and net savings of the single-family program with deemed (BayREN SF) or whole-building custom claims in PY2022 (SoCalREN MF, BayREN MF / MF Electrification).

Table 2-5. PY2022 program savings claims

Program	No. of claims	First year kW		First year kWh		Lifecycle kWh	First year therms		Lifecycle therms
		Gross	Net	Gross	Net	Net	Gross	Net	Net
SoCalREN MF	80	409	311	7,033,773	5,375,111	54,308,367	100,164	75,123	1,094,502
BayREN SF	14,093	446	220	4,331,840	4,186,326	51,603,473	168,539	79,865	975,777
BayREN MF	12	200	150	805,645	604,234	5,824,430	60,682	45,512	607,455
BayREN MF Electrification	14	12	9	428,861	434,077	5,247,432	1,724	1,293	16,434

2.3 Evaluation objectives

Table 2-6 lists the research questions and study objectives for our process and impact evaluation. Process evaluation findings cover marketing and outreach and program performance topic areas and their associated study objectives and research questions. Impact evaluation findings cover energy savings.

Table 2-6. REN evaluation research questions and study objectives

Topic	Study objectives	Research questions
Process evaluation		
Marketing and outreach	Determine if REN marketing and outreach efforts are effective at reaching their intended audience.	• Who constitutes the target market for the REN programs? • What marketing strategies do the RENs programs employ to reach their target market? • Are the demographic characteristics of participants in line with the target market identified by the RENs? • Do participants' reported methods of learning about the programs align with the marketing approaches identified as successful by RENs?
Program performance	Determine how REN program offerings provide unique value, align with CPUC objectives, and benefit program participants.	• How do REN programs "demonstrate new and unique value toward California's energy, climate, and equity goals," as specified by Decision 19-12-021? – How do REN programs address gaps (as defined by CPUC Decision 12-11-015 and Decision 19-12-021), particularly in multifamily housing? – How well do RENs serve HTR customers? Which ratepayers are still being underserved? • How do REN programs complement or overlap with other programs available to program participants? – How do RENs coordinate with other program administrators (including other RENs) to reach more customers, avoid duplication of effort, and be more effective? • What are REN participants' perceived/self-reported program benefits?
Impact evaluation		
Energy impacts	Determine the gross and net savings for programs with projected savings, and the reasons for any differences found between the projected and actual savings.	• What are the gross energy savings of the REN programs with deemed savings? • What proportion of the savings can be attributed to the program (e.g., net savings)? • What are the causes for the differences, if any, between reported and targeted savings for REN programs?

3 METHODOLOGY

This section outlines the data and the methodology DNV used to evaluate the PY2022 REN programs. It includes the data sources, a summary of program measures and energy consumption data, and the primary research, process evaluation, and impact approaches.

3.1 Data

This section describes the data sources and data collection efforts that were used to conduct the PY2022 REN process and impact evaluation.

3.1.1 Data sources

We used various datasets from both primary and secondary sources. Table 3-1 below summarizes these datasets and their purpose in the evaluation.

Table 3-1. Summary of data sources and evaluation objectives

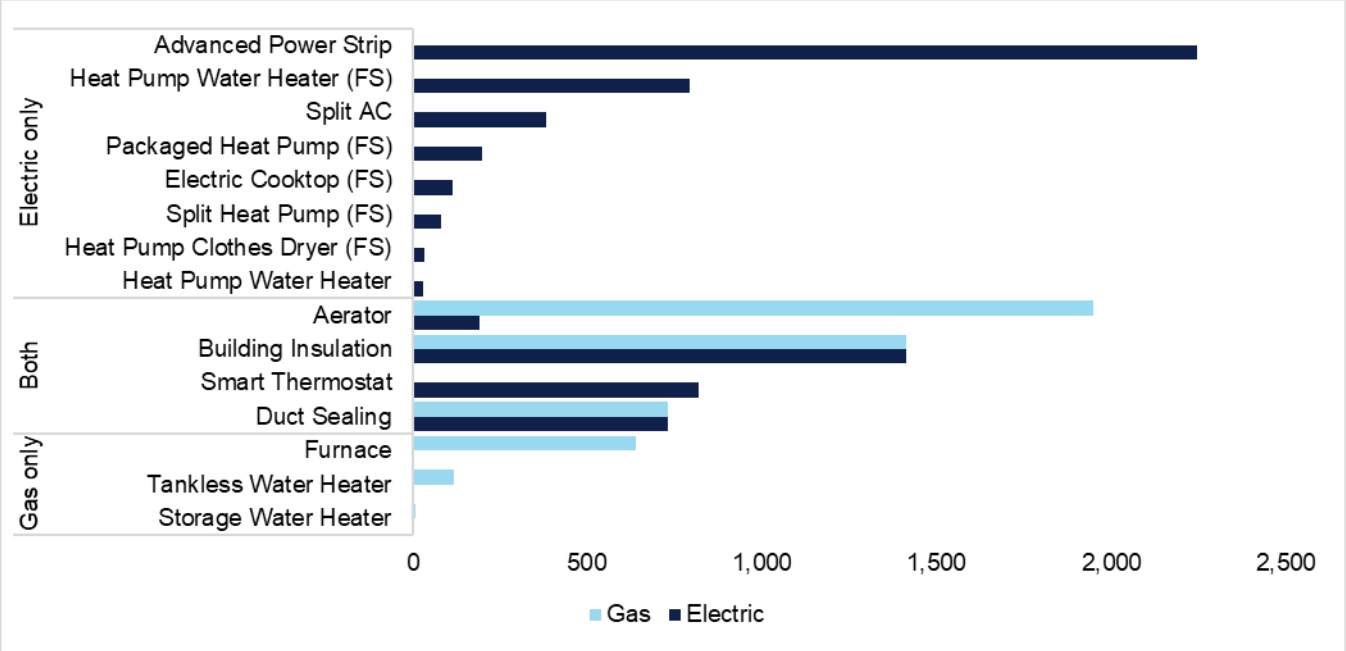
Data	Description	Evaluation purpose
REN program data	Program-related information, including participants' contact information (names, emails, and phone numbers) and details on installed measures for energy efficiency programs with claimed savings	Understand participation patterns, participant experience, and verify gross savings
Program tracking data	Tracking data that PAs filed with the CPUC in CEDARS that provides program names, measures, number of claims, savings per measure and claim, incentives, etc.	Identify program participants, installed measures, and claimed (ex-ante) savings
Utility billing and AMI data	Customer energy consumption data (kWh and therms) and bill rates	Evaluate energy usage impact of energy efficiency programs with claimed savings
Weather data	National Oceanic and Atmospheric Administration (NOAA) and climate zone (CZ) 2022 reference temperature files (CZ2022)	Weather normalized energy consumption used to determine impact of energy efficiency programs with claimed savings
PA Customer Information System (CIS) Data	Details on customer characteristics such as housing type, zip code, and climate zone	Analyze participant demographics, household information, and geographic distribution
U.S. Census Data	Block group level data on language, geographic region, and rental status from the American Community Survey (ACS)	Analyze demographic information, geographic factors, and rental status that influence program participation
U.S. Office of Management and Budget (OMB) Data	Combined statistical area (CSA) used to define metro and non-metro areas	Classify areas into metro and non-metro categories, allowing regional analysis of program reach and effectiveness
California Environmental Protection Agency (CalEPA) Data	CalEnviroScreen data measuring economic, health, and environmental burdens at the census tract level used to define disadvantaged communities	Analyze environmental and economic factors affecting program participation, focusing on areas with higher burdens for targeted interventions
Telephone/web surveys	Web surveys with residential participants and phone surveys with property manager participants	Inform net-to-gross ratios (NTGRs) and net savings, assess program performance, and gather insights into participant experiences and feedback

Data	Description	Evaluation purpose
In-depth interviews (IDIs)	Interview non-residential participants (public sector, real estate, and building department professionals, workforce training participants), PA program staff, and implementers	Assess program performance, analyze participation, and gain qualitative insights into program effectiveness and stakeholder perspectives
Site visits	Visit selected single-family and multifamily residential sites	Verify installation and collect information on installed measures
Secondary Data	Program and other documents (California policies, CPUC decisions, program implementation plans (PIPs), JCMs, and previous REN studies)	Assess program performance and gain insight into program value

3.1.2 Program measures

We assessed the tracking data to understand the type of measures for which the BayREN SF program claimed electric, gas, or both electric and gas savings claims. Figure 3-1 provides the total number of participants who installed these measures in PY2022. Most participants installed measures that the program expected to deliver electric savings. Our evaluation approach reflected the type of fuel for which the program claimed savings for each measure. For example, while fuel substitution heat pumps reduced gas use, the program claimed the electric equivalent of the gas reduction but not the gas savings (reduction). Our analysis examined the overall electric consumption impact of such measures.

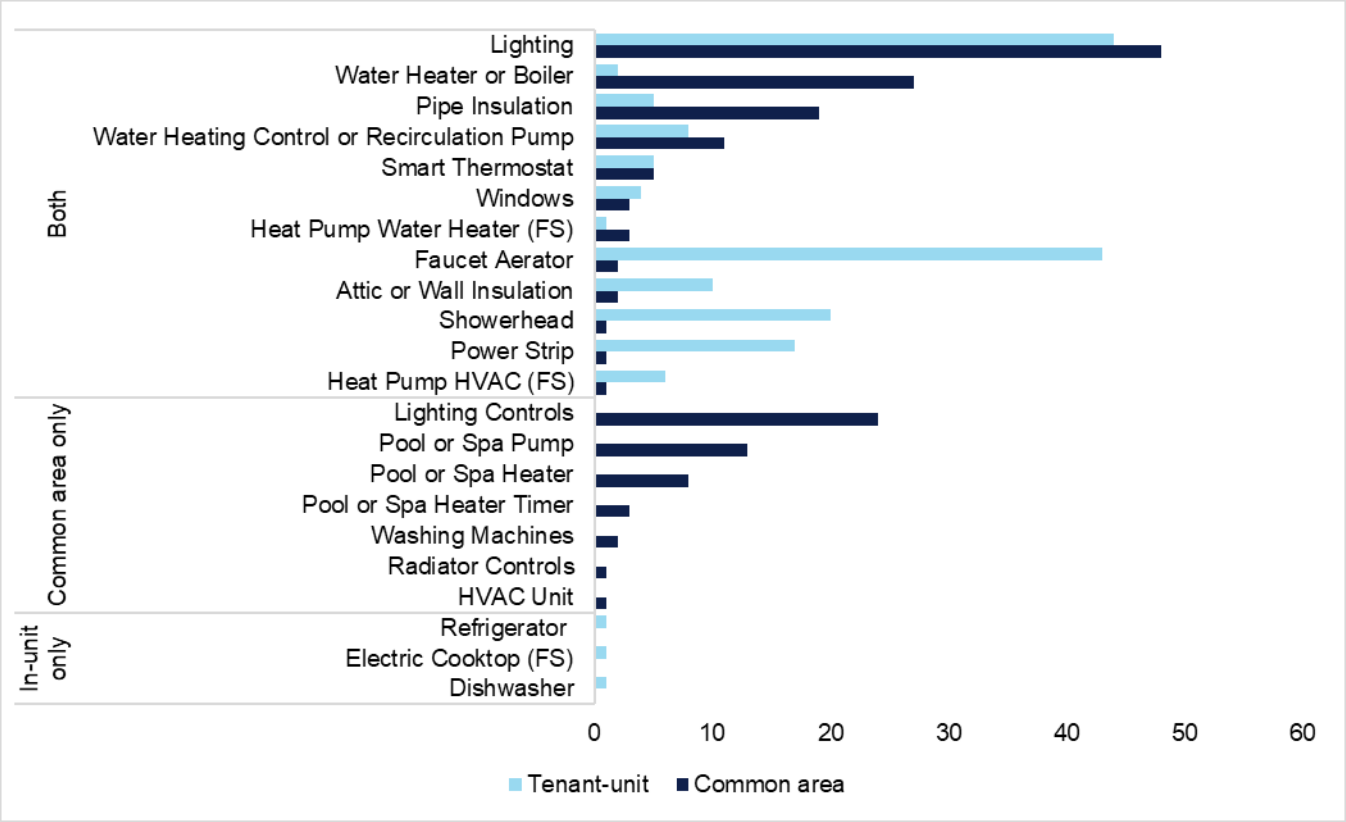
Figure 3-1. Number of participating single-family homes with REN program measures



*FS = fuel substitution

We also used data from the project files provided by the RENs to understand the measures installed by the multifamily programs in PY2022. These programs delivered both common area and in-unit (tenant) measures. While the programs provided a few in-unit-only measures, they mostly installed similar measure types that served both common areas and tenant units. Like the single-family program, the multifamily programs installed heat pumps (HVAC and water heating) and electric cooktops that replaced their gas equivalents. Figure 3-2 summarizes the number of buildings that received the measures categorized by where the installations occurred.

Figure 3-2. Number of participating multifamily buildings with REN program measures



3.1.3 Energy consumption data for single-family participants

We obtained energy consumption data to evaluate the BayREN SF program from PG&E, which provides energy to the customers in the program, at multiple levels of granularity including monthly, daily, and hourly (for electric only). We used monthly billing data to identify non-participants (those without any program-sponsored measures) whose energy use patterns can help inform baseline energy consumption. The hourly electric and daily gas data served to fine-tune the identification of non-participants and served as the basis for site-level modeling. Finally, hourly electric usage and daily data gas usage data were included in models used to estimate the effect of the program on energy use and demand.

We processed the energy consumption data we received before use in analysis. We prepared the billing data by removing duplicate reads, sites with total zero energy use for the year, and reads that correspond to onsite solar energy production. We also aggregated the billing data to the billing month so that there are 12 reads in a year. Billing values that reflect multiple smaller read intervals were summed to the monthly level to accomplish this. We included only customers who had a full year of pre-installation (matching period) data in the analysis.

To process the daily gas data, we reviewed the data for duplicate entries at both the customer and day levels. We either combined or removed these duplicates. Additionally, we filtered out any negative values and instances of zero annual gas usage across the analysis period. Furthermore, we limited our analysis to customers with complete matching period data. For the hourly electricity data, we used a similar screening process. We excluded households with onsite solar production because it was not possible to determine their overall energy consumption with the available data.[39] Additionally, we excluded days missing more than four hourly reads and had zero total consumption.

Table 3-2 presents the number of customers for whom we used energy consumption data in the evaluation. The table indicates the starting household counts from the tracking data considered for use in the evaluation and for whom we requested and received data; the number of customers without onsite solar (not net-metered), and finally customers with interval (advanced metering infrastructure [AMI]) data with the requisite pre- and post-installation data of at least 328 days available in each period of the analysis.

Table 3-2. Single-family customer counts used in the evaluation, PY2022

Single-family participant data attrition	Electric only	Gas only
Customers with PY2022 BAYREN SF claims	5,563	4,549
Customers for whom AMI data was requested	5,563	4,549
Customers for whom some data was received	3,886	3,472
Customers with matched and sufficient data used in the analysis*	2,056	3,414

*Customers without onsite solar (electric) and at least 90% of pre- and post-installation period data.

3.1.4 Primary research

In this section, we describe our primary data collection efforts. These include our data collection methods, sample design, and survey approaches, including survey modes and dispositions. Primary research for the process and impact evaluations included residential single-family customer web surveys, multifamily property manager phone surveys, residential single-family and multifamily site visits, non-residential IDIs, and PA and program implementer IDIs. Survey instruments and interview guides are provided in Appendix L: Survey and interview guides.

3.1.4.1 Data collection

Table 3-3 summarizes our data collection efforts. It provides the target groups, data collection structure, and the number of respondents we targeted for data collection.

Table 3-3. Summary of primary data collection efforts – evaluation of PY2022 REN programs

Target group	Data collected	Frame source	Mode	Stratification approach	Sample frame	Targeted sample size
PAs and implementers	Program outreach and features, coordination with other PAs, program gaps and overlaps, and customer participation trends	Tracking and REN program data	IDI	N/A	35	Census[40]

[39] Utility records provide net-metered electricity use, which reflects the difference between delivered and received kWh but not the amount of onsite solar production.
[40] Census indicates that DNV attempted to collect information from all participants in the population.

Target group	Data collected	Frame source	Mode	Stratification approach	Sample frame	Targeted sample size
Non-residential participants (public sector, real estate, and building department professionals, workforce training participants)	Program awareness, motivation for participation, experience (benefits, barriers, satisfaction), participant and market characteristics	REN program data	IDI	Program	2,094	59
Property manager participants	Program influence – net-to-gross (NTG), program awareness, motivation for participation, experience, barriers, and building characteristics	REN program data	Phone survey	Program and savings level	77	54
Residential single-family participants	Program influence – NTG, demographic data, occupancy, program awareness and experience, and participation in other programs	Program tracking data	Web survey	Census	5,329	Census
Multifamily sites	Verify measure installation and use and determine installed measure quality	REN program and program tracking data	Site visit	Program	77	28
Single-family sites	Verify measure installation and use, determine installed measure quality, and HVAC and water heating characteristics	REN program data Program tracking data	Site visit	Program	1,329	5

3.1.4.2 Sample design

Our single- and multifamily surveys used, respectively, a census and a stratified random sample approach to determine which participants to contact. Under the census approach (for single-family participants), we attempted to collect data from each participant with a valid e-mail address via a web survey. Under the stratified random sample approach (for multifamily participants), we grouped sampling units into strata based on the program (BayREN and SoCalREN) and savings (measured in BTU). We determined the sample sizes needed for each stratum to achieve a targeted relative precision (±10%) at a desired confidence level (90%) for both impact and process metrics. Once we calculated the required sample sizes for each stratum, we chose a random sample of properties from the population based on the stratification plan. We pre-randomized those properties we did not select for the primary sample as replacements if we needed to replace any primary sample points due to nonresponse (could not be contacted, refused participation, or could not be evaluated for some other reason).

We conducted site visits for both single-family and multifamily properties when participants opted in to participate in such visits at the end of their surveys. We selected several single-family sites to inspect the installations of electrification measures. We did not use a statistically based sampling method to choose the sites since our focus was on the quality and accuracy of the installations. For multifamily participants, we selected sites based on a stratified random sampling approach to produce statistically valid estimates of installation rates.[41] See Appendix E: Sampling for more details.

For the non-residential IDIs, we chose a random sample of five from the list of participants provided by the RENs for each program. In addition, we selected backup samples and used them in cases where any of the initially selected participants could not be reached. In programs with less than five participants, we attempted to contact all of them. For example, the BayREN WUSave program had two participating municipal water utilities in PY2022, and we interviewed one participant for whom we had contact information.

3.1.4.3 Survey approach

3.1.4.3.1 Residential single-family web survey

We administered a residential web survey to participants who received measures from the BayREN's SF program. Survey topics included questions to gauge program influence, motivations for participation, perceived program benefits, satisfaction, and household and demographic characteristics. We drew the survey sample from a list of program participants with valid email addresses.

DNV conducted the web-based survey over a period of roughly 4 weeks in December 2023 and January 2024. The survey questions and invitation email were written in both English and Spanish. To incentivize survey participation, we offered participants a chance to win one of five $150 gift cards and sent out three reminders to prompt them to complete the survey. In conducting this survey, DNV adhered to established best practices, which included:

- Giving respondents a link to the CPUC valid survey website to verify the authenticity of the survey
- Cobranding the survey with the CPUC and PA logos to legitimize the validity of the survey as coming from a trusted source
- Sending the survey invitation from an email address within the PA domain to avoid invitations being caught in spam filters
- Including a letter from the CPUC study manager emphasizing the importance of this research and participant responses to energy efficiency programs

Table 3-4 provides the sample disposition for the single-family web survey.

Table 3-4. Single-family participant web survey sample disposition

Single-family participants	Total
Sample frame (invitations emails sent)	5,329
Partially completed surveys	103
Completed surveys	676
Response rate	13%

[41] As discussed in the impact method section 3.3, only the multifamily program impact approach relied on installation verification to determine program impact.

3.1.4.3.2 Residential single-family follow-up site visits

We conducted site visits among a subset of the BayREN SF participants who installed fuel substitution measures, responded to the web survey, and were willing to participate in follow-up research. The site visits were to inspect if the measures were installed and still in use and to collect information on the HVAC and water heating characteristics in place.

We completed five single-family site visits. We offered every site visit participant a $50 gift card. We conducted these site visits for approximately 2 weeks, from late December 2023 to early January 2024. A typical visit lasted approximately 30 minutes. During the visit, the DNV engineer verified that the installed electrification measures were in place.

3.1.4.3.3 Residential multifamily property manager survey

We conducted a telephone survey of property owners/managers who participated in multifamily programs, including BayREN's MF / MF Electrification program and the SoCalREN's MF program.[42] Property managers were responsible for the decision to participate in these programs and therefore the most appropriate contacts from whom to collect data. We collected information to determine program influence, identify reasons for participation, understand program experience, including perceived benefits, gauge program satisfaction, identify barriers to energy efficiency and program participation, and determine building characteristics.

We drew the survey sample from the list of program participants with contact information provided by the RENs. DNV attempted to contact participants by both phone and email to participate in the survey. We conducted the phone surveys for roughly 6 weeks, from late December 2023 to early February 2024. To incentivize participation, we offered property managers the chance to win one of five $200 gift cards. Table 3-5 summarizes the disposition of the multifamily survey.

Table 3-5. Multifamily property manager phone survey sample disposition

Multifamily participants	Total	BayREN MF / MF Electrification	SoCalREN MF
Sample frame	77	19	58
Attempted calls	77	19	58
Completed surveys	34	12	22
Response rate	44%	63%	38%

3.1.4.3.4 Multifamily site visits

DNV asked residential multifamily phone survey respondents about their willingness to participate in follow-up research (i.e., subsequent site visits). We conducted site visits of properties whose managers indicated interest in such visits to verify if the incentivized measures were installed and still in use.

We completed 13 site visits for BayREN and SoCalREN's multifamily programs. We conducted these site visits for approximately 4 weeks from early January to early February 2024. A typical visit lasted approximately 60 minutes. During the visit, the DNV engineer verified both the common area and in-unit installed measures were still in place. We offered every participating property manager a $200 e-gift card. Of the 13 site visits we conducted, one participant declined the incentive due to rules that prevented them from accepting. Table 3-6 below summarizes the disposition of the multifamily site visits.

[42] We did not collect information through a survey for 3C-REN's Multifamily Program (TCR-RES-002) because there were no claimed savings and participants in PY2022.

Table 3-6. Multifamily property manager site visit sample disposition

Multifamily participants	Total	BayREN MF / MF Electrification	SoCalREN MF
Sample frame	77	19	58
Completed site visits	13	8	5
Response rate	17%	42%	9%

3.1.4.3.5 Non-residential in-depth interviews

DNV completed targeted IDIs with up to five randomly selected participants via telephone from each non-residential program.[43] We collected information on how participants learned about the programs, their perception of program benefits, satisfaction and barriers, and facility and participant characteristics. We conducted the IDIs over 7 weeks, from December 2023 to February 2024. Table 3-7. provides the programs, the sample frame, and the number of participants in the non-residential IDIs.

Table 3-7. PY2022 programs included in non-residential participant IDIs

Program ID and name	Participant type	Sample frame	Number of completed IDIs
BayREN C&S	Public (local government building department staff)	368	8
BayREN WUSave	Public (municipal water utilities)	2	1
BayREN Green Labeling	Real estate professionals (realtors, lenders, assessors)	194	5
SoCalREN RLF	Public (agencies in DACs)	4	4
SoCalREN EE PDP	Public (agencies)	110	5
SoCalREN DER DAC	Public (agencies in DACs)	31	5
SoCalREN PA NMEC	Public (agencies)	6	4
SoCalREN PA SSP	Public (agencies)	3	3
SoCalREN Kits for Kids	School classrooms / students	248	5
SoCalREN WE&T	Building professionals	145	1
3C-REN C&S	Public and private sector building professionals	423	5
3C-REN WE&T	Public and private sector building professionals	553	3
3C-REN SF NMEC	Building professionals	7	2
Total	All participants	2,094	51

3.1.4.3.6 PA and implementer in-depth interviews

We conducted IDIs among REN program staff and implementer partners to better understand how the programs operated in PY2022. We used the data we collected to supplement the information the RENs provided in their PIPs, JCMs, and other

[43] The SoCalREN Residential Kits4Kids (SCR-RES-A4) program is residential. However, we conducted in-depth interviews with participating school representatives instead of the minor participating students. The 3C-REN Single Family NMEC (TCR-Res-003) is also a residential program. However, the program participants were contractors, and the program did not claim savings in PY2022. Two of SCR's public programs (SCR-PUBL-B3 and SCR-PUBL-B4) were resource programs with claimed savings in PY2022. We conducted IDIs with select participants instead of NTG/program attribution research for these programs. These programs had non-deemed savings claims (with one claiming savings based on site NMEC methods) for which another contract group (Group D) conducts NTG research.

program documentation. In particular, we gathered information on programs' outreach activities, how programs met their objectives, identified and addressed gaps, coordinated activities with other PAs, and how much they supported HTR and DAC participation.

We conducted two separate IDIs with PAs, one in July 2023 and another in January 2024. The second set of IDIs also involved implementers. Because of the breadth of the interview topics across 18 programs, we developed pre-interview questionnaires for this IDI round, which we sent to participants via email. We then reviewed participant responses to the questionnaire and conducted follow-up interviews via Microsoft Teams. Table 3-8 provides the interview log, including the call dates for each interview.

Table 3-8. REN PA and implementer interview log

REN	First PA interview call date	Second PA and implementer call date
BayREN	12-July-23	17-Jan-24
SoCalREN	12-July-23	16-Jan-24
3C-REN	13-July-23	17-Jan-24

3.2 Process evaluation

DNV conducted a process evaluation through a multi-source approach that included program documentation review, participant surveys, and program staff and implementer IDIs. In this study, we evaluated REN objectives and requirements, compared REN program offerings to those offered by utilities and CCAs, reviewed marketing and outreach strategies, identified how RENs are serving HTR customers and DACs, and assessed RENs' value to California's energy, climate, and equity goals. Part of our approach for the process evaluation included reviewing recent studies and findings. In particular, we included the following recent studies as part of our documentation review:

- 2022 Low Income Needs Assessment, Evergreen Economics
- 2013-2015 Regional Energy Networks and Community Choice Aggregator Multifamily Market Scalability Study, Itron
- 2013-14 Regional Energy Networks and Community Choice Aggregator Programs Impact Assessment, Itron
- Assessment of Regional Energy Networks, CPUC Contract Group B: Deliverable 22B Year 2 Study, Opinion Dynamics / Tierra
- Assessment of Regional Energy Networks, CPUC Contract Group B: Deliverable 22B Year 3 Study, Opinion Dynamics / Tierra Assessment of Regional Energy Networks, CPUC Contract Group B: Deliverable 22B Year 4 Study - DRAFT, Opinion Dynamics / Tierra
- BayREN 2019 Process Evaluation, Grounded Research and Consulting
- BayREN's Final 2021 Residential Sector Process Evaluation
- BayREN Residential Contractor Research
- 2021, SoCalREN Portfolio-level Process Evaluation
- 2021, SoCalREN Multifamily Program Process Evaluation

We focused our assessment on what had not been covered by previous evaluations and studies and tailored our approach to provide new insight based on our research questions. In particular, our participant surveys and IDIs provided a new understanding of program performance, outreach strategies, and any uncertainty in the marketplace due to overlapping or complementary programs.

Table 3-9 describes our research objectives for each section and the methodology we used to develop the process evaluation results included in Section 4.

Table 3-9. Process evaluation objectives and methodology by topic

Topic	Objectives	Methodology / data used
Targeted program participants and outreach	• Identify the customers each program intended to reach and the marketing and outreach strategies it deployed to reach them. • Determine the level of success achieved by these strategies.	• Program documentation review including PIPs, annual reports, JCMs, annual budget advice letters (ABALs), logic models, value metrics • PA/Implementer IDIs • Participant IDIs • Participant web and phone surveys
Program features and value	• Determine how the RENs are addressing gaps in IOU and CCA energy efficiency programs through their program offerings. • Assess how REN programs provide unique value.	• CPUC decisions and California state policy • Program documentation review including PIPs, annual reports, JCMs, ABALs, logic models, value metrics • PA/Implementer IDIs • Participant IDIs • Participant web and phone surveys
Complementary activities and coordination	• Assess how RENs are coordinating with IOUs and CCAs to decrease program overlap and any perceived customer confusion, leverage existing partnerships, and work together to enhance participation and program performance.	• Program documentation review including PIPs, annual reports, JCMs, ABALs, logic models, value metrics • PA / implementer IDIs • Participant IDIs

3.3 Impact

This section provides DNV's approaches to evaluate the energy impact of the REN single-family and multifamily programs with claimed savings in PY2022. It details the methods we used to estimate the energy savings of the programs regardless of why the customers participated in the programs (gross savings). It also provides the approach we used to quantify the savings attributable to the programs (net savings).

3.3.1 Single-family gross impact approach

We used energy consumption data analysis to assess energy impacts for the BayREN SF program. The analysis used site-level models to control for the effect of weather on energy consumption and data from a matched comparison group to control for non-program effects. This method most closely aligns with the experimental design consumption data analysis, an enhanced rigor approach, provided in Table 1 for gross energy evaluation of the CA Energy Evaluation Protocols.[44]

[44] https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/c/5212-caenergyefficiencyevaluationprotocols.doc.

Site-level models. We weather-normalized electricity and gas consumption at the individual site level. Weather normalization made it possible to determine trends in energy use based on typical (normal) weather, effectively removing the impact of yearly weather fluctuations on energy use.

We used a variation of the time of week temperature (TOWT) model for the site-level weather normalization.[45] The model used a piecewise-continuous weather trend instead of a single change point as typically specified in PRISM models to account for the effect of weather.[46] The model also included time indicators to account for load variation.

We estimated electric site-level models using hourly data and gas site-level models using daily data for pre- and post-installation periods separately. The hourly site-level electric models included hour-of-the-day indicators and the daily site-level gas models included day-of-the-week indicators. For both fuels, we ran separate summer, winter, and shoulder site-level models to capture impacts that vary by season.[47]

We used electric model coefficients and typical meteorological year (TMY) data to generate hourly electric load that reflected consumption under typical weather (or weather-normalized values) in both the pre- and post-periods for each site. We used a similar approach to estimate gas consumption that reflected TMY, but at the daily level.

We developed energy and peak demand savings estimates and load and savings shapes from this single set of site-level regression models based on data from participants and comparison group customers. This approach meant that overall, we based annual savings estimates on the same model fits used to estimate peak kW savings regardless of the peak definition. We detail how we used the weather-normalized values to determine impact and savings shapes below.

Matching. We used a two-step process to create a matched comparison group to control for pre-post population trends unrelated to the program. The two steps involved matching participants with non-participants based on billing data and refining the matching using AMI data. In both steps, we stratified customers by climate zone to ensure similarity in weather conditions of matched customers. Within each climate zone, we selected non-participants who have comparable load profiles as the participants.

In the first step, we used billing data to identify 10 candidate matches for each participant from a pool of PG&E residential customers who had not participated in any program during PY2021 and PY2022. We selected the 10 non-participant candidates using annual, winter-to-shoulder, and summer-to-shoulder consumption ratios. In the second step, we requested and used AMI data to match each participant to one non-participant. In addition to annual consumption and the seasonal ratios used in the first stage, we included maximum 6 p.m. load in the electricity matching process. In both steps, annual consumption accounted for size, and the ratios indicated levels of pre-installation heating and cooling needs. In the second step, the maximum 6 p.m. load captured behavior during the peak period. Additionally, we included tenure, representing the length of time customers were in their current residence, as a matching variable in both steps. Additional information on this process is described in Appendix H: Matching results.

3.3.1.1 Energy impact approach

To estimate impact, we summed the weather-normalized usage over the hours and days of the year. We summed these values separately for pre- and post-periods to obtain normalized annual consumption (NAC) for each participant and matched non-participant. We then calculated the difference in pre- and post-period NAC (pre-post delta NAC) for each customer. Using this

[45] The source of the original TOWT modeling approach is Mathieu, Johanna L., Phillip Price, Sila Kiliccote, Mary Ann Piette. 2011. "Quantifying changes in building electricity use, with application to Demand Response." IEEE Transactions on Smart Grid 2:507- 518. The original model featured 3-month rolling models that predicted load for the central month. It also featured an occupancy variable derived from the data, allowing for two distinct temperature trends.

[46] In past studies, we primarily used PRISM for annual savings. TOWT models provide better hourly and daily fits and allows us to use a uniform model for energy and demand.

[47] Summer includes June through September, winter from December to February, and the shoulder period comprises all other months.

data, we fit a regression model of pre-post delta NAC as a function of participant-type indicator variables.[48] The estimate for each indicator variable is the average impact associated with each participant type.

3.3.1.2 Load and savings shapes

We examined load and savings shapes as part of our assessment of the peak demand impact of the single-family program, which is the primary interest of our load analysis. We developed these shapes using the weather-normalized 8760 hourly electric and 365 daily gas values. In particular, we developed participant average daily and hourly load shapes and average hourly summer and peak demand savings shapes.

3.3.1.3 Peak demand approach

We estimated peak demand using a methodology similar to that used to assess energy impacts, but we computed the pre-post difference using weather-normalized hourly values during peak periods. We used the DEER peak period definition to calculate peak impact. According to the 2020 DEER definition,[49] a peak period is three consecutive non-holiday weekdays between June 1 and September 30, with the hottest temperatures within the 15-hour window of 4 p.m. to 9 p.m. The DEER definition considers the average daily and afternoon temperature (12 p.m. to 6 p.m.) and the maximum temperature for 3-day heatwave candidates. Table 3-10 provides the DEER TMY heat wave periods for the PY2022 participant climate zones.

Table 3-10. DEER TMY-based heat wave definitions by climate zone

Climate zone	CZ2022 (Title 24 2022) weather files			
	Start date	Weekday	Peak temperature (°F)	3-day average temperature (°F)
CZ02	26-Aug	Wednesday	102	74.7
CZ03	26-Aug	Wednesday	87	71.3
CZ04	26-Aug	Wednesday	101	80.0
CZ12	29-Jun	Monday	107	84.5

Source: https://cedars.sound-data.com/deer-resources/deer-versions/2023/file/11/download

3.3.2 Multifamily gross impact approach

To evaluate the impact of the REN multifamily programs with whole-building custom claims (SoCalREN MF and BayREN MF / MF Electrification), we conducted installation verification and engineering desktop reviews of measure savings. This approach reflects elements of the basic-level rigor measurement and verification (M&V) approach provided in the CA Energy Evaluation Protocols.[50] Specifically, it falls under the *Verification and Source of Stipulated Data* components listed in Table 5 of the M&V protocol for basic-level rigor evaluation.

For verification, we collected on-site data from participants (13 sites and 51 measures) selected via a sample design to meet precision targets of 90/10. We used the data to verify whether the claimed measures were installed and in operation and calculate program-level in-service rates. The source of stipulated data for the evaluation came from DEER measure packages and custom calculations provided in program project files, two of the listed sources in the protocol. Based on these, we reviewed the appropriate application of measure package values for deemed savings claims and the calculations for custom savings claims provided in project documents.

[48] We provide details on the participant-type indicator variables used in the models in the impact result section 4.5.1. In general, participant-types included customers with electrification and non-electrification only, and both measures.

[49] DEER 2020 - CEDARS (sound-data.com)

[50] https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/c/5212-caenergyefficiencyevaluationprotocols.doc.

We completed a review of all 26 BayREN claims,[51] with 89 measures and 79 SoCalREN claims, with 260 measures. We adjusted the savings to reflect correct savings values in cases where we identified discrepancies between program tracking data and project document calculations or in the project document calculations. We calculated gross realization rates (GRRs) for each program based on our calculated in-service rates and documentation review.

3.3.3 Net impact evaluation

We surveyed program participants to determine what proportion of installations would likely have occurred absent the program. This proportion is the free-ridership (FR) rate for each measure group or program. The complement of free-ridership (1 - FR) is the portion of the savings due to the program, which is the ratio of net to gross savings or NTGR. Net savings are the product of gross savings and the estimated NTGR. Gross savings estimate changes in energy use due to program participation, regardless of why customers participated, while net savings estimate changes in energy use without free-riders. A NTGR of 1.0 signifies that the program gets credit for all the verified savings, which implies that the program completely influenced the efficiency, quantity, and timing of the energy efficient measures. In most cases, the influence of the programs and the NTGRs are less than 1.0. For example, a NTGR of 0.75 indicates that 75% of the claimed savings for the project or measure should be credited to the program with the remaining 25% estimated to be free-ridership.

We surveyed PY2022 REN single-family participants and multifamily property managers who made decisions about program installations. We calculated the degree of free-ridership and the proportion of verified energy savings attributable to each program based on survey responses. To quantify free-ridership, we asked participants how likely they would have been to install the measures without program incentives. The program received full attribution if they indicated being very unlikely to install the measures without the incentives. Otherwise, we asked additional questions to quantify their level of free-ridership. In particular, our questions focused on timing, quantity, and efficiency. Combined, these aspects allow for estimates of net energy (kWh, kW, and therm) savings attributable to each measure, as these savings depend on the number of measures installed (quantity), the efficiency of the measures (efficiency), and when the measures are installed (timing).

- **Timing:** The timing question indicates when participants would have installed each measure without the program. The program receives full credit for any measure that participants stated they would not have installed at all or would have installed 24 months or later. The program receives partial credit for accelerating the installation compared to when respondents indicated they would have installed the measure without the program.
- **Efficiency:** The efficiency question is relevant to the measures installed by the programs for which standard or intermediate efficiency versions were available in the market. The program receives full credit for the measure if the respondents indicated they would have installed nothing or a standard efficiency measure instead of the efficient program measure. The program receives partial credit if respondents indicated they would have installed an intermediate efficiency version of the measure. We asked this question to ensure that respondents who installed measures absent the program are treated as free-riders only if they would have installed the efficient equipment.
- **Quantity:** The quantity question asks about the number of units that would have been installed without the program. This question is relevant to measures where programs allowed more than one installation per participating site. The program receives credit if the respondents indicated they would have installed fewer measures without the program.

Appendix F details how we scored participant survey responses to derive free-ridership values. We calculated measure-level NTGRs based on the responses, which we used to calculate measure- and program-level net savings for the single-family program. We calculated measure-level NTGRs, which we used to calculate program-level net savings for the multifamily program. Our sample sizes for multifamily programs were not large enough for net savings calculations at the measure level.

[51] BayREN completed 20 multifamily projects associated with the 26 claims reported in the tracking data in PY2022.

4 FINDINGS

This chapter organizes DNV's findings by the three research topics we covered: marketing and outreach, program performance, and energy impacts. Table 4-1 lists the study objectives associated with these topics, the report section(s) that address each objective, and the contents within each section.

Generally, our discussions begin with a summary of key themes or trends, followed by deeper analyses by market sector or sub-topic. We share supplementary findings about program challenges and barriers in Appendix D: Program challenges and barriers.

Table 4-1. Evaluation findings chapter contents

Topic	Study objectives	Report section	Section contents
Marketing and outreach	Determine if REN marketing and outreach efforts are effective at reaching their intended audience.	Marketing and outreach (4.1)	Analysis of program marketing and outreach activities and outcomes.
Program performance	Determine how REN program offerings align with CPUC objectives, provide unique value, and benefit program participants.	Program features and unique value (4.2)	Assessment of how programs address gaps in energy efficiency and provide unique value to support state goals and objectives.
		Program coordination (4.3)	Characterization of how RENs coordinated, complemented, and/or overlapped with IOU/CCA programs and activities.
		Participant experience and benefits (4.4)	Analysis of participants' experience and perceived benefits.
Energy impacts	Determine the gross and net savings for programs with claimed savings, and the reasons for any differences between claimed and actual savings.	Impact (4.5)	Estimates and analysis of programs' gross and net impacts.

4.1 Marketing and outreach

This section summarizes our research on the REN program target markets, outreach strategies, and customer reach. We first describe who the REN programs targeted and the methods they used to reach them based on program documents and interviews with PAs and implementers. Next, we examine the demographic and geographic data of the participants, based on participant surveys and utility CIS and ACS data, and contrast them with the overall population of the REN territories to evaluate the degree to which the programs reached the intended market participants, particularly HTR customers and DACs. Finally, we present the outcomes of the participant surveys and interviews, which reveal how participants became aware of the programs and if they align with the REN outreach efforts.

4.1.1 Summary findings

Participant-reported methods of learning about the programs partially align with the marketing approaches identified as successful by RENs.	Program implementers reported that direct outreach (through emails, phone calls, and site visits) and partnerships (with contractors and various organizations) were the most effective means of reaching participants. For single-family participants, contractors and community organizations were the primary way they learned about the program. The methods through which multifamily participants learned about the programs partially align with those reported by program staff. Contractors and direct outreach were the second and third most frequently mentioned avenues of learning about the program.
BayREN single-family program participant characteristics do not parallel those targeted by the program.	The BayREN Home+ single-family program did not reach its intended target market. Compared to the single-family population in the counties served by BayREN, program participants were less likely to be on the CARE/FERA rate (19% versus 23%) or have HTR status (4% versus 6%). Evaluation survey participants demonstrated higher levels of education and similar levels of income, English proficiency, and energy burden as in the general population. If the program had reached its target, we would have observed most participant households whose income was below the median.
The BayREN and SoCalREN multifamily programs were successful at reaching their target market.	Relative to the multifamily population in the BayREN and SoCalREN service territories, the multifamily program participants were more likely to live in DAC areas (54% versus 26%) and have HTR status (30% versus 22%). Furthermore, most (70%) participants lived in properties with 100+ units, reflecting the participants targeted by one of the programs. The remaining 30% lived in properties with less than 100, reflecting the focus on smaller properties of the other program.

4.1.2 REN program targets

This section examines the customer and market segments that the REN programs targeted. The purpose is to determine if program marketing and outreach efforts effectively reached their intended audience and ultimately provided customer benefits. We identified the target markets the programs reached by reviewing program documents, primarily PIPs supplemented with annual reports.

Table 4-2 summarizes the target market of the REN residential programs. The REN residential programs targeted underserved populations. They prioritized access to energy-saving resources for those who may face barriers due to economic constraints or language differences. The programs also extended beyond residential buildings to address energy efficiency in community settings, specifically through school participation.

Table 4-2. Target markets of PY2022 REN residential programs

Program	Target market
BayREN MF / BayREN MF Electrification	Targeted buildings traditionally not served well by EE programs, including buildings with fewer than 100 units, independently owned or owner-occupied properties, deed-restricted or unsubsidized affordable housing, properties with residential ownership structures like homeowners associations (HOAs), and those in DACs.

Program	Target market
BayREN SF	Focused on reaching underserved single-family households, particularly moderate-income households that earn between $40,000 to $125,000, whose income exceeds income-qualification thresholds but still falls below the median income. It also targeted households where English is not the primary language.
SoCalREN MF	Targeted HTR / DAC participants, ranging from individually owned single properties to corporate-owned multi-site properties with five or more units.
SoCalREN Kits for Kids	Targeted DAC and rural HTR school districts with historically low participation in utility programs. It aimed for 50% of schools in the program to be Title 1 or DAC. Title 1 schools have a high concentration of students from low-income households.
3C-REN MF	Targeted multifamily property owners and managers in HTR communities.
3C-REN SF NMEC	Available to all single-family homes but provided aggregators serving HTR/DAC participants with incentive multipliers to encourage participation in HTR communities.

Table 4-3 summarizes the target market of the REN public agency and commercial programs. The programs targeted organizations in underserved communities, including DAC and low-income communities, to ensure equitable energy efficiency service delivery. They also concentrated efforts on specific demographics, such as small businesses with facilities under 50,000 square feet to address the needs of diverse participant types.

Table 4-3. Target markets of PY2022 REN public agency and commercial programs

Program	Target market
BayREN WUSave	Targeted municipal water utilities in the Bay Area.
BayREN SMB	Targeted HTR small businesses. In particular, it aimed to reach businesses with facilities under 50,000 square feet and had been underrepresented in accessing program services and incentives.
SoCalREN RLF	Exclusively served underserved organizations, including Title 1 schools and public agencies in DACs and rural areas defined by Rural-Urban Commuting Area (RUCA) codes of the U.S. Department of Agriculture (USDA).
SoCalREN EE PDP	Targeted public agencies in SCE and SCG service territories (such as cities, counties, tribes, school districts, water districts, sanitation districts, and other special districts).
SoCalREN DER DAC	Targeted public agencies in SCE and SCG service areas (such as cities, counties, tribes, school districts, and special districts) that only operated in DAC, rural, and low-income communities.
SoCalREN PA NMEC	Targeted more than 700 public agencies in the SoCalREN territory, including those delivering services to disadvantaged, rural, and low-income communities.
SoCalREN PA SSP	Focused on delivering comprehensive deemed and custom energy efficiency projects to underserved public agencies in disadvantaged, rural, and low-income communities.

Table 4-4 summarizes the target market of the REN WE&T and C&S programs. The C&S programs targeted public agency and other building professionals to enhance enforcement and compliance with building codes, while the WE&T programs focused on workforce development to meet evolving industry standards and career opportunities in the energy sector.

Table 4-4. Target markets of PY2022 REN WE&T and C&S programs

Program	Target market and outreach
BayREN C&S	Targeted local government building department staff involved in building codes and standards.
BayREN Green Labeling	Targeted real estate professionals (realtors, lenders, and appraisers) and the workforce to train them in understanding marketing and selling energy-efficient and green homes.
SoCalREN WE&T	Targeted participants in Title 1 schools, diverse contractors, and in-school and at-risk youth.
3C-REN WE&T	Targeted existing building professionals, students and emerging professionals, and disadvantaged workers.
3C-REN C&S	Focused on local government building departments and local building professionals, including architects, contractors, engineers, field inspectors, and plan checkers, with resources to enforce and comply with Title 24.

4.1.3 Outreach approaches

We reviewed the PIPs and annual reports and gathered insights from PA and implementer IDIs to understand the marketing and outreach methods employed by the programs. We used the information to characterize the marketing approaches that the programs implemented and identify the successful approaches. The RENs' marketing and outreach methods ranged from direct outreach (e.g., emails and postal mailings) to cross-program promotions. The outreach activities included many creative elements, such as advertisements and programming segments in local Spanish and Chinese media outlets, partnerships with community youth organizations, community events to promote successful programs, and direct outreach to multifamily tenants to find champions for multifamily programs. Overall, we found that the RENs used the following outreach methods and approaches to engage prospective customers:

- **Direct outreach** – site or in-person visits, phone calls, mail campaigns, targeted emails, email outreach
- **Partnerships** – collaboration with organizations serving or associated with program target segments, such as rental housing associations, affordable housing organizations, local associations of realtors, community and local organizations, installation contractors, other PAs, local government organizations (municipalities, counties, regional public agencies)
- **Community engagement** – event and conference attendance (for example, attendance of multifamily property owner association events, housing authority and developer meetings, and local C&S organization events)
- **Educational activities** – workshops and webinars
- **Mass media** – TV and radio feature segments and advertisements
- **Digital outreach** – website promoting contractors to multifamily customers, social media posts
- **Cross-program marketing** – collaborations with other REN programs

The successful marketing and outreach approaches reported by the PAs and implementers varied by sector. They reported direct outreach (through in-person and site visits, emails, and phone calls) and partnerships (with contractors and community organizations) worked best for residential sector programs. Success in the public sector primarily required partnerships that led to introductions for "warm leads" (i.e., individuals or organizations interested in the program) and subsequent participation. WE&T and C&S programs found success through direct outreach, leveraging their extensive email lists, and partnerships with organizations associated with the participants they targeted. Table 4-5 summarizes the program outreach strategies reported by program staff and implementers as successful within the respective sectors.

Table 4-5. Successful marketing strategies by type

Program type	Successful marketing strategies identified by PAs and implementers
Residential	• Direct outreach through mail, phone call, in-person, or site-visits • Partnerships with housing and community organizations, installation contractors, and local government entities
Public agency	• Partnerships with local government/public agencies • Cross-program promotions
WE&T	• Partnerships with local organizations, such as association of realtors, schools, and suppliers catering to building professionals
C&S	• Direct outreach through targeted emails

4.1.3.1 Residential program outreach

The residential marketing and outreach strategies deployed across the three RENs exhibited similar themes. The residential programs most commonly used direct outreach methods such as mail campaigns, phone calls, and site visits. They also employed partnerships to reach prospective participants. During IDIs, the PA and implementer interviewees reported these direct outreach methods and partnerships were the most effective marketing and outreach strategies. For example,

- BayREN MF program staff noted that direct mailers were generally the most effective way of reaching property owners, accounting for roughly half of new program leads in PY2022.
- 3C-REN MF program staff reported that the most effective outreach in PY2022 was a direct mailer that resulted in 115 leads (out of the 118 for the year cited in the 3C-REN annual report).
- SoCalREN MF program staff indicated that site visits had the most impact in getting participants enrolled given the complexity of planning and executing on such projects which require multiple in-person outreach visits.
- SoCalREN Kits for Kids relied on in-person and phone outreach for its engagement efforts. Three out of the five teachers who participated in IDIs reported learning about the program through direct outreach efforts (email).

The programs used similar methods to reach HTR/DAC participants. However, for these participants, the programs included innovative elements to enhance their outreach efforts, such as advertisements and programming segments in Spanish and Chinese media outlets, partnerships with unique community organizations (Rising Sun, a youth organization in the BayREN territory, and Promotores Network in Santa Barbara), and direct outreach to multifamily tenants to find champions for multifamily programs.

Table 4-6 details the outreach methods and the methods we identified as successful based on PA and implementer IDIs in the residential sector.

Table 4-6. Residential sector outreach methods and successful strategies

Program	Reported successful outreach strategies	Other outreach methods
BayREN MF / BayREN MF Electrification	• Direct outreach – mailers to property owners /managers • Partnerships with organizations that cater to small multifamily properties • Partnerships with property management companies used by HTR property managers (e.g., rental associations) *	• Educational activities – workshops and webinars • Community engagement – events and conferences
BAYREN SF	• Partnership with installation contractors and local organizations (such as the youth group Rising Sun)	• Digital outreach – website promoting the program • Cross-program promotion – collaboration with the Green Labeling program • Mass media outreach – TV and radio feature segments in Spanish and Chinese*
SoCalREN MF	• Partnerships with installation contractors • Direct outreach – multifamily site visits and phone calls	• Community engagement – multifamily property owner association events • Digital outreach – website promoting contractors to multifamily customers
SoCalREN Kits for Kids	• Direct outreach – in-person and phone outreach to school decision-makers, email outreach	• Community engagement – events such as “Big Check” presentations to celebrate the Kits for Kids program
3C-REN MF	• Direct outreach – targeted mail campaigns • Partnership with affordable housing organizations, contractors, and other PAs*	• Community engagement – conferences and housing authority and developer meetings • Educational activities – workshops and webinars
3C-REN SF NMEC	• Partnership with community organizations, local government entities (municipalities), and other PAs • Partnership with a community organization (Promotores Network in Santa Barbara) to serve geographically isolated Spanish-speaking communities*	• Cross-program promotion – collaboration with 3C-REN's WE&T and C&S programs

*Additional efforts to reach HTR/DAC customers

4.1.3.2 Public agency and commercial program outreach

For the public and commercial sector, partnerships emerged as a dominant and effective outreach strategy with six of the seven programs collaborating with different partners. Programs such as BayREN WUSave and SoCalREN's public agency programs (SoCalREN RLF, SoCalREN EE PDP, SoCalREN DER DAC, SoCalREN PA NMEC, and SoCalREN PA SSP) partnered with local government and other regional organizations as a part of their outreach efforts. In particular:

- SoCalREN program staff reported that the PA uses its network of over 230 public agencies and partners with established relationships with a variety of public agency departments to convert warm leads into program enrollments.
- Out of the 214 public agencies that SoCalREN served in PY2022, 13 were new to public agency programs. SoCalREN enrolled seven of these new agencies through collaboration with regional partners.
- BayREN's WUSave program collaborated with local governments to use their connections with municipal water utilities to promote the program and arrange introductory meetings with potential participants.

Given the unique nature of public programs and their participants, partnerships provided avenues to generate meaningful leads and foster long-term relations. PA interviews, in particular, emphasized the need for warm leads to succeed in this area, as direct outreach without such leads is unlikely to succeed. The REN programs' local presence offered them an advantage over other PAs in leveraging their deep and existing relationships with local government organizations.

Most of the programs in this sector limited participation to HTR/DAC and underserved customers or heavily targeted those customers. Thus, their outreach methods to these customers were similar to those described above. In some instances, they supplemented these methods through multilingual materials to ensure that they reached additional customers. Table 4-7 details public agency and commercial sector outreach methods and successful strategies.

Table 4-7. Public agency and commercial sector outreach methods and successful strategies

Program	Reported successful outreach strategies	Other outreach methods
BayREN WUSave	• Partnership with local government organizations (counties)	• Direct outreach – utility profile/ mapping tool for targeted outreach • Multilingual direct and digital/ social media outreach
BayREN SMB	• Not identified – program in early stages	• Implementation partner conducted outreach • Partnership with local government agencies provided outreach support
SoCalREN RLF	• Cross-program promotion – collaboration with other SoCalREN public agency programs	• Direct outreach – email newsletters and factsheets
SoCalREN EE PDP	• Partnership with regional public agencies (network of more than 230 public agencies) to get "warm" leads	• No additional methods identified
SoCalREN DER DAC	• Partnerships with regional public agencies	• No additional methods identified
SoCalREN PA NMEC	• Partnerships with local organizations (e.g., Councils of Government)	• No additional methods identified
SoCalREN PA SSP	• Partnerships with local organizations (e.g., Councils of Government)	• No additional methods identified

4.1.3.3 WE&T and C&S program outreach

REN WE&T and C&S programs primarily focused on building partnerships and leveraging their extensive email lists for direct outreach. Aspects of the WE&T and C&S programs are unique compared to their counterparts because they aim at educating and training rather than direct intervention in the market through energy efficiency measures. During PA/Implementer interviews, the program managers stated that targeted outreach (e.g., through email) and partnerships were successful strategies. For example:

- BayREN's Green Labelling program partnered with local realtor associations for outreach.
- SoCalREN and 3C-REN's WE&T programs collaborated with schools and community organizations for outreach.
- 3C-REN's WE&T program also used email marketing based on its distribution list and conducted personal outreach to energy champions in architectural associations, contractor associations, supply houses, and green building councils.
- 3C-REN and BayREN's C&S programs relied primarily on targeted emails for distributing marketing materials.

As market support programs (without a particular focus on DAC/HTR), most WE&T and C&S programs did not have customized marketing approaches to reach this customer segment. However, some programs used similar methods to reach underserved constituents. Table 4-8 summarizes the WE&T and C&S sectors' successful and other outreach methods.

Table 4-8. WE&T and C&S sector outreach methods and successful strategies

Program	Reported successful outreach strategies	Other outreach methods
BayREN C&S	• Direct outreach – email outreach to local organizations	• Digital outreach – social media posts • Community engagement – participation C&S related events and organizations
BayREN Green Labeling	• Partnerships with local associations of realtors	• Digital outreach – paid social media ads • County workshops
SoCalREN WE&T	• Partnerships with academic institutions and community groups	• No additional methods identified
3C-REN WE&T	• Partnerships with community groups and institutions • Partnerships with organizations (such as schools and suppliers catering to building professionals) to reach HTR, DAC, and disadvantaged workers*	• Direct outreach – targeted emails, site visits to distribute marketing materials • Community engagement – industry events and conferences
3C-REN C&S	• Direct outreach – targeted emails, site visits to distribute marketing materials	• Community engagement – industry events and conferences

*Additional efforts to reach HTR/DAC customers

4.1.4 Demographic characteristics of participants

We used information from single-family participant and multifamily property manager surveys and utility CIS and ACS data to understand if the characteristics of the participants the programs reached and served in PY2022, including the proportions of HTR/DAC and other underserved customers, were consistent with the target market of the programs. Table 4-9 lists the characteristics we constructed from the surveys and CIS and ACS data. Additionally, we used information from the non-residential interviews to gain a general sense of participants and their customers and constituents; given the small sample sizes, the findings are anecdotal for these customers.

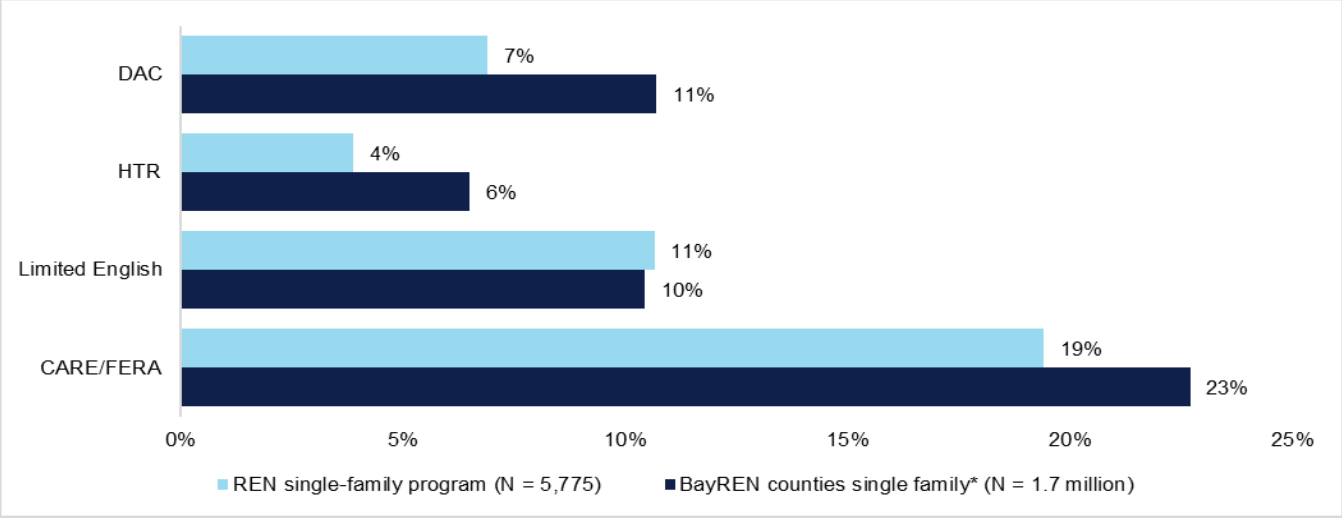
Table 4-9. Participant characteristics in PY2022 REN residential surveys, CIS, and ACS data

Source	Residential single-family characteristics	Residential property manager characteristics	Non-residential participant and customer characteristics
Survey	Home type Own or rent Age of occupants Primary language Ethnicity and race Education level Income Energy insecurity	Building type Housing affordability Utility bill responsibility Electric and gas meter type Building vintage	Additional languages Ethnicity and race Income
ACS/CIS	HTR DAC CBSA metro Limited English	HTR DAC CBSA metro Limited English CARE/FERA (BAYREN02-A)	N/A

4.1.4.1 Single family participants

The BayREN Home+ single-family program served a smaller proportion of HTR and DAC customers than are present in the service territory where it operated.[52] Figure 4-1 compares the demographic profile of the PY2022 BayREN single-family program participants to the single-family population in BayREN counties based on utility CIS and ACS data. As the figure shows, while the program served comparable proportions of customers with limited English proficiency, it served fewer low-income, DAC, and HTR customers than present in the overlapping territory. For example, 11% of single-family customers in BayREN counties were in DACs compared to 7% of the BayREN single-family participants who were in DACs.

Figure 4-1. BayREN PY2022 single-family program participant and BayREN counties' demographics



*Source: PG&E single-family residential accounts

[52] See Appendix K for details on how the study determined HTR status.

The BayREN Home+ program served more affluent single-family households than it intended to reach. Table 4-10 provides information on the socioeconomic status of the BayREN single-family program participants based on survey results. While the BayREN single-family program served more participants with higher educational attainment than found in the population, it reached households whose income and energy insecurity occurred at approximately the same proportion as they appeared in the population. However, the program did not reach marginalized communities at rates higher than their proportion in the BayREN territory.

- BayREN single-family program participants had high levels of educational attainment. More than 78% of single-family participants had a bachelor's degree or higher, a significantly higher proportion than in the Bay Area. The proportion of people with a bachelor's degree or higher in BayREN counties ranged from 35.9% (Napa County) to 70.5% (Solano County), averaging around 52%.[53] Even given the high average educational attainment of the area, the single-family program participants were more educated than average.
- The income distribution of BayREN single-family participants skewed towards the higher end**.** Excluding participants who did not wish to say, 53% reported incomes above $121,681. Counties served by BayREN have median household incomes that ranged between $99,266 (Sonoma County) to $165,762 (Santa Clara County), averaging around $130,000 a year in the nine counties. If BayREN aimed to serve more underserved and disadvantaged customers, we would have observed more participants whose income is below the median.
- Single-family households experienced energy insecurity in line with the state average. Approximately a quarter of BayREN single-family participants faced some form of energy insecurity, and 12% reported keeping their homes at an unsafe or unhealthy temperature. These proportions closely resembled the rates of energy insecurity observed in the state, as indicated by Census data.

Table 4-10. Economic characteristics of BayREN single-family participants, REN PY2022

Characteristic	Participants (n=676)
Education level	
Graduate or professional degree	45%
Bachelor's degree	33%
Some college, associate degree, or trade school	13%
High school diploma or less	3%
Prefer not to answer	6%
Income	
Over $163,801	30%
$121,681 up to $163,800	7%
$70,281 up to $121,680	19%
Less than $70,280	14%
Prefer not to answer	31%
Energy insecurity	
Burdened in any of the following ways	24%
Unable to pay for household necessities	19%
Kept household at an unsafe or unhealthy temperature	12%
Unable to pay for energy bill	8%

[53] ACS data on education attainment. https://www.census.gov

The BayREN Home+ single-family program served households whose primary language is not English in proportion to their presence in the population. Table 4-11 presents the demographic profile of the BayREN single-family program participants. The information indicates that:

- Most participants' primary language is English, but a notable proportion have other primary languages**.** Approximately 11% of participants reported a primary language other than English in a similar proportion to their presence in the population.[54] The most common primary language other than English was Chinese, which included Mandarin and Cantonese.
- BayREN single-family program participants come from diverse ethnic and cultural backgrounds. One-third of participants who reported their race identified as a minority. Roughly 30% of participants who reported their race identified as Asian.
- BayREN single-family participant households tend to be older**.** Almost half of the participating households included seniors (those 65 years or older). The program served more households with older occupants than are typically present in the state, where about a third of homes have members who are 65 and older.[55] Census data also indicated that about a third of California homes have children. Since a little under a third of participants reported having children (those 17 and under), the program served homes that mirrored this demographic dimension.

Table 4-11. Demographic characteristics of BayREN single-family participants, REN PY2022

Characteristic	Participants (n=676)
Age composition	
Seniors 65 and up	42%
Children under 17	27%
Children under 5	11%
Primary language	
English	87%
Chinese (including Mandarin and Cantonese)	4%
Spanish	1%
Other	5%
Prefer not to answer	2%
Race	
White	61%
Asian	27%
Black or African American	2%
American Indian or Alaska Native	1%
Other	4%
Prefer not to answer	10%

As expected, the BayREN Home+ single-family program served predominantly single-family homeowners. Table 4-12 summarizes the housing characteristics of the BayREN single-family program participants. The table provides information on the dwelling type and rental status of the participating households. As the table indicates, most participants reside in single-family homes that they own.

[54] Please see Figure 4-1 for population proportions.
[55] ACS Table DP02. https://data.census.gov/table/ACSDP1Y2022.DP02?g=040XX00US06

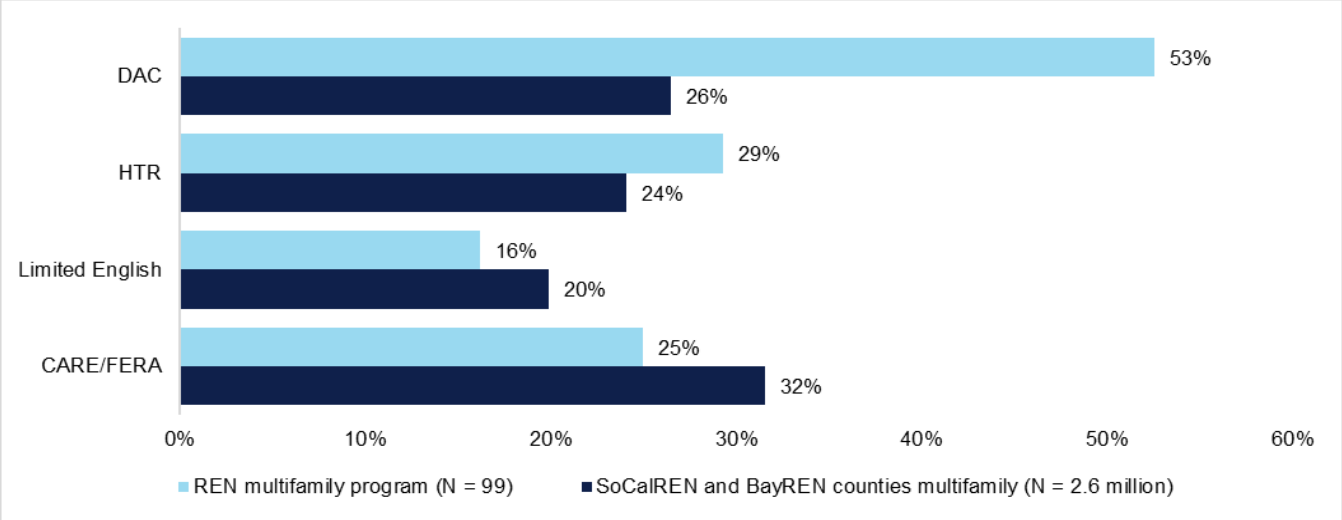
Table 4-12. Housing characteristics of BayREN single-family participants, REN PY2022

Characteristic	Participants (n=676)
Home Type	
Single-family detached from any other home	84%
Single-family attached to one or more houses (e.g., duplex, condominium)	7%
Apartment or condominium in a building with 5 or more units	5%
Apartment or condominium in a building with 2-4 units	3%
Manufactured home or other	1%
Tenure	
Own	89%
Rent	10%
Don't Know	1%

4.1.4.2 Multifamily participation

The BayREN and SoCalREN multifamily programs served a higher proportion of HTR and DAC participants than are present in the service territories where the programs operated.[56] Figure 4-2 provides the demographic profile of the multifamily participants and their comparators based on CIS and ACS data. We used the PG&E and SCE multifamily populations in the counties served by BayREN and SoCalREN as comparators. As the figure indicates, the programs served more DAC and HTR customers than present in the BayREN and SoCalREN service territories. The program CARE/FERA percentage in the figure reflects the value for BayREN's MF Electrification subprogram since the tracking data included tenant utility identifiers only for this subprogram. Since the HTR calculation relies on CARE/FERA values, the absence of such values for all tenants served by the program likely understates the proportion of HTR customers the multifamily programs served. Based on the available CARE/FERA information, the BayREN and SoCalREN multifamily programs also served similar proportions of CARE/FERA customers as those in the REN service territories.

Figure 4-2. BayREN and SoCalREN PY2022 multifamily program participant demographics compared to population



Note: REN multifamily program CARE/FERA value was only available for BayREN's multifamily subprogram

[56] See Appendix K for details on how the study determined HTR status.

The BayREN and SoCalREN multifamily programs reached low-income customers in close proportion to their presence in their service territories. Table 4-13 provides the market rate and low-income units in participating buildings, which gauge the extent to which properties offered affordable housing. Multifamily survey respondents indicated that 68% of units were market rate and 25% were income-qualified. If we include a third of the other or unknown to the income-qualified group,[57] our calculations suggest that the programs served multifamily buildings with approximately 27% low-income households. Moreover, as stated above, the utility identifiers for the BayREN MF Electrification subprogram indicate that 29% were on CARE/FERA (a low-income proxy). Based on billing data,[58] 30-33% of all households in the counties served by the programs are on CARE/FERA rates. Thus, the BayREN and SoCalREN multifamily programs served a similar proportion of low-income participants as present in the REN service territories.

Table 4-13. Affordability of participating BayREN and SoCalREN multifamily rental units

Characteristic	Response	(n = 34)
Housing affordability	Most/all units are market-rate housing	68%
	Most/all units are income-qualified	25%
	Other	5%
	Don't know	3%
	Calculated market rate units	73%
	Calculated low-income units	27%

The BayREN and SoCalREN multifamily programs served the types of buildings they intended to reach. Table 4-14 provides information on the participant building types and sizes based on the survey responses. The SoCalREN MF program targeted large (corporate-owned multi-site properties with five or more units) and small properties, while the BayREN MF program targeted buildings with fewer than 100 units. The SoCalREN MF program constituted approximately three-fourths of the PY2022 multifamily programs. The survey results indicate that 70% of participating multifamily buildings were large apartment or condominium buildings (>100 units), in line with the proportions targeted. The remainder (28%) were smaller multifamily properties with less than 100 units, reflecting the proportions targeted by the BayREN MF program.

Table 4-14. Participating multifamily building characteristics

Characteristic	Response	(n = 34)
Building Type	Apartment or condominium (5 or more units)	86%
	Townhouse, duplex, or row house	6%
	Other	8%
Size of property	100 or more units	70%
	30 to100 units	16%
	10 to 30 units	6%
	less than 10 units	6%
	Don't know	3%

[57] According to the National Low Income Housing Coalition (NLIHC), in 2020, approximately 33% of California's rental homes were affordable and available to households whose income was 50% of the area median income (i.e., low-income households). https://nlihc.org/housing-needs-by-state/california

[58] Additionally, information on the CPUC website indicates that similar percentages of residential customers are on CARE/FERA. https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/care-fera-program

The BayREN and SoCalREN multifamily programs targeted buildings and residents likely to benefit from the energy efficiency upgrades. The survey asked property managers to indicate if electricity and gas use are individually or master-metered and if tenants are responsible for paying their utility bills. We sought this information to examine the extent to which the energy efficiency potential of installed measures benefits tenants. As Table 4-15 indicates, most (86% for electricity and 60% for gas) tenants are responsible for paying their bills, indicating the in-unit measures installed would directly impact tenant energy bills. Most properties are individually metered, suggesting the in-unit and subsequent use of the installed equipment would also directly impact tenant bills. Additionally, since most multifamily participant buildings were older, with over half built before 1979, the upgrades completed (such as building envelope measures) have a high potential to provide notable energy efficiency improvements.

Table 4-15. Participating multifamily building and participant characteristics

Characteristic	Response	(n = 34)
Responsibility for utility bill	Tenant responsible for gas and electricity utility bills	62%
	Tenant responsible for electric but not gas utility bills	24%
	Utility bills included in the rent	5%
	Other	7%
	Don't know	2%
Meter type	Electric individually metered	94%
	Gas individually metered	70%
Building vintage	Before 1979	53%
	1980-2000	29%
	2000+	17%
	Don't know	2%

4.1.4.3 Public agency and commercial participants

Interviewee responses suggest that the programs served public agencies operating in the types of communities the programs targeted. Table 4-16 shows interviewees' reports of the languages spoken at their organizations and the socioeconomic make-up of their constituents, including the average share of low or low-to-moderate-income constituents. These data suggest that most public agency program participants likely operated in disadvantaged communities, with most interviewees indicating a relatively high proportion of low and low-to-moderate-income constituents. However, the completeness, consistency, and variation of the interviewee responses raise questions. For example, one interviewee estimated that 0% of their constituents were low or low-to-moderate income. A thorough demographic analysis based on secondary data would be more reliable for drawing concrete conclusions.

Table 4-16. Public agency and commercial program participant organization and constituent characteristics

Program	Interviewees	Languages besides English spoken at agency	Average share of constituents	
			Hispanic/Latino or other non-White	Low or low-to-moderate income
BayREN WUSave	1	Spanish	32%	100%
SoCalREN RLF	4	Spanish and Chinese	41%	62%
SoCalREN EE PDP	5	Spanish	18%	30%
SoCalREN DER DAC	5	Spanish, Chinese, Korean	61%	82%

Program	Interviewees	Languages besides English spoken at agency	Average share of constituents	
			Hispanic/Latino or other non-White	Low or low-to-moderate income
SoCalREN PA NMEC	4	Spanish and Chinese	48%	45%
SoCalREN PA SSP	3	Spanish, Chinese, Tagalog, Korean, Vietnamese, Hindi/Urdu, Other	78%	17%

4.1.4.4 WE&T and C&S participants

The socioeconomic composition of WE&T and C&S program participants reflected the mix of participant types the training programs targeted, including public- and private-sector building professionals and diverse and disadvantaged workers and contractors. We asked WE&T and C&S program participants from four of the programs about their race/ethnicity and incomes. Because BayREN C&S program participants were local government building department representatives, we asked these participants about the languages spoken at their agencies and the constituents whom they served. Table 4-17 summarizes the ethnic identity and self-reported income group of the participants or their constituents. Six of 14 WE&T and C&S program participants reported that they were Hispanic/Latino or other non-white races, and four classified their incomes as low or low-to-moderate. On average, the eight BayREN C&S interviewees estimated that one-third of their constituents were not white, and 5% were low or low-to-moderate income; their responses reflect a mix of the socioeconomic background of participants or constituents of participating agencies in line with the programs' targets. However, given the small sample sizes and undefined income ranges, we suggest against drawing conclusions about participant populations.

Table 4-17. WE&T and C&S program participant demographic and constituent characteristics

Program	Interviewees	Hispanic/Latino or other non-White	Low or low-to-moderate income
Self-descriptions		**Count of interviewees**	
BayREN Green Labeling	5	2	2
SoCalREN WE&T	1	1	0
3C-REN WE&T	3	2	1
3C-REN C&S	5	1	1
Total	**14**	**6**	**4**
Constituent descriptions		**Average share of constituents**	
BayREN C&S	8	33%	5%

4.1.5 Source of program awareness

We used residential surveys and non-residential IDIs to understand how participants first heard about the programs. We used the information to determine if how participants learned about the programs is consistent with the marketing approaches the RENs focused on.

Figure 4-3 illustrates that most single-family program participants first heard about the program. Approximately 40% of single-family participants reported first hearing about the program through contractors or community-based organizations (CBOs). These findings support PA and program implementer statements that partnerships with contractors and CBOs were successful at reaching single-family participants. Additionally, these results suggest that online marketing might be more effective at reaching single-family homes than PAs and implementers assume.

Figure 4-3. Primary source of information about REN single-family program

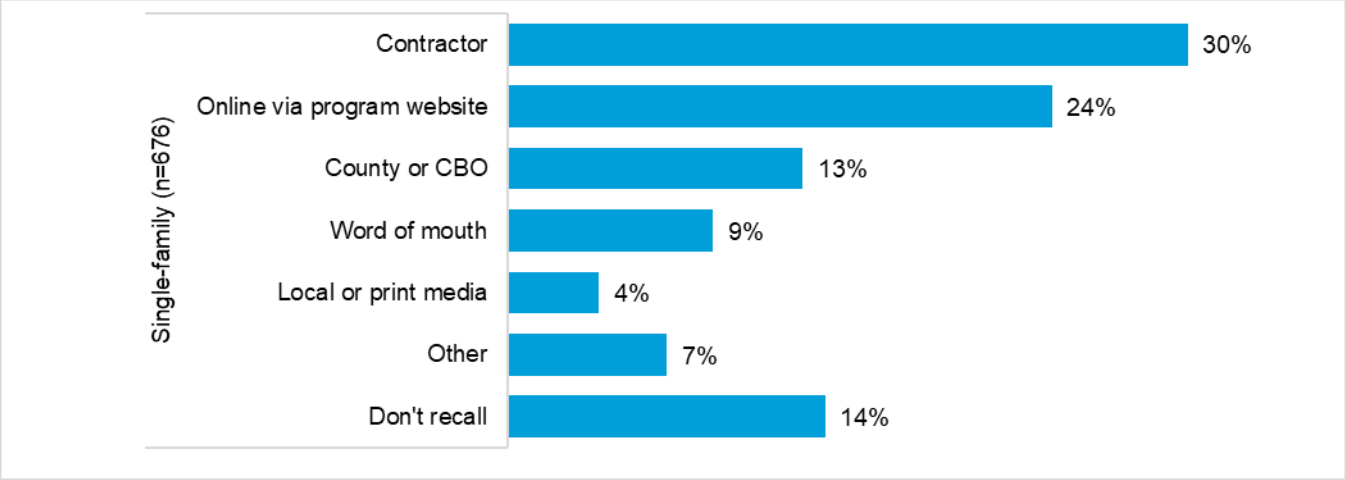
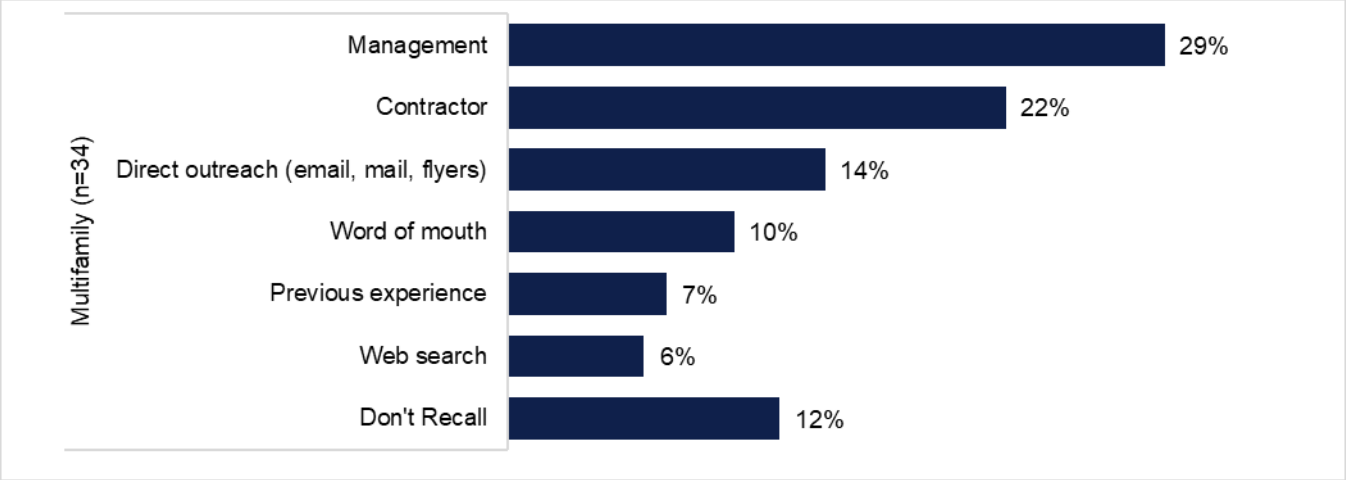


Figure 4-4 shows how multifamily participants first heard about the REN programs in which they participated. Multifamily participants reported that they most often heard about the REN programs from their upper managers and contractors. Other sources of awareness were much less common. About one-third of multifamily reported first hearing about the program through contractors or direct outreach methods. These outreach methods are partially consistent with the successful outreach strategies (partnerships and direct outreach) reported by the PAs and program implementers.

Figure 4-4. Primary source of information about REN multifamily programs



From our non-residential IDIs, participants reported becoming first aware of the programs primarily through direct outreach (mostly emails), cross-program marketing (particularly for SoCalREN's public agency programs), and partnerships and community engagement. Since we conducted IDIs with a few (up to five) randomly selected participants, it is impossible to draw

firm conclusions. However, direct outreach and partnerships feature among the methods participants heard about the non-residential programs.

It is worth noting that most of the WE&T participants we spoke to did not remember where they first heard about the program. They remembered the training but not who or what program provided the training. When probed, the respondents often said they attended so many trainings that it was hard to remember who sponsored the training or how they first heard about it.

4.2 Program features and unique value

In this section, we assess how the REN programs demonstrated unique value as defined in CPUC D.12-11-015 (and later updated by D.19-12-021). Based on the criteria in these decisions, programs demonstrated unique value if they:

- Offer energy efficiency services that other PAs cannot or do not intend to undertake (“Unique”)
- Pilot activities that fill gaps and are scalable (“Pilot”)
- Serve HTR customers (“HTR”)

We analyzed the key features of the programs to assess how effectively they addressed the CPUC requirements and gaps in energy efficiency services. We reviewed various program documents (PIPs, program annual reports, and JCMs) and information from primary research activities (PA and implementer interviews) for this purpose.

4.2.1 Summary findings

REN residential programs demonstrated value by serving traditionally overlooked populations.	The primary value of the REN residential programs is their inclusive approach to serving traditionally overlooked populations. They aimed to or enabled energy efficiency among such populations by providing tiered and additional financing, customized and hands-on support, and promoting decarbonization efforts.
REN public agency and commercial programs provided value by addressing service gaps, particularly among underserved groups.	The programs identified and addressed gaps in traditional energy efficiency programs by offering services tailored to the needs of their target demographics. For example, BayREN's WUSave program addressed water conservation efforts, contributing to state-mandated water efficiency targets, while SoCalREN's PA NMEC program supported projects ineligible for IOU incentives. The programs also provided better financing options than traditional programs to fill these gaps.
REN C&S and WE&T programs demonstrated value by addressing regional needs and gaps in knowledge and skills.	These programs focused on enhancing awareness about codes and standards, providing training and upskilling opportunities, and promoting electrification as an essential strategy for reducing greenhouse gas (GHG) emissions. They offered customized support, mentorship, and technical assistance to local governments, building professionals, and diverse populations within the real estate and building industries. By emphasizing local relevance and regional focus, the programs promoted energy efficiency, sustainability, and workforce development while addressing specific educational gaps and challenges within their regions.

4.2.2 Overarching program features

In their effort to fulfill the CPUC's unique value requirements, the RENs engaged in activities to fill gaps in energy efficiency while ensuring equity and program accessibility for HTR and other underserved communities. Table 4-18 categorizes program features that differentiate REN from other PA programs and where they apply by sector.

Table 4-18. Sector-level features of PY2022 REN programs

Features	Residential	Public agency and commercial	WE&T and C&S
Target underserved communities	✓	✓	✓
Improve geographic/local coverage	✓	✓	✓
Address knowledge and other activity gaps		✓	✓
Ensure renter equity	✓		
Provide tiered incentives/additional financing	✓	✓	
Enable customization/offer tailored support	✓	✓	✓
Provide hands-on support	✓	✓	✓
Focus on electrification/decarbonization	✓	✓	✓

4.2.3 Residential program features and value

The PY2022 REN residential programs undertook energy efficiency activities that differentiated them from other PA programs, as defined in CPUC D.12-11-015. Table 4-19 on the following page summarizes the features that differentiated the PY2022 residential programs and the CPUC value requirements they fulfilled. We classified the features based on their primary value, even though some aspects of these differentiators spanned multiple categories. Energy efficiency initiatives that served HTR customers were the most frequent activity that illustrated the unique values of the REN residential programs.

Table 4-19. Assessment of key features and differentiators of PY2022 residential programs

Description of value	Feature	Features by program					
		BayREN MF / MF Electrification	BayREN SF	SoCalREN MF	SoCalREN Kits for Kids	3C-REN MF	3C-REN SF NMEC
HTR	**Ensure renter equity**	Required core measures[59] so program benefits are shared between renters and property owners.					
	Improve geographic / provide local coverage					Filled a geographic gap since the 3C-REN territory is outside IOU outreach and implementation efforts.	Offered geographic coverage since most homes are far removed from IOU outreach and implementation efforts.
	Provide better incentives / financing						Set three times higher incentives for HTR customers.
	Target underserved communities	Identified historically underserved small property owners to provide broad support.	Targeted moderate-income households that are unable to afford retrofit and decarbonization projects without support.	Targeted HTR and DAC multifamily properties. In 2022, 50% of projects were in HTR and DAC communities.	Presented clean energy career concepts to students in underserved communities.	Targeted HTR, DAC, and CPUC Underserved multifamily properties. In 2022, 83% of projects served such customers.	Provided incentives for most homes that face prohibitive costs because they were built before the California code.
Pilot	**Focus on electrification / decarbonization**	Piloted and fully launched the multifamily electrification subprogram.					

[59] A "core measure" refers to a fundamental or essential action or strategy aimed at improving energy efficiency. Appliance upgrades, building envelope improvements, lighting upgrades, and HVAC system optimization and upgrades are all examples of core measures.

Description of value	Feature	Features by program					
		BayREN MF / MF Electrification	BayREN SF	SoCalREN MF	SoCalREN Kits for Kids	3C-REN MF	3C-REN SF NMEC
Unique	**Enable customization / offer tailored support**			Allowed for incremental installation phases where multiple measures could be installed over time.		Allowed for more lenient program criteria and customizable construction scopes.	Enabled participants to customize financially feasible solutions and pick contractors to encourage program measure uptake.
	Focus on electrification / decarbonization	Explored storage and microgrid opportunities. Helped MF residents participate in DSM programs.[60]					Set higher incentives for electrification projects, particularly heat pumps, to ensure greater emission reductions.
	Provide better incentives / financing		Layered incentives with Bay Area Air Quality Management District funded efforts and CCAs.	Offered higher incentives to HTR / DAC participants.		Offered sizable incentives and incentive layering assistance to property managers, particularly to motivate HTR participation.	Included incentive adders for projects that use a local contractor with an address within the tri-county region.
	Provide hands-on support		Provided Energy Advisors that acted as educators and advocates.	Provided direct measure recommendations to tackle lack of in-house technical expertise.	Provided direct instructional and engagement support.	Provided local technical assistants (boots-on-the-ground partners) to multifamily properties.	

[60] DSM (demand side management) programs encompass a range of plans and technologies strategically used to manage and alter energy consumption levels and patterns among customers.

REN energy efficiency programs had several features that differentiated them from other PA programs. In terms of target markets, the REN programs made a concerted effort to serve the populations traditionally overlooked by other energy efficiency programs, including homes that are far removed from IOU outreach and implementation efforts. The BayREN MF program focused on difficult-to-serve populations (e.g., small properties) in its jurisdictions, encompassing a broader definition than covered by HTR/DAC. The program ensured renter equity by requiring core measures, so that program benefits are shared between renters and property owners. Similarly, SoCalREN's and 3C-REN's MF programs offered higher incentives to motivate HTR and underserved property managers to make energy efficiency upgrades.

SoCalREN and 3C-REN targeted households, which traditionally do not qualify for incentives offered by other programs. 3C-REN's SF NMEC program provided incentives for homes that were not eligible for traditional program incentives but faced prohibitive energy efficiency costs. SoCalREN's Kits for Kids program collaborated with its public agency partners to identify and serve HTR/DAC communities with low participation. The program served households of third and fourth-grade students, especially in HTR/DAC communities.

The residential programs in the REN portfolio also undertook considerable efforts to promote decarbonization. The BayREN multifamily program made significant advances to support decarbonization through electrification projects. The program explored opportunities in storage and microgrids and facilitated multifamily residential participation in DSM programs (through a partnership with OhmConnect) to enhance its decarbonization efforts. The program also collaborated with the city government to prevent rent increases resulting from energy upgrades. While these activities may have not be entirely novel, their application in the multifamily sector specifically to support electrification was innovative.

Similarly, 3C-REN's SF NMEC program promoted the adoption of electrification measures, particularly heat pump projects, by offering relatively high incentives. It provided three times higher incentives to HTR than non-HTR customers to encourage electrification among this segment of the residential population. Furthermore, the program included an adder for projects engaging local contractors within the tri-county region to promote regional sustainability efforts and economic support.

The REN residential programs' hands-on and customized support also differentiated them from other PA programs providing similar offerings. BayREN's SF program provided Energy Advisors who acted as educators, facilitators, and advocates to fill a gap in the market. SoCalREN's MF program provided hands-on support by offering direct measure recommendations to tackle the lack of in-house technical expertise. Similarly, 3C-REN's MF program provided "boots-on-the-ground" partners to multifamily properties. Both multifamily programs allowed customization by granting participants the flexibility to pursue incremental installation phases and install multiple measures over time. They also accommodated varying financial solutions and allowed participants the autonomy to select contractors of their choice.

Finally, the residential programs provided avenues for additional funding and incentives. BayREN's SF program layered incentives with Bay Area Air Quality Management District funded efforts and CCAs. SoCalREN's MF program offered higher incentives to HTR/DAC and 3C-REN's MF program offered sizable incentives to property owners and managers, particularly to motivate HTR participants to make energy-efficiency upgrades they would not make otherwise.

4.2.4 Public agency and commercial program features and value

In PY2022, the REN public agency and commercial programs also offered energy efficiency services with various features, which set them apart from other PA programs in the same sector. These features allowed the programs to meet the unique value requirement laid out by the CPUC. The primary differentiating feature of REN public and commercial programs is their focus on addressing energy efficiency service gaps, as shown in Table 4-20.

Table 4-20. Assessment of key features and differentiators of PY2022 public agency and commercial programs

Description of value	Feature	Feature by program						
		BayREN SMB	SoCalREN DER DAC	SoCalREN PA SSP	SoCalREN RLF	BayREN WUSave	SoCalREN EE PDP	SoCalREN PA NMEC
HTR	**Provide tiered incentives / additional financing**			Provided enhanced incentives to fund energy upgrades for public agencies in underserved communities.				
	Target underserved communities	Focused on serving HTR SMBs.	Focused on public agencies in disadvantaged, rural, and low-income communities.	Designed uniquely to support underserved public agencies' resiliency efforts.	Tailored to the unique needs of public agencies in disadvantaged, rural, and low-income communities.			
Unique	**Address knowledge and other activity gaps**			Filled a gap left by the closing of SCE's Public Sector Core Custom and Deemed programs.		Addressed a gap through activities that contribute to water efficiency targets.	Provided project managers, technical advisors, contractors, etc.	Allowed programs not eligible for other PA energy efficiency services to undertake EE projects.
	Enable customization / offer tailored support		Provided a dedicated project manager to identify solutions, prepare proposals, and share budgeting and other templates.	Provided no-cost technical services and financial analysis support.			Provided a "one-stop shop" support, including project design, procurement, agency approval, construction, and project close-out.	Provided access to customized technical assistance, such as procurement and construction support.

Description of value	Feature	Feature by program						
		BayREN SMB	SoCalREN DER DAC	SoCalREN PA SSP	SoCalREN RLF	BayREN WUSave	SoCalREN EE PDP	SoCalREN PA NMEC
Unique	**Focus on electrification / decarbonization**	Provided the opportunity to participate in DR programs[61] through aggregators.	Delivered Pathway to Zero reports to educate agencies on clean energy strategies.					
	Improve geographic / local coverage	Offered the only SMB sector energy efficiency program in the Bay Area.				Offered only to local utilities in the Bay Area.		
	Provide tiered incentives / additional financing	Employed a pay-for-performance (P4P) approach with support from its third-party implementer.			Provided up-front 0% interest construction financing to public agencies in underserved communities.	Offered the only on-bill tariff water-saving program in California resulting in negligible up-front costs to all participants.		

[61] Demand response (DR) programs are a crucial aspect of decarbonization efforts because they help to balance electricity supply and demand, leading to a more efficient use of resources and a reduction in GHG emissions.

REN public agency and commercial programs had several facets that set them apart from other PA programs. The programs targeted underserved segments not traditionally served by the IOUs. BayREN's SMB program focused on small businesses in the HTR communities that traditionally have difficulty accessing energy efficiency programs. The program targets small businesses with facilities under 50,000 square feet, a segment often overlooked by larger initiatives. The SoCalREN RLF and DER DAC programs supported public agencies in disadvantaged, rural, and low-income communities.

The programs also sought to address gaps by offering services not provided by traditional PA programs. BayREN's WUSave program addressed a specific gap in energy efficiency programs by uniquely focusing on water conservation efforts to contribute to state-mandated water efficiency targets. SoCalREN's PA NMEC program also supported projects that were ineligible for IOU incentives. In particular, it helped projects claim savings relative to existing condition baseline rather than code or standard practice baseline to address stranded savings (savings that would not have occurred otherwise).

Additionally, the REN public agency and commercial programs provided better financing options for their participants than available through traditional energy efficiency programs. The BayREN WUSave program is the only on-bill tariff water-saving program in California. BayREN's SMB program employed a P4P approach with support of its third-party implementer to offer participation without up-front costs. SoCalREN's PA SSP program provided higher monetary incentives to support energy upgrades for public agencies in underserved communities. SoCalREN's RLF provided no-interest upfront financing for small and midsized projects in underserved communities.

The programs also offered customized and hands-on solutions to enable participants achieve energy efficiency goals. Unlike similar programs by SCE and SCG, SoCalREN's public agency offerings were more comprehensive, covering detailed financial analysis, procurement, and construction management. SoCalREN's EE PDP provided tailored assistance, including procurement assistance and project management support from design to close-out. It also offered experts to enrolled agencies, including project managers, financial advisors, and contractors. SoCalREN also offered similar comprehensive and customized support to participants in its DER DAC and PA NMEC programs.

Finally, these programs offered services that focused on electrification and decarbonization. SoCalREN's DER DAC is the only public sector program that offered reports (Pathway to Zero) to educate public agencies on clean energy and sustainability strategies. In PY2022, the DER DAC program delivered 14 Pathway to Zero reports.

4.2.5 WE&T and C&S program features and value

Table 4-21 provides the key features of the PY2022 WE&T and C&S program activities and the unique values they offered. As for the other sectors, we grouped the programs' features based on the primary value they provided, even though some of the features extend over multiple categories. The WE&T and C&S programs demonstrated value by offering energy efficiency services that filled regional gaps in knowledge and skills.

Table 4-21. Assessment of key features and differentiators of PY2022 WE&T and C&S programs

Description of value	Feature	Feature by program				
		BayREN C&S	BayREN Green Labeling	SoCalREN WE&T	3C-REN C&S	3C-REN WE&T
HTR	**Address knowledge and other activity gaps**			Entry-level workforce skills training, diverse and SBE/DVBE[62] contractor training, in-school and at-risk youth training, homeless workers training.		
Pilot	**Address knowledge and other service gaps**		Introduced a Home Energy Score (HES) system to advance energy audits and EE literacy and encourage energy efficiency retrofits by homeowners.			
Unique	**Address knowledge and other activity gaps**	Increased the C&S and reach code knowledge and enforcement capabilities of local government building department staff.	Offered real estate professional and workforce training to increase energy efficiency knowledge.		Provided local building professionals and departments with access to training, tools, and one-on-one technical support to fill regional energy education gap.	Addressed training gaps within the local building workforce to enhance code compliance.
	Enable customization / offer tailored support	Provided shorter trainings targeted at more specific participants to accommodate individuals with limited availability.				Provided on-demand, web-based, and in-person training to accommodate the schedules of local professionals. Provided local workforce training with certifications unavailable in other PA programs.

[62] Small Business Enterprise and Disabled Veteran Business Enterprise.

Description of value	Feature	Feature by program				
		BayREN C&S	BayREN Green Labeling	SoCalREN WE&T	3C-REN C&S	3C-REN WE&T
Unique	**Focus on electrification / decarbonization**	Promoted electrification through regional forums offered to building department staff.	Launched the Electrification Checklist trainings among the workforce to promote the shift from gas to electric measures.			
	Improve geographic / provide local coverage				Offered locally relevant training to meet the specific needs of the local workforce.	
	Provide hands-on support				Provided hands-on and technical support on-site for tracking and reporting systems, best practice guides and checklists, and policy support.	

The REN C&S and WE&T programs offered services tailored to the regions they served, with offerings designed to enhance awareness about codes and standards used in the buildings and provide training and upskilling opportunities for careers in the energy sector.

The PY2022 BayREN and 3C-REN C&S programs aimed to reduce GHG emissions by improving codes and standards enforcement through customized support and tailored training of local government and other building professionals. The programs identified and addressed educational gaps in C&S knowledge and enforcement capabilities within their regions. Through PA/Implementer IDIs we learned that BayREN's C&S program focused on supporting local governments' ability to develop and enforce local reach codes and energy policies and enforce or implement the California Energy Code. BayREN C&S program supported 61 of the 109 Bay Area local governments with training or other compliance improvement activities and with policy assistance through Regional Forums or a reach code working group.

3C-REN leveraged its local knowledge to offer customized support and training targeted at the regional workforce. As a geographically isolated region, it was not feasible for tri-county workers to travel to utility training facilities in Los Angeles or the Bay Area. To combat this challenge, 3C-REN programs fostered meaningful partnerships with local entities. For example, 3C-REN partnered with local American Institute of Architects (AIA) chapters to co-host training series. Through communication with contractors 3C-REN also identified a lack of contractors with passive house knowledge and began offering annual certification training to address this gap.[63] Both programs emphasized the importance of local relevance and regional focus in their initiatives.

The REN C&S programs also offered tailored training and support to address the specific needs of local governments and building professionals. For example, BayREN provided customized training and templates, best practice guides, and checklists to bridge knowledge gaps among building department staff, while 3C-REN offered technical assistance for tracking and reporting systems. Additionally, the programs provided hands-on support and mentorship to help building professionals enforce codes and standards effectively. 3C-REN's "Code Coaches" provided on-site assistance and were available on-call for the region, while BayREN provided shorter, targeted training to accommodate participants with limited availability.

Finally, the C&S programs promoted electrification as a key strategy for reducing GHG emissions. BayREN hosted regional forums and webinar series to promote electrification among building department staff, while 3C-REN provided technical assistance and training to support electrification efforts within the region.

The PY2022 REN WE&T programs (BayREN Green Labeling, SoCalREN WE&T, and 3C-REN's WE&T) promoted energy efficiency, sustainability, and workforce development within the real estate and building industries. Each program addressed knowledge gaps within its target sector and employed tailored approaches to close those gaps. BayREN's Green Labeling program focused on closing energy knowledge gaps in the real estate industry through real estate professional and workforce training, alongside implementing a Home Energy Score (HES) system. Similarly, SoCalREN's WE&T program targeted workforce development to support diverse populations such as youth, disabled veteran business enterprises, and small businesses, including specific initiatives for homeless and disadvantaged workers. Concurrently, 3C-REN's program aimed to enhance code compliance and address training gaps within the local building workforce through educational and mentoring initiatives, accommodating different learning preferences and schedules.

[63] Passive house is a design and construction standard, focused on the building envelope, that produces dramatic reductions in building energy use and carbon emissions, while also prioritizing human comfort and health.

4.3 Program coordination

In this section, we used primary data (PA/Implementer interviews) and reviewed program documentation (JCMs, PIPs, annual reports, and ABALs) to assess how each of the three RENs coordinated in PY2022 with IOUs and CCAs in their region to decrease any perceived customer confusion, leverage existing partnerships, and collaborate to enhance participation and program performance. We sought to identify how REN programs complement or overlap with other utility or CCA programs and assess how PAs coordinate with each other to reach more customers, avoid duplication, and be more effective. Key findings are summarized below, followed by detailed explanations of program coordination efforts by RENs.

4.3.1 Summary findings

The RENs coordinated with the IOUs in ways that were more ad hoc and nuanced than described in the JCMs.	In our initial PA interviews with BayREN, SoCalREN, and 3C-REN conducted in July 2023, DNV specifically asked if the JCMs accurately reflect the level of coordination between the RENs and the IOUs. The RENs responded that the JCMs did accurately reflect coordination efforts at the time they were drafted. The JCMs documented coordination protocols formulated between the IOU partners and the RENs. However, we found that the JCMs did not accurately reflect the actual, day-to-day level of coordination between RENs and utilities as most coordination and collaboration was more complex and nuanced and occurred through ad-hoc email, phone calls, smaller meetings, etc.
The RENs tended to have less formal coordination with the CCAs than the IOUs.	Through PA/Implementer interviews, we found that RENs regularly coordinate and partner with CCAs in their territories. These efforts were seldom guided by the JCMs. Instead, they occurred through ad hoc meetings, phone calls, and emails. Even when a JCM existed between a REN and a CCA, it did not include comparable programs across all categories. For example, in PY2022, MCE offered the Green Workforce Pathways Program (a WE&T program), which provided education and training opportunities for existing energy efficiency contractors and job opportunities for people looking to join the energy efficiency workforce. While the BayREN/MCE JCM did not mention the Green Workforce Pathways Program, the program's Implementation Plan discussed coordination efforts with both BayREN and PG&E.
BayREN had well-defined coordination protocols; the other RENs' protocols were less well-defined.	BayREN coordination protocols included process flow charts showing the key decision points that determined which PA/program best met particular customer needs. There were separate decision trees for each type of program: single-family, multifamily, commercial, and C&S. The JCMs for SoCalREN and 3C-REN mentioned similar coordination protocols, but the processes were not well defined and, with one exception, did not include illustrative charts to map these processes to support and guide coordination efforts. The 2022 JCM between SoCalGas, SCE, and SoCalREN did include an "NMEC Decision Tree" [64] that outlined how SoCalREN's EE PDP and DER DAC programs coordinated with the IOUs to help public agencies determine whether SoCalREN's PA NMEC program or similar IOU programs were most appropriate or beneficial to the participating agency. But this decision tree only related to specific aspects of SoCalREN's public agency programs.

[64] 2022 Joint Cooperation Memorandum (JCM) of SoCalGas, SCE, and SoCalREN Pursuant to Decision (D.) 18-05-041, p. 95.

All three RENs had regular communication with utilities.	BayREN residential, commercial, WE&T, and C&S teams met once a month with PG&E and MCE in addition to regular ad-hoc communication consisting of phone calls, emails, and meetings. During PA/Implementer interviews, BayREN also noted that they had weekly calls with PG&E related to administration items such as contract issues, invoicing, or data issues. SoCalREN residential, WE&T, and C&S teams met with utilities once per quarter. However, SoCalREN's public agency coordination efforts with utilities were much more robust, including monthly coordination calls with the Joint PAs (SoCalREN, SCE, and SCG), monthly SCE-specific project coordination calls, and the *SoCalREN-IOU Coordination Plan for Public Agencies* created by the Joint PAs in 2013. All of 3C-REN's coordination teams for residential and non-residential programs also either held quarterly coordination meetings or stated they held regular coordination meetings but did not specify a cadence.
Coordination with third-party implementers was complicated and created challenges.	During PA/Implementer interviews and program documentation review, we identified that the JCMs did not address the impact of third-party implementers on coordination efforts. Third-party implementers managed a large majority of both REN and utility programs (e.g., third-party implementers managed 14 of the 18 programs included in our evaluation). There was a variance in attendance by IOUs at regular coordination meetings. Often, neither utility nor REN staff attended the regular coordination meetings. SoCalREN noted that coordinating directly with third-party program implementers had been more resource intensive, presumably because it took longer and additional effort to communicate with the utilities directly because they had to go through the implementers first. SoCalREN also noted that third-party implementers regarded the RENs more as competition instead of an ally because of the performance-based contracts the third-party implementers have with the utilities.

4.3.2 BayREN

As previously indicated, BayREN covers nine counties in the Bay Area and shares this territory with PG&E and seven CCAs, as shown in Table 4-22.

Table 4-22. Summary of CCAs and IOUs within BayREN territory in PY2022

PA (REN, IOU, or CCA)	Year established	ETA approved by the CPUC	Active programs in CEDARS in 2022
BayREN	2013	N/A	6 (3 residential, 1 commercial, 1 public agency, 1 C&S)
PG&E	1905	N/A	143 (9 agricultural, 27 commercial, 35 cross-cutting, 15 industrial, 27 public agency, 30 residential)
CPSF	2015	2022	None
EBCE[65]	2016	2022	None
MCE	2010	2012	19 (4 agricultural, 5 commercial, 3 cross-cutting, 4 industrial, 3 residential)
PCE	2016	2022	None
SJCE	2017	2021	2 (1 commercial, 1 residential)
SVCE	2016	N/A	None
SCP	2014	2022	1 commercial

[65] Now Ava Community Energy (Ava).

While there are seven CCAs in BayREN's territory, and three of the seven had active programs listed in CEDARS in PY2022, the JCMs only outlined PY2022 coordination efforts between BayREN and PG&E and between BayREN and MCE. There were no JCMs on file for SJCE or SCP even though they both had active energy efficiency programs in PY2022.[66] However, during interviews with BayREN program managers, we found that BayREN coordinated and partnered with more CCAs than just MCE. For example, BayREN's Multifamily BAMBE program partnered with SCP to bring extra non-ratepayer CCA funds needed for electrification upgrades within SCP's territory. BayREN's Single-Family Home+ program referred customers to statewide programs as well as programs from other CCAs, such as PCE. However, for the purposes of this evaluation, we focused on coordination efforts documented in the JCMs: between BayREN, PG&E, and MCE.

4.3.2.1 Residential program coordination efforts

Table 4-23 provides a high-level summary of comparable residential programs across BayREN, PG&E, and MCE and key points of coordination and collaboration.

Table 4-23. Comparable BayREN, PG&E, and MCE residential programs and their coordination efforts

Program type	BayREN	PG&E	MCE	Coordination efforts
Single-family	Home+ (SF)	• P4P Programs (HomeIntel and Home Energy Rewards) • Plug and Load Appliances • Energy Savings Assistance – Common Area Measures (ESA-CAM)	• Single-Family Direct Install or Home Energy Savings (HES) • WE&T	• Monthly meetings • Coordination protocol flow chart/decision tree • Ad-hoc meetings to address urgent issues • Single point of contact for application processing and data sharing
Multifamily	BAMBE (MF / MF Electrification)	• Multifamily Energy Savings Program (MESP) • Home Energy Check-up • ESA-CAM	• Multifamily Comprehensive	• Monthly meetings • Coordination protocol flow chart/decision tree
Other	Green Labeling	• WE&T	• N/A	• Coordinated trainings, but no formal coordination protocol

Single-Family Coordination. BayREN, PG&E, and MCE all offered single-family programs and coordinated their efforts as outlined in the JCM. The BayREN Home+ program was available to all single-family homes, but targeted HTR participants defined as moderate income and/or where a language other than English was spoken. In PY2022, there were several PG&E programs with similar offerings for single-family residents within this target market: two P4P programs (HomeIntel and Home Energy Rewards), Plug Load and Appliances (PLA), Home Energy Check-up, and a midstream heat pump water heater (HPWH) program. HomeIntel and Home Energy Checkup were both behavior-based programs and did not offer measures or incentives. Both PG&E's Home Energy Checkup (HEC) and Energy Savings Assistance – Common Area Measures (ESA-CAM) were available to single-family and multifamily residential customers. ESA-CAM is available to those households with income at or below 200% of the federal poverty line, while HEC is available to all households. Of PG&E's single-family program offerings, only Home Energy Rewards and PLA targeted similar markets and offered comparable measures and

[66] We also found a JCM between BayREN, PG&E, and East Bay Community Energy (EBCE), but that covered coordination efforts for PY2023.

incentives to BayREN's SF program. According to the JCM, the Home Energy Rewards program was only offered in Contra Costa County in PY2022 and was not an option for residents in most of BayREN's territory. The primary difference between BayREN's SF program and the other programs was that Home+ customers were required to install measures through a BayREN participating specialty contractor.

The coordination protocol required BayREN SF Home Energy Advisors to guide customers toward PG&E programs if the customers expressed interest or if the Energy Advisors determined that they were a better fit for those programs. BayREN staff indicated that the SF program considered itself a central "aggregator" for single application processing and data sharing across PG&E programs, complementary statewide programs (such as the statewide Technology and Equipment for Clean Heating [TECH]), and other CCA programs (such as PCE's residential programs and rebates). BayREN saw this central aggregator role as filling a gap in the industry and simplifying the process for contractors and participants. BayREN and PG&E's single-family residential teams held monthly check-in calls, with additional ad-hoc meetings to address any urgent issues. The standing agenda for these meetings included updates on program uptake, challenges, contractor issues, data sharing, double-dip processes, and marketing and outreach.[67]

In PY2022, MCE offered two single-family programs that were comparable to BayREN's SF program. MCE's Single-Family Direct Install, also known as the Home Energy Savings program, offered no-cost energy efficiency measures for single-family residents in MCE's service area, which covered four of the counties within BayREN's territory. The primary differences between BayREN's SF programs and MCE's Home Energy Savings program were related to program design and delivery. The HES program was direct install and targeted lower moderate-income households. BayREN's SF program provided rebates, targeted moderate-income households, and required homeowners to find a participating contractor.

We included MCE's WE&T program as a comparable residential program because BayREN's SF program included education and training activities and the JCM grouped these together regarding coordination of residential programs. MCE's WE&T program offered electrification workshops and mentoring with contractors in the field. The BayREN SF program offered participating contractors trainings and one-on-one mentoring with a focus on specialty contractors. Both BayREN and MCE coordinated training activities with PG&E's WE&T program to prevent duplication of efforts. BayREN promoted MCE training as appropriate. However, there does not appear to be much difference in the type of training offered, delivery method, or targeted participants. BayREN and MCE single-family residential program management staff met once a month for general coordination efforts and as needed for more urgent matters.

Multifamily Coordination. BayREN, PG&E, and MCE all offered multifamily programs and coordinated their efforts as outlined in the JCM. BayREN's MF / MF Electrification program was comparable to two PG&E programs: Multifamily Energy Savings Program (MESP) and Energy Savings Assistance – Common Area Measures (ESA-CAM). There were several differences between the BayREN MF and MESP programs. The BayREN MF program was open to any multifamily property owner interested in multi-measure projects, with increased incentives for electrification measures and an emphasis on core, in-unit measures. The program also provided no-cost technical assistance to guide property owners through the process from start to finish. PG&E's MESP offered direct install of low- or no-cost measures that could serve as a catalyst to property owners participating in deemed or custom upgrades. MESP customers could install any of the available measures, while BayREN's MF participants were required to install at least three measures, including one core measure. BayREN MF's bundled measure incentive approach was designed to encourage major renovations and upgrades. The BayREN MF program was unique in that it provided personal attention and assistance to property owners interested in comprehensive upgrades. In contrast, the other programs took single-measure and/or direct install approaches. PG&E's ESA-CAM program

[67] The Home+ program also offered contractor training on workforce and installation standards and for professional development and coordinated with PG&E's WE&T program activities, as appropriate.

offered no-cost energy efficiency measures for eligible deed-restricted properties.[68] The ESA-CAM program, like BayREN MF, provided free technical assistance to guide property owners through the process.

MCE also offered a multifamily program, the Multifamily Comprehensive program, which provided technical assistance, rebates, and no-cost direct install for single measures. MCE's multifamily program targeted property owners interested in a measure-by-measure approach rather than a comprehensive upgrade. BayREN and PG&E coordination protocol showed that if customers had at least three measures, including one core measure, and targeted 15-20% savings, they were eligible for BayREN MF. If customers could not implement a minimum number of BayREN MF measures, those customers would be referred to a single point of contact (SPOC) at PG&E who would then direct them to the program that best suits their needs. BayREN, PG&E, and MCE had monthly coordination calls to ensure alignment in program design.

Other Residential Coordination. We have included BayREN's Green Labeling program in the WE&T category because program delivery is focused on training. However, the BayREN JCMs included it in residential program offerings and identified that the closest program within PG&E's offerings was its WE&T program, which provided some training directed at real estate professionals, but the coursework was not as comprehensive or diverse. The two programs coordinated their trainings, but there was not a formal coordination protocol.

4.3.2.2 Non-residential program coordination efforts

Table 4-24 provides a high-level summary of comparable non-residential programs across BayREN, PG&E, and MCE.

Table 4-24. Comparable BayREN, PG&E, and MCE non-residential programs and their coordination efforts

Program type	BayREN	PG&E	MCE	Coordination efforts
Commercial	SMB Commercial	• Commercial Deemed Incentives • Commercial Calculated • CoolSave Grocery Comprehensive Retrofit and Commissioning • Advanced Energy Program for High Tech and Biotech • Healthcare Energy Fitness Initiative • Smart Labs Program – Energy and Ventilation • NetOne Program – Comprehensive Commercial • RAPIDS Wastewater Program • Government and K-12 Schools Program	• Commercial Upgrade Program	• Monthly coordination calls • Cross-program referral protocols
Public agency	WUSave	• N/A	• N/A	• N/A
WE&T and C&S	Codes and Standards	• Compliance Improvement • Reach Codes • Building Codes Advocacy	• Green Workforce Pathways Program*	• Monthly coordination calls

* MCE's Green Workforce Pathways Program is not mentioned in the JCM.

[68] In the context of multifamily properties, "deed-restricted" refers to properties that have legal restrictions placed on them, often related to income or affordability requirements. These restrictions are recorded in the property's deed and are intended to ensure that the property remains affordable to low- or moderate-income households for a specified period of time.

Commercial Program Coordination. BayREN, PG&E, and MCE all offered commercial programs and coordinated their efforts as outlined in the JCM. There were several PG&E commercial programs comparable to the BayREN SMB program. However, they all targeted businesses whose facilities were greater than 50,000 square feet. PG&E also customized its commercial program offerings to specific industries such as healthcare, grocery stores, and biotechnology. The BayREN SMB program was the only resource acquisition program that used a population NMEC approach to serve HTR small businesses.

While there was not much program overlap or potential for customer confusion given the SMB program's focus on businesses with facilities less than 50,000 square feet, BayREN's program leveraged PG&E programs when it benefited the customer. Also, even though a customer seemed to be a good fit for BayREN's program based on the size of the business, not all businesses were good candidates for an NMEC approach due to the requirement for baseline energy data. For this reason, BayREN may have referred businesses to other PG&E or CCA programs. Likewise, other utility or CCA programs may also have been eligible for the BayREN Microloan program,[69] which was a subprogram of the SMB Commercial program.

For these reasons, close coordination between BayREN, PG&E, and MCE was important. For PY2022, the BayREN SMB program had a referral protocol in place with PG&E and MCE programs. In the absence of baseline data, BayREN referred the customer to a direct install program offered by PG&E. The PAs held monthly calls and exchanged lists of projects to identify potential instances of double dipping, where a customer or project receives incentives or benefits from multiple programs for the same energy efficiency measures.

MCE's Commercial Upgrade Program used multiple implementation partners to provide a comprehensive approach to energy efficiency upgrades based on individual customer needs and opportunities. The program divided customers into small and medium businesses, large commercial entities, and customers fit for its population NMEC sub-program. Using this approach, MCE's Commercial Upgrade Program served any non-residential customer within MCE's service area and leveraged custom, deemed, NMEC, and strategic energy management (SEM) participation pathways.

The key differentiators for BayREN's SMB program were its specific focus on small business sectors (including retail, professional offices, restaurants, gyms/multi-use buildings, and grocery/corner stores with facilities under 50,000 square feet) and upfront incentives based on modeled savings estimates followed up by incentives for metered savings in compliance with NMEC methodology. Alternatively, MCE's Commercial Upgrade Program served all non-industrial and agricultural businesses, including small business customers.

BayREN and MCE program managers held monthly calls to ensure complementary program development, identify areas of potential coordination, and prevent double-dipping. Specifically, BayREN and MCE shared lists of projects within MCE's service territory that were underway to prevent double-dipping. To simplify the process, BayREN SMB program and MCE's Commercial Upgrade Program would not serve any customer who had participated in a ratepayer-funded energy efficiency rebate program during the 12 months of the customer's baseline period.

WE&T and C&S Program Coordination. BayREN, PG&E, and MCE all offered WE&T and C&S programs. BayREN and PG&E C&S programs targeted similar audiences (i.e., local government building departments and other public agencies involved with building codes). PG&E developed comprehensive tools, templates, trainings, and other resources that were broadly useful and effective. BayREN adapted those tools to create customized, agency-specific approaches to C&S training.

[69] BayREN's Business Microloan program offers interest-free microloans of up to $2,500 for energy-saving upgrades specifically designed for small businesses. The program operates in collaboration with the San Francisco nonprofit Mission Asset Fund (MAF).

MCE did not offer any comparable C&S programs, nor did BayREN and MCE's JCM for PY2022 mention any coordination efforts for C&S or WE&T programs. However, MCE offered the Green Workforce Pathways Program, which was designed to leverage industry and stakeholder expertise to provide education opportunities for existing energy efficiency contractors and job opportunities for people looking to join the energy efficiency workforce. While the BayREN/MCE JCM did not mention the Green Workforce Pathways Program, the program's Implementation Plan discussed coordination efforts with both BayREN and PG&E. BayREN's Implementation Plan noted that MCE collaborated with contractors and program implementers, including those outside of MCE's energy efficiency programs, such as BayREN's MF contractors, to ensure that program offerings aligned with existing program goals. Additionally, MCE facilitated connections between contractors and PG&E's Pacific Energy Center to provide training in both technical and non-technical skills identified during roundtable discussions. BayREN and PG&E C&S teams had monthly coordination calls to discuss ongoing and planned activities in order to identify opportunities for cooperation and collaboration and to prevent duplicated efforts and activities. The PAs also assisted in each other's marketing and outreach efforts, as appropriate.

4.3.3 SoCalREN

SoCalREN serves seven entire counties and parts of five other counties in southern California. SoCalREN shares these territories with SCE, SCG, and 10 CCAs as shown in Table 4-25.

Table 4-25. Summary of CCAs and IOUs within SoCalREN territory in PY2022

PA (REN, IOU, or CCA)	Year established	ETA approved by the CPUC	Active programs in CEDARS in 2022
SoCalREN	2013	N/A	8 (2 residential, 5 public agency, 1 WE&T)
SCE	1909	N/A	120 (7 agricultural, 26 commercial, 29 cross-cutting, 10 industrial, 22 public agency, 26 residential)
SCG	1867	N/A	154 (7 agriculture, 28 commercial, 37 cross-cutting, 8 industrial, 36 public agency, 38 residential)
AVCE	2017	N/A	None
CPA	2017	N/A	None
DCE	2020	N/A	None
EPIC	2022	N/A	None
LCE	2015	2018 (closed by 2022)	None *
OCPA	2021	Advice letter not approved.	None
PRIME	2017	N/A	None
Pomona Choice Energy	2019	N/A	None
RMEA	2018	N/A	None
San Jacinto Power	2016	N/A	None

* CEDARS shows two active LCE programs in 2022 (one commercial and one residential), but these programs were both closed by 2021.

There are 10 CCAs in SoCalREN's territory, but none of them offered energy efficiency programs in PY2022 that reported savings in CEDARS. There was only one JCM that outlined PY2022 coordination efforts between SoCalREN, SCE, and SCG. Even though the JCM did not include any CCAs, some of them offered energy efficiency programs that did not use

ratepayer funds. For example, CPA's Power Response – Multifamily Community program worked with multifamily building owners, managers, and residents to alleviate electric grid stress. The program provided smart thermostats to common areas and residents that will automatically adjust when electric grid use is high to maximize energy savings and lower electric bills during peak times. Another CCA, OCPA, has partnered with SoCalREN since 2021 on the creation and implementation of energy efficiency programs that impact residents, businesses, and public facilities and encouraged its customers to participate in these programs.

Based on initial PA interviews DNV conducted in July 2023, we learned that SoCalREN did not have the challenge of competing CCA programs because most of the CCAs in their area chose not to administer energy efficiency programs. However, SoCalREN collaborated on program promotion with CCAs to reach the CCA's constituents and subscribers. This cooperation was a value-added complementary opportunity for SoCalREN community members to actively participate in CCA programs. For the purposes of this evaluation, we focused on coordination efforts documented in the JCMs.

4.3.3.1 Residential program coordination efforts

Table 4-26 provides a high-level summary of comparable residential programs across SoCalREN, SCE, and SCG. SoCalREN did not implement any single-family residential programs, so we compared its multifamily program to similar offerings from the utilities: SCE's Multifamily Third-Party program and SCG's Multifamily Whole Building program. SoCalREN's Kits for Kids program spanned both single-family and multifamily households, but neither SCE nor SCG offered comparable programs, so we did not include Kits for Kids in this coordination discussion.

Table 4-26. Comparable SoCalREN, SCE, and SCG residential programs and their coordination efforts

Program type	SoCalREN	SCE	SCG	Coordination efforts
Multifamily	MF program	Multifamily Program	Multifamily Whole Building Program	• Quarterly meetings • Ad-hoc communication
Other/both	Kits for Kids	N/A	N/A	N/A

Multifamily coordination. SoCalREN's MF program was most similar to SCG's in that they were both whole building programs that required installation of at least three measures, including one core measure, and they both offered tiered incentive levels based on the type of property. SCG's program also targeted multifamily properties within DACs. Alternatively, SCE's multifamily program was available to all levels of multifamily buildings (i.e., low-income, affordable-to-moderate income, market-rate), including those located in DACs. SCE's program also allowed for single measures and did not require a whole-building approach. All three programs provided technical assistance and recommendations as well as a SPOC to guide participants through the entire process and direct them to other utility or REN programs as appropriate to best suit their needs.

Because SoCalREN's MF program offered dual-fuel (gas and electric) options, collaboration and coordination efforts between SoCalREN, SCE, and SCG (the Joint PAs) on their multifamily programs were critical to program success, participant satisfaction, and increased energy savings. By coordinating efforts within multifamily programs, they could facilitate more comprehensive energy efficiency retrofits. This coordination involved integrating their existing offerings with SoCalREN's whole-building program. The Joint PAs also provided information and referrals across all program implementers. The JCM noted that the Joint PAs communicated via email or in regular coordination meetings, but it did not specify the cadence of those meetings for the residential sector. In PA/Implementer IDIs, we learned that the SoCalREN and utility residential teams met once a quarter.

In addition to the formalized protocols and coordination meetings, SoCalREN and the IOUs and CCAs communicated regularly via email, phone, or in ad-hoc coordination meetings. Each of the SoCalREN sectors met regularly with the corresponding IOU partners. The public sector had its own monthly meeting, while the residential sector met quarterly.

4.3.3.2 Non-residential program coordination efforts

Table 4-27 provides a high-level summary of comparable non-residential programs across SoCalREN, SCE, and SCG. SoCalREN did not have any active commercial programs in PY2022. Because there were almost 40 public agency program offerings between SoCalREN, SCE, and SCG, the discussion below is organized by SoCalREN public agency program and includes the key program features that differentiate it from comparable SCE and/or SCG programs. As described in the JCM, SoCalREN leveraged the standardized coordination protocol with IOUs. The programs were addressed in monthly project coordination meetings with IOU program implementers and adhered to the coordination protocol outlined in the *SoCalREN-IOU Coordination Plan for Public Agencies*.

Table 4-27. Comparable SoCalREN, SCE, and SCG non-residential programs and coordination efforts

Program type	SoCalREN	SCE	SCG	Coordination efforts
Commercial	N/A	49 commercial, industrial, or cross-cutting programs active in PY2022	66 commercial, industrial, or cross-cutting programs active in PY2022	N/A
Public agency	• RLF • EE PDP • DER DAC • PA NMEC • PA SSP	8 programs active in PY2022	26 programs active in PY2022	• Monthly coordination calls with the Joint PAs • Monthly SCE-specific project coordination calls • SoCalREN-IOU Coordination Plan for Public Agencies created by the Joint PAs in 2013
WE&T and C&S	• WE&T Program	WE&T Integrated Energy Education & Training Program	WE&T Integrated Energy Efficiency Training (IEET)	• Monthly coordination calls • Workforce Advisory Committee

SoCalREN's RLF program supported energy efficiency upgrades of public agency facilities with a priority on supporting projects that serve DACs, rural, and low-income communities. Loans through the RLF were short-term bridge loans financed through non-ratepayer funds. The program was designed to increase public agency participation in energy efficiency programs by providing a low-cost financing solution. The primary differences between the RFL and comparable programs offered by SCE and SCG were that the RLF was a non-resource program open only to public agencies, loan distribution was provided up-front, the loan term was up to 5 years, and repayment method was off-bill. Both SCE and SCG programs were open to all commercial and public agency customers, used ratepayer funds as the source of the funding, allowed up to 10 years (SCE) or 15 years (SCG) or the effective useful life (EUL) of the equipment to repay the loan, and used on-bill financing to repay the loan.

SoCalREN's EE PDP collaborated with public agencies to identify and execute customized energy efficiency projects tailored to their specific needs. The EE PDP offered project management and technical support throughout the entire project lifecycle, including technical assistance, procurement assistance, construction management support, and financing support. Savings achieved from these projects were claimed through other programs, including SCE, SCG, and other SoCalREN resource programs such as the Metered Savings Program and the PA SSP. The primary differences between the EE PDP

and comparable programs offered by SCE and SCG were that the EE PDP was only available to public agencies, was a non-resource program that funneled projects to other resource programs, and provided services such as detailed financial analysis, procurement, and construction management support not offered by utility programs. Because the EE PDP leveraged other SCE and SCG resource programs to complete projects and achieve savings, the utilities were involved in the participant enrollment process. Based on the type of measures proposed (electric, gas, or both), the utilities participated in a presentation to introduce the participating agency to the EE PDP team and any applicable program partners.

Similar to the EE PDP, ***SoCalREN's DER DAC program*** was a non-resource program that provided comprehensive support for electric and gas energy efficiency projects. The program encompassed technical assistance, procurement guidance, financial services, construction management, and full project management support through project completion. The difference is that the DER DAC program included the consideration of distributed energy resources (DERs)[70] during energy efficiency audits and provided recommendations for integrating DERs in selected projects. Also, the program was specifically offered within DACs, rural, and low-income communities. SCE and SCG did not offer any comparable programs. Like the EE PDP, the DER DAC program was addressed in monthly project coordination meetings with utilities and adhered to the coordination protocols outlined in the *SoCalREN-IOU Coordination Plan for Public Agencies*.

SoCalREN's PA NMEC program was a resource program that used NMEC methodology to calculate energy savings. Participants were first identified through the EE PDP or DER DAC programs. While this program was open to all participants, it offered increased incentives for DAC, rural, or low-income communities. The program addressed complex projects that were ineligible for IOU incentives and were seeking high impact retrofit, retro-commissioning, or operational measures that resulted in 10% or greater of energy savings. The program helped projects to meet or exceed code or standard practice and achieve that may otherwise have not occurred. The PA NMEC program provided project management support and technical expertise (supplemental to EE PDP and DER DAC), created M&V plans, and offered training for facility personnel to bolster savings persistence.

In addition to the protocols described under other SoCalREN coordination descriptions, the Joint PAs developed an *NMEC Participation Coordination for Public Agencies* document. Public sector coordination meetings between SoCalREN, SCE, and SCG occurred on a monthly basis. In 2021, SCE was in the solicitation phase to select third-party implementers for the public agency sector, with the goal of implementing those programs in PY2022. Therefore, we do not have specific program coordination efforts to discuss relative to comparable SCE programs. SoCalREN's PA NMEC program was comparable to SCG's High Opportunity Program and Projects (HOPPs) program. The primary differences between these two programs were that the HOPPs program was open to all public agencies (not just those in DACs, rural, or low-income communities) and only included measures that reduced energy usage to achieve 20% savings and at least 7,000 therms.

SoCalREN's PA SSP provided incentives to public agencies for comprehensive deemed and custom energy efficiency electric projects. The resource program offered enhanced incentive rates for disadvantaged, low-income, Title I schools, and rural customers. Like the NMEC program, the PA SSP leaned on EE PDP and DER DAC for technical assistance and project management support. The program was designed to serve as a temporary gap-filling program to supplement the public agency segment while waiting for new third-party SCE programs to be on-boarded and enter the market. The PA SSP launched in March 2022 and there was insufficient time to identify and complete projects to meet its energy savings goals for that year. As described above, since SCE was in the process of soliciting third-party implementers for public agency programs, we do not have specific program coordination efforts to discuss relative to comparable SCE programs. And because the PA SSP only included electric measures, there were no comparable SCG programs.

[70] Distributed energy resources (DERs) are small-scale electricity supply or demand resources that are interconnected to the electric grid.

SoCalREN's WE&T program provided training, tools, and career opportunities to increase the size, skill level, and diversity of the energy efficiency labor force in southern California. The WE&T program targeted participants among Title 1 schools, diverse contractors, and opportunity youth. The WE&T program filled critical gaps in workforce development by providing targeted support for diverse populations, including youth, disadvantaged workers, and small businesses, while addressing the demand for clean energy employment opportunities. The program differed from those of SCE and SCG because it focused on entry-level workforce skills training, diverse and SBE/DVBE contractor training, and in-school and at-risk youth. As noted in the JCM, it was also the only program with local workforce training offerings for homeless and DAWs.

For the WE&T program, SoCalREN follows a collaborative framework established in 2013 when the Workforce Advisory Committee and Small Business Advisory Committee joined forces to address barriers related to education and training. These collaborative efforts involve a diverse range of partners, including labor organizations, industry associations, community-based groups, community colleges, utilities, and participating agencies. Additionally, the Joint PAs held monthly coordination calls for WE&T programs that leverage strategies and tactics and support core program activities.

4.3.4 3C-REN

3C-REN fully covers three counties and shares this territory with PG&E, SCE, SCG, and three CCAs as shown in Table 4-28.

Table 4-28. Summary of CCAs and IOUs within 3C-REN territory in PY2022

PA (REN, IOU, or CCA)	Year established	ETA approved by the CPUC	Active programs in CEDARS in 2022
3C-REN	2017	N/A	4 (2 residential, 1 WE&T, 1 C&S)
PG&E	1905	N/A	143 (9 agricultural, 27 commercial, 35 cross-cutting, 15 industrial, 27 public agency, 30 residential)
SCE	1909	N/A	120 (7 agricultural, 26 commercial, 29 cross-cutting, 10 industrial, 22 public agency, 26 residential)
SCG	1867	N/A	154 (7 agriculture, 28 commercial, 37 cross-cutting, 8 industrial, 36 public agency, 38 residential)
3CE	2017[71]	N/A	None
SBCE	2019	N/A	None
Clean Power Alliance	2017	N/A	None

Because neither 3CE nor SBCE had active programs in PY2022, there was no need for them to be included in the JCM between 3C-REN, PG&E, SCE, and SCG. However, during PA/Implementer interviews, we learned that 3C-REN regularly coordinated with the CCAs in its region, as did all of the RENs included in our evaluation. For example, one of 3C-REN's program managers noted that the 3C-REN SF NMEC program was layered incentives from 3CE's single-family program, which was also layered incentives from the TECH Clean California initiative. As a result, there was regular coordination between all three of these organizations.

[71] Monterey Bay Community Power was founded in 2017 and changed its name to Central Coast Community Energy in 2020.

4.3.4.1 Residential program coordination efforts

Table 4-29 provides a high-level summary of comparable residential programs across 3C-REN, PG&E, SCE, and SCG and key points of coordination and collaboration.

Table 4-29. Comparable 3C-REN, PG&E, SCE, and SCG residential programs and coordination efforts

Program type	3C-REN	PG&E	SCE	SCG	Coordination efforts
Single-family	• SF NMEC * • Single-Family Direct Install	• P4P Programs (Comfortable Home Rebates, HomeIntel, and Home Energy Rewards)	• Residential Direct Install	• Residential Advanced Clean Energy Program	• Email • Regular coordination meetings • Protocols for referrals and double-dipping
Multifamily	MF Program*	• Multifamily Energy Savings Program (MESP) • Home Energy Check-up • ESA-CAM	• Residential Third-Party Program	• RES-Home Upgrade Program • MF Space and Water Heating Program • Multifamily Energy Alliance	• Quarterly meetings • Ad-hoc communication

* Not included in the JCM for PY2022.

Single-family coordination. 3C-REN's SF NMEC program was not included in the JCM for PY2022 (dated June 15, 2021) because the program launched in December 2021. The only 3C-REN single-family program included in the JCM for PY2022 was the Single-Family Direct Install program, which was replaced by the SF NMEC program. We assume that the coordination efforts described under the former single-family program carry over to the new program. According to the JCM, the IOUs and 3C-REN planned for regular communication via email and meetings, a clear communication chain, and a defined protocol to verify customer eligibility to prevent double dipping. The IOUs committed to informing 3C-REN of available programs and resources, delivering written notice of advice letters and PIP filings and uploads, and flagging any new, similar programs.

The JCM also stated that 3C-REN had the right to determine how it wanted to leverage IOU resources for low- and moderate-income households, enabling cross-promotion and continuity of services between IOUs and 3C-REN. While the JCM mentioned specific protocols to handle referrals across programs/PAs and prevent double-dipping, neither of the protocols had sufficient details and did not provide flow charts/decision trees that mapped out these protocols.

Multifamily coordination. 3C-REN's MF program was also not included in the JCM. During PA/Implementer interviews, the program manager explained that the program design process was still in process when the PY2022 JCM was written (the program launched in October 2021). Nonetheless, the JCM mentioned that the IOUs would inform 3C-REN about multifamily programs and resources. The program manager confirmed that 3C-REN met with the IOUs quarterly to share program updates and coordinate referral processes, held ad hoc meetings to address challenges and opportunities, and coordinated closely on project validation.

4.3.4.2 Non-residential program coordination efforts

Table 4-30 provides a high-level summary of comparable non-residential programs across 3C-REN, PG&E, SCE, and SCG and key points of coordination and collaboration.

Table 4-30. Comparable 3C-REN, PG&E, SCE, and SCG non-residential programs and coordination efforts

Program type	3C-REN	PG&E	SCE	SCG	Coordination efforts
WE&T	• Building Performance Training	• Integrated Energy Education and Training (IEET)	• IEET	• IEET	• Quarterly meetings • Regular, ad hoc communication
C&S	• Energy Code Connect	• Statewide C&S Compliance Improvement Subprogram	• Statewide C&S Compliance Improvement Subprogram	• Statewide C&S Compliance Improvement Subprogram	• Quarterly meetings • Regular, ad hoc communication

WE&T Coordination. The primary goal of 3C-REN's Building Performance Training program was to address training gaps within the local building workforce and enhance code compliance through education, training, and mentoring. The program is meant to complement utility and CCA services. First, 3C-REN has a deeper engagement with the local workforce, fostering meaningful partnerships with local entities. Additionally, unlike the PG&E WE&T program, 3C-REN Building Performance Training (WE&T) program offered Building Performance Institute (BPI), Home Energy Rating System (HERS), or North American Technician Excellence® (NATE) certification opportunities for participants. While CCA programs typically targeted union members, the 3C-REN program focused on small, independent businesses within the local community.

PG&E, SCE, and SCG WE&T programs were part of a portfolio of education, training, and collaboration between the IOUs as part of the Statewide WE&T program. PG&E's IEET program included more than 400 residential and small business trainings provided in-person and Energy Centers or online via simulcast, webinar, and on-demand. PG&E's program did not offer soft skills training (e.g., interviewing skills, resume writing, etc.) and also did not offer certifications like the 3C-REN WE&T program, but did offer classes to prepare students to take the tests required for certification.

Both SCE and SCG's WE&T programs targeted an audience of existing technical and foodservice workers as well as those entering the workforce. The 3C-REN WE&T program's primary target audience included market actors who design, build, maintain, and operate buildings and building systems—engineers, technicians, building operators, designers, contractors, etc. Additionally, WE&T supported postsecondary[72] institutions that trained future generations of the energy workforce by providing them energy efficiency, sustainability, and green career awareness classes, internships, materials, and resources.

According to the JCM, the IOUs and 3C-REN met regularly to coordinate and established a clear chain of communication. IOUs provided 3C-REN with lists of scheduled WE&T trainings. 3C-REN leveraged existing IOU curricula and training by communicating training needs via email or in regular coordination meetings with IOU partners. PAs kept a standing agenda item at quarterly meetings to report which training topics were under development. If they observed gaps, 3C-REN developed additional resources and shared them with the IOUs.

C&S Coordination. 3C-REN's Energy Code Connect (C&S) program provided local government building departments and local building professionals with resources to enforce and comply with Title 24, preparing to transition to ZNE-ready 2020 codes. The program issued best practice guides and checklists, offered policy support, conducted one-on-one training and mentorship, and provided on-site support and technical assistance for tracking and reporting systems. 3C-REN's C&S program efforts were meant to increase knowledge of code, improve compliance and permit closure, enhance enforcement coordination and consistency, and encourage a standardized regional permitting process. 3C-REN's C&S program relied heavily on tools already developed by the IOUs, other RENs, CEC, and Energy Code Ace.[73]

[72] Postsecondary education refers to higher-level education that follows successful completion of high school (also known as secondary school). It encompasses a range of educational institutions and programs, including universities and colleges and trade, technical, and professional schools.

[73] Energy Code Ace is a comprehensive online resource designed to assist individuals and professionals in complying with California's Title 24, Part 6 building energy code and Title 20 appliance standards. It is part of the California Statewide Codes & Standards Program.

PG&E, SCE, and SCG C&S programs were all part of California's Statewide C&S Compliance Improvement subprogram and offered the same suite of classes and training. The IOUs provided 3C-REN with their respective lists of available C&S trainings. 3C-REN reviewed the list to determine which existing offerings to leverage and coordinated with the IOUs to deliver training. 3C-REN aimed to provide coverage not currently being provided by the IOUs, as well as services targeting HTR markets that may complement existing IOU resources. The majority of 3C-REN's C&S program activities were related to offering Energy Code and Green Building Standards trainings, Regional Forums, and the Energy Codes Coach service.

If 3C-REN observed gaps in IOU resources, 3C-REN notified the IOUs or prepared new materials to fill that gap. The PAs communicated training needs via email or regular coordination meetings. At quarterly meetings, they discussed trainings in development to prevent duplication of efforts. 3C-REN and IOUs shared event calendars, worked to identify appropriate contacts, confirm and share existing resources, and determine if resources should be jointly offered or built upon.

4.4 Participant experience and benefits

In this section, we focus on program benefits based on participant experiences. We used primary data we collected for this purpose. Understanding participant experiences helps shed light on how the REN programs align with CPUC objectives of ensuring that RENs benefit participants. Table 4-31 shows the data collection efforts, pool of interviewees, sample size, and topic areas associated with program experience that we analyzed. For the residential programs, we examined the motivations for program participation, reported benefits, and levels of satisfaction with overall and various program elements to understand the extent to which REN programs benefited participants. We used information from single-family and multifamily participant surveys and non-residential program IDIs for this purpose. The non-residential participant interviews collected information about the helpfulness and impact of program services, support, and features, as well as overall experience. In addition to directly asking about knowledge gained and use of program offerings, we assessed interviewees perception of how the programs expanded their professional networks and benefited HTR communities and DACs.

Table 4-31. Program experience topics and samples by data collection effort

Data collection targets	Respondents	Sample size	Topics
Single-family surveys	Homeowners and occupants	676	• Motivations • Benefits • Satisfaction
Multifamily surveys	Property managers	34	• Motivations • Benefits • Satisfaction
Kits for Kids IDIs	Teachers	5	• Satisfaction
SF NMEC IDIs	Contractors	2	• Benefits • Satisfaction
Public agency and commercial IDIs	Public agency and water utility representatives	22	• Helpfulness • Overall experience • Expanding network • Value of financing • Similar programs • Benefits to community
WE&T and C&S IDIs	Building and real estate professionals, contractors, and local government code officials	22	• Helpfulness • Overall experience • Additional training • Expanding network • Benefits to community

4.4.1 Summary findings

Residential participants were strongly motivated by rebates and incentives.	Single-family participants reported that they were drawn to participate in the programs because of the incentive and rebate opportunities (75%) and a desire to reduce their energy bills (68%) and carbon emissions (54%). Multifamily participants were motivated to participate by incentives and rebates (60%), a wish to reduce operation and maintenance costs (37%), and corporate policy or guidelines (35%).
Residential participants saw savings and improved comfort from the programs.	Single-family participants observed energy savings (61%) and bill reductions (42%) after participating in the program; a slight majority (58%) confirmed they had experienced improved comfort from the program. However, about 20% of single-family participants said that they did not see any benefits from participating in the program or were uncertain if they did. Approximately 75% of multifamily participants noted energy and bill savings from their participation, and close to one-half (49%) saw decreased operation and maintenance costs. Two 3C-REN SF NMEC contractors indicated that they were able to lower installation costs for customers because of program incentives. One confirmed that the program enabled them to better serve HTR and disadvantaged individuals. The other observed that the program expanded their professional network.
Residential participants had high levels of satisfaction with the programs.	Most single-family (84%) and multifamily (91%) participants were satisfied with their overall program experience. Single-family participants were most satisfied with the information they received, while multifamily participants expressed the highest satisfaction with their energy and/or cost savings. Teachers in SoCalREN's Kits for Kids programs were satisfied with all aspects of the program. They were noticeably satisfied with the support that they received from the program implementer, but they wished that the program offered more educational resources (and recalled some problems with the postcard submittal process). 3C-REN's SF NMEC contractors were satisfied with the program, program incentive amounts, and their interactions with a former Recurve representative. They reported discontent with the time it took to process program incentives.[74]
Public agency program participants gave consistently positive feedback.	When public agency program participants were asked about helpful aspects of program services and support, they emphasized the extensive assistance they received. Some even expressed that without the program's support, completing their projects would have been challenging. The program's commitment to delving into details—such as bids, measure specifications, incentive applications, and financing—was particularly valuable. This finding underscores the importance of thorough and dedicated program support for successful project implementation.

[74] As of March 2024, 3C-REN and its consultants are working to streamline incentive payouts. 2022 was the first year to pay incentives and required new protocols be established. Since then, efficiencies are in place to improve payment timelines.

The majority of WE&T and C&S program participants indicated that their overall experience was positive but identified a few challenges.

Generally, WE&T and C&S program participants appreciated learning new skills, being kept apprised of best practices and current events, and the programs' efforts to make complex or obscure information and content more accessible. However, one interviewee reported a challenge contacting program staff. Two interviewees noted difficulty attending live training due to schedule constraints, with one suggesting the need for on-demand training. When asked to identify the most helpful aspect of the program training, only one of the eight BayREN C&S program participants was able to pinpoint something specific. Specifically regarding WE&T and C&S programs, we found that some participants struggled to answer questions simply because too much time had passed since they participated, or they had trouble distinguishing REN program from other trainings.

4.4.2 Residential experience

DNV collected information about single-family, multifamily, and teacher participants' experiences via web and phone survey to gain insights on the motivations for participation, perceived benefits, and overall satisfaction with the program.

4.4.2.1 Motivations

Table 4-32 summarizes motivators of program participation. The majority of both single-family (75%) and multifamily respondents (60%) cited that incentives and rebates influenced their decision to participate in the program. Additionally, more than half of single-family respondents said their desire to reduce energy bills and carbon emissions also influenced participation. Across multifamily programs, a third of respondents confirmed that they were influenced by a desire to reduce operation and maintenance costs. For multifamily participants, a third also stated corporate policy or guidelines, which suggests again that RENs are effectively leveraging partnerships with property management companies and multifamily property-owner associations to get participants. Overall, only a third of multifamily respondents reported being influenced by a desire to benefit tenants, which further emphasizes the importance for these multifamily programs to ensure renter equity through requirements such as core-measures so that the benefits of participation also reach underserved tenants.

Table 4-32. Factors motivating program participation

Participation motivators	
Single-family participants	**(n=676)**
Incentives or rebates	75%
Reduce my energy bills	68%
Reduce carbon emissions, climate change, or good for the environment	54%
Other benefits (e.g., increase comfort, safety, convenience, decrease maintenance costs)	36%
Contractor recommendation	32%
Equipment that needed maintenance or replacement	28%
Family, friend, colleague, or neighbor recommendation	7%
Other	2%
Don't know	2%
Multifamily participants	**(n=34)**
Utility rebates / incentives	60%
Reducing operation and maintenance costs	37%
Corporate policy or guidelines or directive to participate	35%
Equipment failure or end of useful life	33%
Reducing carbon emissions / good for the environment	31%

Participation motivators	
Tenant benefits / appeal to renters (improve occupant comfort, reduce energy bills)	30%
Contractor recommendation	14%
Previous program participation	14%
Renovation / addition / remodel	14%

4.4.2.2 Benefits

Single-family and multifamily participants. Table 4-33 shows the variety of benefits from participation that respondents reported experiencing. In both single and multifamily programs, the majority of participants saw energy and/or bill savings from the program. Additionally, more than 40% of respondents indicated their participation led to increased comfort in their home. Overall, participants seem to feel they have benefited from participating in the program in a variety of ways. However, 20% of participants in the single-family program said that they did not feel they received any benefits from participating in the program or were uncertain if they did.

Table 4-33. Perceived benefits of program participation

Benefits from program	
Single-family participants	**(n=676)**
Energy savings	61%
Increased comfort (reduced drafts, quieter interior, manage interior temperatures, etc.)	45%
Bill reductions	42%
Improved safety (no gas leaks, better lighting, etc.)	23%
Decreased maintenance costs	16%
Other	5%
Don't know	11%
None of these	9%
Multifamily participants	**(n=34)**
Energy and bill savings	75%
Decreased operations and maintenance costs	49%
Increased comfort (reduced drafts, quieter interior, manage interior temperatures, etc.)	41%
Improved safety (no gas leaks, better lighting, etc.)	36%
Indoor air quality improvements	17%
Other	5%
Don’t know	3%

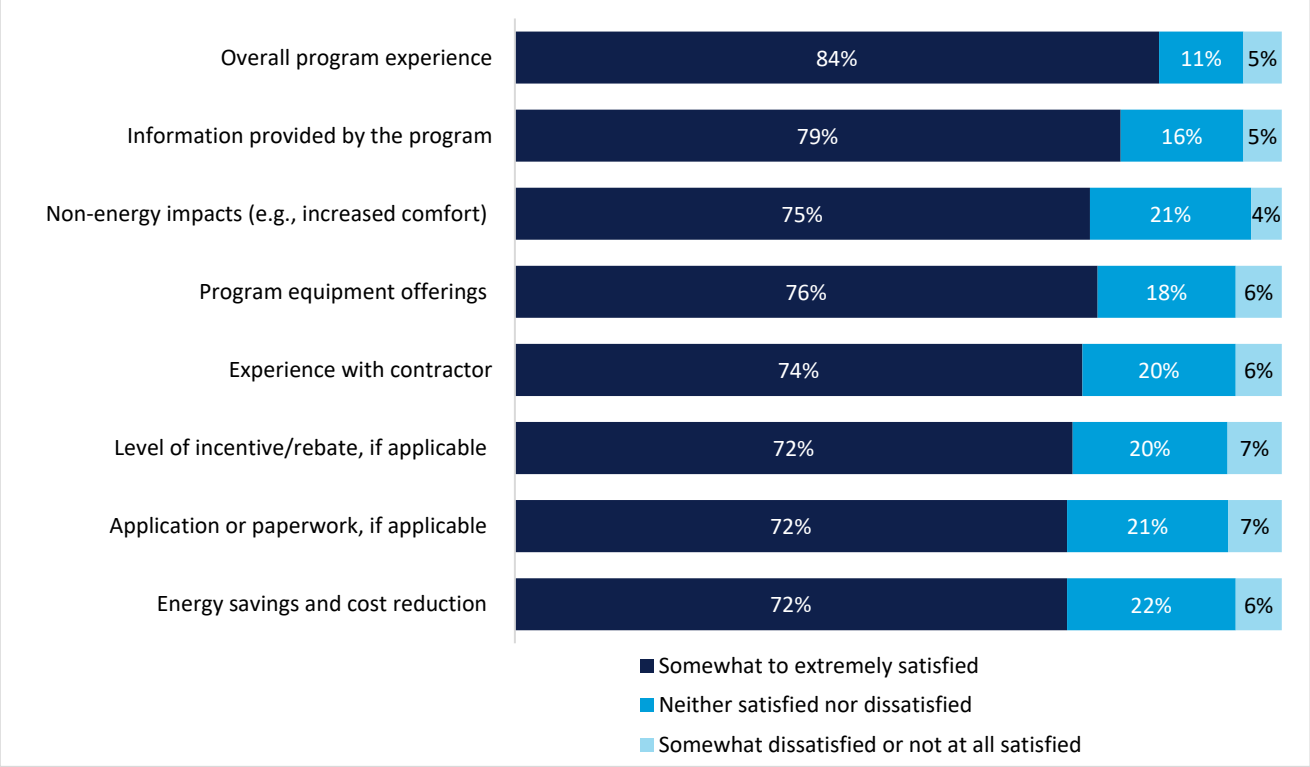
SF NMEC contractors. Both contractor interviewees reported that the 3C-REN SF NMEC incentives enabled them to lower installation costs for customers. When asked, only one of the two contractors confirmed that the program improved their ability to serve individuals who are HTR or disadvantaged. The interviewee also agreed that the program expanded their professional network. The other interviewee mentioned that the program yielded their company new customers.

4.4.2.3 Satisfaction

We asked single-family and multifamily participants, teachers participating in Kits for Kids, and contractors participating in 3C-REN’s SF NMEC program to rate their level of satisfaction with their overall program experiences and various aspects of the programs. Their ratings indicate that participants are quite satisfied with the programs.

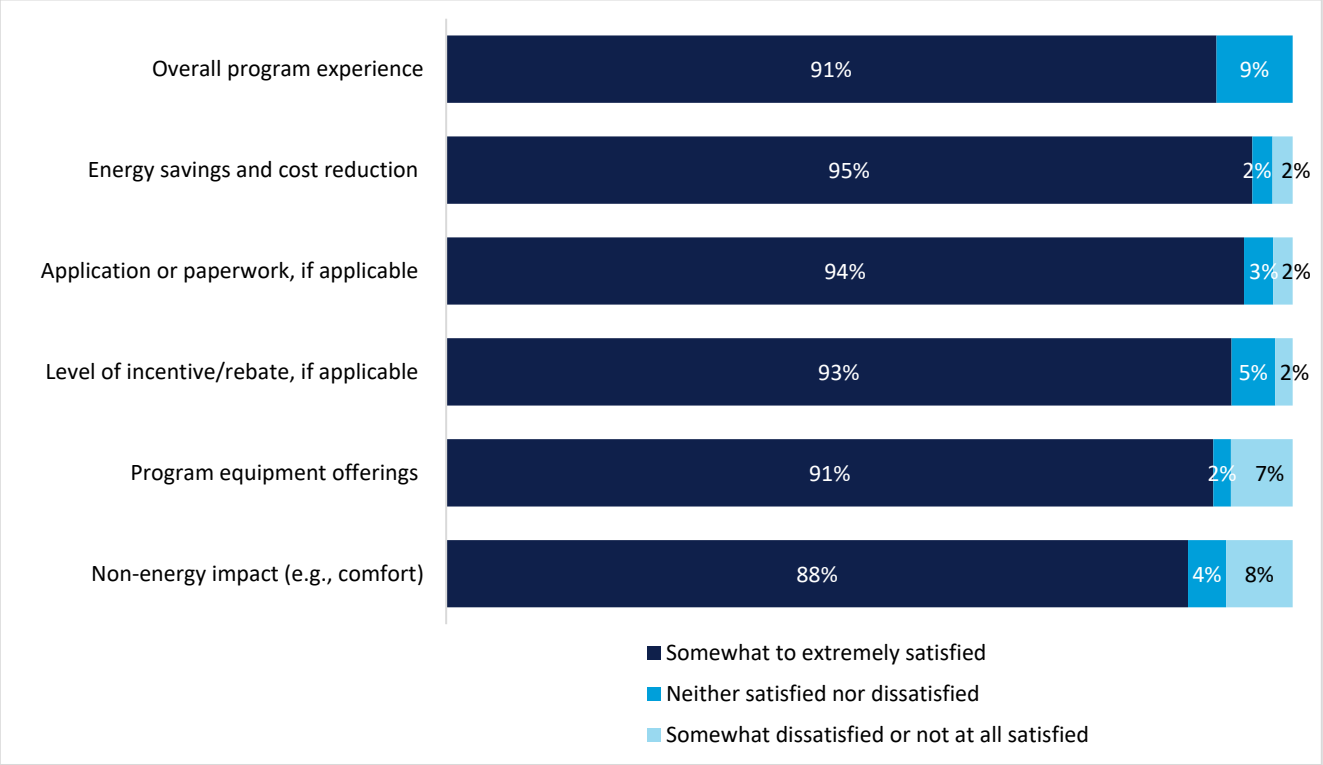
Single-family participants. As shown in Figure 4-5, 84% of single-family participants were *somewhat* or *extremely* satisfied with their overall program experience. Their ratings indicated that they were most likely to be satisfied with the information they received (79%). Compared to all other program aspects, participants were most likely to express some level of dissatisfaction with the levels of incentive (7%) and paperwork (7%).

Figure 4-5. Single-family program participant satisfaction (n=676)



Multifamily participants. As shown in Figure 4-6, 91% percent of multifamily program participants reported being *somewhat* or *extremely* satisfied. Those who were aware of their energy and/or cost changes were highly likely to report being satisfied with their savings (95% of 27). However, five of the 32 who answered this question said that they did not know if they their energy and/or cost changed (not shown); this may be an indication of the amount of time passing since measures were installed, respondents' relationship to bill payments, and/or their level of attention to energy costs. Compared to other program aspects, multifamily participants appeared least satisfied with non-energy impacts (8%) and equipment offerings (7%).

Figure 4-6. Multifamily program participant satisfaction (n=34)



Sample sizes vary by question because bases exclude "Don't know" responses. On average, three respondents said "Don't know" to the questions.

Kits for Kids teachers. Using a scale from 1 to 5, with "1" being not at all satisfied and "5" being extremely satisfied, all five Kits for Kids teacher interviewees rated the overall program a "5." As shown in Table 4-34, interviewees were pleased with all aspects of the program. They were particularly satisfied with the support that they received from the program implementer (4.8, on average). In the words of one interviewee, "If we needed anything, [REN program staff] were available, and it was a great program for the kids."

Table 4-34. SoCalREN Kits for Kids program satisfaction among participating teachers

Program element	Average rating	Count of "extremely satisfied" interviewees (n=5)
Overall program	5.0	5
Online postcard verification process	4.6	4
Support for engaging students	4.4	2
Instructions for distributing kits	4.6	3
Support from REN/implementer	4.8	4

The teachers remarked on how enthusiastic and engaged the students and their families were, noting the recipients' eagerness to save money and energy and help the community and environment. However, two teachers wanted to supplement that enthusiasm with more educational resources. One recalled, "[Students] were really excited about the box, but then, for more information, I was on my own to find stuff that was interesting. They had the cute little monsters, but the kids would have liked more."

While four out of five teachers rated the online postcard verification process a "5", three teachers reported less than perfect experiences with or perceptions of the postcards. One teacher noted receiving two postcard types (one through the kits and one distributed to the teacher). The teacher explained that the students and parents were confused about which postcard to submit. Another teacher expressed disappointment that the grant went to the school, not to their classroom. The interviewee recommended better communication on that logistic.

SF NMEC contractors. Both 3C-REN SF NMEC program contractor interviewees reported that they were satisfied with program incentive amounts. While both commented that the incentive was beneficial, the length of processing time was not ideal. One observed that another local program processed payments within 20 days, while 3C-REN took 45 to 75 days.[75] Both interviewees reported being extremely satisfied with their interactions with the third-party implementer representative (who had since left the company). One referred to the former employee as "responsive," and the other reflected that the representative "made the process quite a bit smoother"; this interviewee later suggested that the program offer a contractor liaison. The other shared that they had a little confusion around making calculations, but they found that the third-party implementer employee was helpful: "As long as there is someone who can help, it is all good." In the words of one interviewee, "Overall, it's been a positive experience, especially for a brand-new program."

4.4.3 Public agency and commercial experience

In this section, we report public agency and commercial program participants' responses to DNV evaluators' questions about their experiences with the programs. We begin by summarizing our findings and then provide details by topic area. Table 4-35 shows the research questions we addressed and the associated interview topics.

Table 4-35. Public agency and commercial program interview topics mapped to research questions

Research questions	Interview topics
How do REN programs "demonstrate new and unique value toward California's energy, climate, and equity goals"?	• Helpfulness of services and support • Overall experiences • Impact on participants' energy-efficiency and other networks • Value of financing
How do REN programs complement or overlap with other programs available to program participants?	• Similar programs
Where and who are the customers that the REN programs reach? Are RENs reaching HTR customers and disadvantaged communities?	• Benefits to community

As shown in Table 4-36, we conducted 22 interviews with participants across six public agency and commercial programs, which represents 14% of the population of participants. SoCalREN program participant interviewees were public agency representatives and the BayREN WUSave participant represented a municipal water utility. Given that participation in

[75] As of March 2024, 3C-REN stated that the incentive timeframe has been reduced to approximately 30-45 days. Initial payment delays were due to program start up.

BayREN's SMB Commercial program was limited (only two participants in PY2022), we did not interview those participants as part of this evaluation.

Table 4-36. Public agency and commercial program interviewee sample

Program	Sample frame	Interviewees
BayREN WUSave	2	1
SoCalREN RLF	4	4
SoCalREN EE PDP	110	5
SoCalREN DER DAC	31	5
SoCalREN PA NMEC	6	4
SoCalREN PA SSP	3	3
Total	**156**	**22**

When asked to identify helpful aspects of program services and support, public agency program participants remarked on the extent of support that they received. Some reflected that they would not have been able to complete projects in the absence of the program's support, underscoring the value of the programs' willingness to dive into details on bids, measure specifications, applications for incentives and financing, and more. Interviewers gave program participants the opportunity to share more about their overall experiences in the programs. As shown in Table 4-37, their responses were consistently positive. Further, participants regularly caveated or downplayed negative feedback.

Table 4-37. Public agency and commercial program participant reported overall experiences

Program	Overall experience themes
BayREN WUSave	• Satisfied with results despite minimal savings • Found participation process easy and positive • Concluded it was a worthwhile experience
SoCalREN RLF	• Appreciative of financing and step-by-step support • Hopeful to participate again in the future
SoCalREN EE PDP	• Thrilled with hands-on support • Impressed with responsiveness • Appreciated flexibility on timelines
SoCalREN DER DAC	• Appreciated helpfulness • Impressed with responsiveness and availability • Hopeful to participate again in the future
SoCalREN PA NMEC	• High opinion of program staff • Program liaisons integrated well with county staff • Valued design expertise • Able to trust recommendations
SoCalREN PA SSP	• Appreciated helpfulness • Hopeful to participate again in the future • Great to work with program staff

Nine of the 22 public agency and commercial program participant interviewees recalled participating in similar programs when asked (Table 4-38). Interviewers asked the participants to describe the other programs and identify how those programs differed from the REN program. None of the participants drew pointed comparisons between the operations or structures of REN programs and the other programs.

Table 4-38. Public agency and commercial program participant reported participation in similar programs

Program	Interviewees	Reported participating in similar program (count of interviewees)
BayREN WUSave	1	1
SoCalREN RLF	4	2
SoCalREN EE PDP	5	2
SoCalREN DER DAC	5	1
SoCalREN PA NMEC	4	1
SoCalREN PA SSP	3	2
Total	**22**	**9**

Two-thirds of SoCalREN interviewees confirmed that the public agency program services and offerings expanded their professional and/or energy efficiency networks (Table 4-39). They specifically mentioned connecting with representatives from other cities, contractors, service providers, and desktop reviewers. We did not ask BayREN WUSave participants about the impact of the program on their networks given its program design.

Table 4-39. Public agency program participant observations of expanded networks

Program	Interviewees	Observed expanded network (count of interviewees)
SoCalREN RLF	4	3
SoCalREN EE PDP	5	1
SoCalREN DER DAC	5	5
SoCalREN PA NMEC	4	3
SoCalREN PA SSP	3	2
Total	**21**	**14**

Interviewers explained how REN public agency and commercial programs sought to help serve members of communities that face a combination of economic, health, and environmental burdens. As shown in Table 4-40, many interviewees (17 of 22) confirmed that the program benefitted burdened communities. Interviewees often drew connections between lowering energy bills or saving money on big projects resulting in more funds to support or offer services to their constituents. Aligning with the SoCalREN DER DAC program's focus, all DER DAC interviewees (five of five) observed this change.

Table 4-40. Public agency program participant observations of benefits to community

Program	Interviewees	Observed benefits to community (count of interviewees)
BayREN WUSave	1	1
SoCalREN RLF	4	3
SoCalREN EE PDP	5	2
SoCalREN DER DAC	5	5
SoCalREN PA NMEC	4	3
SoCalREN PA SSP	3	3
Total	**22**	**17**

When it comes to the value of program financing, two SoCalREN RSF participant interviewees indicated that their projects were possible due to the upfront 5-year, no-interest loan. However, when asked, none of the RSF participant interviewees reported increasing project scope due to RSF financing.

4.4.3.1 Helpfulness of services and support

Interviewers asked public agency interviewees to specifically comment on the helpfulness of services and support relevant to the program's respective design.

SoCalREN RLF program. DNV asked the four SoCalREN RLF participants to describe the financing guidance and support they received and how the RSF program impacted the agency more broadly. A few interviewees' responses indicated that the program's efforts were valuable. One interviewee shared, "It has helped us a lot" in that the program provides "free consultants." Another interviewee said they would not have upgraded their blower without program financing: "the upgraded blower will allow us to operate cleaner and use less energy. The board probably would not have given [approval] without the incentives/financing." The third interviewee seemed to imply, yet not explicitly assert, that they may pursue other projects in the future simply because they know the program is available.

SoCalREN EE PDP. SoCalREN EE PDP participants frequently recalled receiving support with *energy use analysis or audits*, *technical performance specifications and scope of work or staff approvals*, and *incentive and financing application support*. When asked to identify the most helpful aspects of the program services or support listed in Table 4-41, interviewees broadly appreciated receiving expertise, learning new information, and gaining concrete evidence for their assumptions. One EE PDP interviewee reflected, "To see that what we anticipated for the savings was right was very helpful."

Given the SoCalREN EE PDP focus, we asked if the program's support had increased their agencies' capacity to perform activities in the future without the program support. Interviewees were more likely than not to perceive that the program had increased their capacity to perform *energy use analysis or audits*. In contrast, only one of four interviewees felt that their agency's capacity for drawing its *own technical performance specifications and scope of work or staff approvals* had increased despite receiving that service.

Table 4-41. SoCalREN EE PDP helpfulness according to participants (n=5)

EE PDP service or support	Received service (count of interviewees)	Increased capacity (count of interviewees)	Helpful aspects according to interviewees
Energy use analysis or audits	5	4	• Determining fit in program • Sense of scope and specifications
Technical performance specifications and scope of work or staff approvals	4	1	• Technical knowledge • Knowledgeable third parties • Rapid turnaround
Incentive and financing application support	4	2	• Learning about opportunities • Good matching with vendors
Project management support	3	2	• Assistance finding available incentives • Exposure to expertise
Financial analysis	2	2	• Confirming anticipated savings • Understanding financial viability
Procurement support	1	1	• Free expert help • Verified assumptions

SoCalREN DER DAC program. As shown in Table 4-42, SoCalREN DER DAC participants most frequently confirmed receiving *technical performance specifications*, *incentives and financing application support*, and *energy audits* from the program. When asked to specify what aspects of certain program services were most helpful, the five interviewees appeared to generally appreciate how the program was willing to dive into details and lead pivotal tasks, such as designing projects, preparing entire bids, and reviewing measure details. They seemed particularly pleased with the help they received on incentive and financing applications. Remarking on the program's helpfulness, one interviewee shared, "because they are part of the process, they can often help us find other money if not enough is available through a given program." Another concluded, "I'm not sure if we would have been able to finance without it. [Program liaisons] helped the board make the decision to invest with this support."

Table 4-42. SoCalREN DER DAC program helpfulness according to participants (n=5)

DER DAC service or support	Received service	Helpful aspects according to interviewees
Technical performance specifications	5	• Guidance during contracting • Ensuring correctness • Measure and spec design
Incentive and financing application support	4	• Identifying incentive eligibility • Submitting application on time • Finding opportunities • Convincing board to invest with the support
Energy audits	4	• Benchmarking energy consumption • Identifying the DAC in the area
Project management	3	• Conducted coordination calls
Procurement support and bid analysis	3	• Reviewed equipment for performance and minimum efficiency requirements • Provided data for procurement • Bid preparation
Technical engineering	2	• Performed all technical engineering • Established all specs

SoCalREN PA NMEC program. As shown in Table 4-43, all four SoCalREN PA NMEC interviewees confirmed receiving *incentive and financial analysis support* and *technical performance specifications* from the program. Interviewees pointed to the helpfulness of the program's efforts to estimate savings, ensure proper installations, and identify opportunities. One interviewee found the program particularly helpful with the final project completion reports: "By ensuring that what was constructed was by design and approved, then we could ensure the energy savings calcs were good." Another participant summarized, "They do an audit, determine how to save energy, and calculate what to replace and how much energy it will save. We don't have the ability to do this on our own."

Table 4-43. SoCalREN PA NMEC program helpfulness according to participants (n=4)

PA NMEC service or support	Received service	Helpful aspects according to interviewees
Incentive and financial analysis and support	4	• Estimating energy savings • Found many opportunities • Financial analysis
Technical performance specifications	4	• Determined if technical criteria were met • Equipment recommendations
Project scoping and management	3	• Calculations for scoping • Estimating energy savings • Identifying savings opportunities
Savings verification	3	• Final project inspection and analysis
Construction support	2	• Final project completion reports • Verifying that construction reflected design
Procurement assistance	2	• Coordination support • Time savings
Training for facility personnel	0	N/A

SoCalREN PA SSP program. As shown in Table 4-44, the SoCalREN PA SSP program participant interviewees were enthusiastic about the support that they received. One participant underscored the gravity of SoCalREN's role in compensating for their agency's shortcomings, "They helped us manage the project and ensure what's needed to be done is done. We don't have a robust staff that specializes in what SoCalREN does. Our maintenance staff can't be everywhere at once." Another interviewee applauded the extent of involvement, in terms of finding contractors to create SOWs, estimating costs and incentives, and answering technical questions. The third interviewee noted that the program was helpful with project planning, but the interviewee was primarily focused on the value of the financial benefit.

Table 4-44. SoCalREN PA SSP helpfulness according to participants (n=3)

PA SSP service or support	Received service	Helpful aspects according to interviewees
Incentive and financial analysis and support	3	• Estimating costs and incentives
Project scoping and management	3	• Project planning • Finding contractors to create SOWs • Ensuring completion of steps • Compensating for limited staffing
Technical performance specifications	2	• General technical assistance • Engineering and calculations • Finding contractors to answer questions

4.4.3.2 Overall experience

After asking about the helpfulness of program services and support, we gave program participants the opportunity to share more about their overall experiences in the programs. Their responses were consistently positive. Respondents reiterated their appreciation of the program's helpfulness in terms of services and support, which compensated for their agencies' limited capacities. The participants found program staff to be "great partners" and the "utmost professional," applauding staff responsiveness and technical expertise. Some participants voiced enthusiasm to participate again in the future. Further, participants regularly caveated or downplayed negative feedback.

BayREN WUSave. The municipal representative who participated in BayREN WUSave responded that while savings from program measures were minimal, the interviewee was still satisfied with the results. They concluded that "it's a good program" and participating was "worth our time." The interviewee emphasized that BayREN completes most of the work, making the process easy and positive.

SoCalREN RLF. The four SoCalREN RLF participant interviewees were eager to share how pleased they were with their program experiences. They were appreciative of the program overall, but also specifically with the financing itself and the "step-by-step" support that they received. Two added that they were hopeful that they would participate again in the future. In the words of one participant, "Overall, it really was wonderful for us. We were able to take a situation that we were struggling to take care of and fix it right away."

SoCalREN EE PDP. Four of the five SoCalREN EE PDP participant interviewees shared positive reactions to their overall program experiences. Their attitudes were colored by the hands-on support that they received, reiterating that they would not have the capacity to implement the projects without SoCalREN's services. Two were impressed by the implementer's responsiveness. One participant appreciated the program's flexibility on timelines but still wished for even greater flexibility: "More flexibility on time and products might have helped, but [SoCalREN] did a great job of being flexible with us, so I am not upset about it."

SoCalREN DER DAC. The five SoCalREN DER DAC participants we talked with appeared quite pleased with their experiences, calling the program "great" and characterizing program staff as "awesome people." When asked to reflect on their overall experience, three of the five interviewees reiterated their appreciation of the program's helpfulness. Additionally, one participant emphasized the program's responsiveness and availability. Two interviewees volunteered that they would participate again, with one asserting a preference to work with SoCalREN only. Another interviewee summarized, "There were hoops we had to jump through, but it was great"; however, the interviewee did not describe those hurdles.

SoCalREN PA NMEC program. The four SoCalREN PA NMEC participants we interviewed spoke highly of the program staff, in particular. One interviewee called program staff the "utmost professional," finding that program staff integrated well with the interviewee's county staff. Two participants pointed specifically to the value of the design expertise that they received. One expressed the trust that they felt with SoCalREN: "if you only meet with a salesperson, they might oversize or sell something you don't truly need."

SoCalREN PA SSP program. Two of the three SoCalREN SSP participant interviewees pointed to the program's helpfulness when we asked about their overall experience. In fact, both called the program "very helpful." The third interviewee did not have more to share about their overall experience, but they previously referred to the program liaison's involvement as "very helpful." One participant also expressed a wish for the program to continue. Another called PA SSP their "go-to program," remarking that they have never had an issue with SoCalREN – "always great to work with."

4.4.3.3 Expanding networks

Many SoCalREN participants confirmed that the public agency program services and offerings expanded their professional and/or energy efficiency networks. They specifically mentioned connecting with representatives from other cities, contractors, service providers, and desktop reviewers.

Notably, all five of the SoCalREN DER DAC interviewees reported that their networks expanded due to the program. One interviewee explained, "I met more service providers even though I have been in the industry for a long time. I didn't know much about energy networks [before participating]. The Energy Coalition always has people I can reach out to for advice, [so] I don't need to hire an outside consultant." In contrast, only one of five SoCalREN EE PDP participant interviewees observed that their networks expanded. These two non-resource programs are quite similar in their offerings; however, DER DAC is limited to DAC communities.

Three SoCalREN PA NMEC participants noticed their networks expanded. They reported meeting peers from neighboring cities to compare notes and working more frequently with desktop reviewers.

4.4.3.4 Value of financing

When asked to identify the most attractive feature of the SoCalREN RLF program, one participant said that it allowed their agency to complete the project all at once instead of two phases, which saved money because the RLF provided all the necessary funds upfront through a 5-year, no-interest loan. Another RLF participant shared how their wastewater treatment plant was able to complete a blower project because they received the no-interest loan and an energy efficiency incentive.

Two of the four SoCalREN RLF participants confirmed that the funds and support they received through the RLF changed the scope of their energy efficiency projects. Unfortunately, in those interviewees' explanations they appeared to conflate the RLF with incentive opportunities. For example, one interviewee described how their organization forewent upgrades due to measures not being eligible for incentives. The other interviewee recalled how they minimized the scope of a project so that they "made the money work for the grant." However, that interviewee later reflected that they probably would not have upgraded their blower at all without program financing. Neither reported increasing a project's scope due to RLF financing.

4.4.3.5 Similar programs

While some public agency and commercial program participant interviewees recalled participating in similar programs, their comparisons between those programs and the REN program were primarily observational rather than critical:

- The BayREN WUSave participant interviewee's organization has been updating all HVAC and water meters over a 3-year period through PG&E's Turnkey program. The participant acknowledged that WUSave is much smaller than that of PG&E.
- One SoCalREN RLF participant interviewee appreciated the value of the RLF 0% loan, but they referred to SCE's on-bill financing as *especially* helpful.
- A SoCalREN DER DAC interviewee shared, "There are so many programs out there and they can be hard to find and determine eligibility for." In the interviewee's eyes, SoCalREN eased this uncertainty by directly reaching out to local governments.
- A SoCalREN PA SSP participant explained how SoCalREN could not "do programs with cities," so their organization participated in CPUC's Self-Generation Incentive Program where they received support installing battery storage and solar in parks. Nonetheless, throughout the interview, this interviewee was particularly effusive of the PA SSP, underscoring the reliance their organization has placed on it.

4.4.3.6 Benefits to community

Interviewers explained how the programs' goals were to help serve members of communities that face a combination of economic, health, and environmental burdens. Many public agency program participant interviewees (16 of 21) confirmed that the program is helping communities in need. For the most part, interviewees drew connections between lowering energy bills or saving money on big projects and having more funds to support or offer services to their constituents.

BayREN WUSave. The BayREN WUSave participant interviewee did not describe how the program helped their organization's ability to serve the community. However, the interviewee observed that WUSave makes a concerted effort to engage the Hispanic community and those living in large apartment buildings. They also noted that marketing materials are always in Spanish and English.

SoCalREN RLF. Three of the four SoCalREN RSF participants confirmed that the program has helped their agency provide benefits to communities that face a combination of economic, health, and environmental burdens. One interviewee asserted that their organization would not have been able to complete the project that benefits the community without the program financing and engineering help. Another interviewee shared that the most recent project was in a community center for seniors and other disadvantaged constituents. The third concluded that reducing the agency's costs enables them to fund other needs within the community.

SoCalREN EE PDP. Two of the five SoCalREN EE PDP participants agreed that the program benefits these communities. The concept of this goal had already resonated with a participant who was early in the participation process: "We are in one of the wealthiest areas in California, [so] there is definitely an economic burden [due to high costs of living] for many people participating in these programs." The other interviewee said that the program enabled the city to allocate more funding for health, safety, etc.

SoCalREN DER DAC. All five of the SoCalREN DER DAC participants confirmed that the program has helped their agency provide benefits to burdened communities. This is not surprising given that the program is only available to agencies serving DAC, rural, and low-income communities. Four of the five spoke of the indirect benefit—by lowering energy bills and saving money, the agencies have more funds to support their constituents. In one participant's words, "Since we are such a small area, any money we can save is passed right along." Another interviewee added that the program has created jobs in the community because their agency seeks bids from local contractors to do projects.

SoCalREN PA NMEC. Three of the four SoCalREN PA NMEC program participants confirmed that the program has helped their agency provide benefits to communities that face a combination of economic, health, and environmental burdens. One interviewee asserted that, by virtue, the projects they complete are in DACs, so the program has assisted them in this way. The remaining two participants pointed to the lessened financial burden placed on constituents because of the program incentives and lower energy spending.

SoCalREN PA SSP. All three SoCalREN PA SSP participant interviewees agreed that the program has helped their agency support burdened communities. One interviewee reported that by switching from gas to electric heat pump water heaters, their organization is helping improve indoor air quality. Another explained how the savings in funds benefits the community: "In the sense that they are allowing us to move forward to improve efficiency, then our money is able to go towards other areas of greater need." The third interviewee added how the program has given them ideas of how to help residents save energy.

4.4.4 WE&T and C&S experience

This section includes our analysis of WE&T and C&S program participants' responses to DNV evaluators' questions about their experiences with the programs. Table 4-45 shows the research questions we addressed and the associated interview topics. We begin by summarizing our findings and then provide details by topic area.

Table 4-45. WE&T and C&S program interview topics mapped to research questions

Research questions	Interview topics
How do REN programs "demonstrate new and unique value toward California's energy, climate, and equity goals"?	• Helpfulness and impact of trainings • Overall experiences • Impact on participants' energy-efficiency and other networks
How do REN programs complement or overlap with other programs available to program participants?	• Additional training
Where and who are the customers that the REN programs reach? Are RENs reaching HTR customers and disadvantaged communities?	• Benefits to community

As shown in Table 4-46, we conducted 22 interviews with program participants across five WE&T and C&S programs. This represents 1% of the population of participants who included building and real estate professionals, contractors, and local government code officials. Eighteen of the 22 interviewees confirmed that they completed (not just attended) the program trainings.

Table 4-46. WE&T and C&S program participant interviewee sample

Program	Sample frame*	Interviewees	Completed REN program training
BayREN C&S	368	8	5
BayREN Green Labeling	194	5	5
SoCalREN WE&T	145	1	1
3C-REN WE&T	553	3	2
3C-REN C&S	423	5	5
Total	**1,683**	**22**	**18**

*Sample frame sizes shown do not reflect all participants: BayREN Green Labeling population includes real estate professionals only and the SoCalREN WE&T population excludes youth participants.

Interviewers' questions about the helpfulness and impact of WE&T and C&S program trainings and resources varied by program. In some cases, we asked participants about the helpfulness of the respective program overall. In other cases, we asked participants about specific program features or training topics. Overall, many (16 of 22) WE&T and C&S program participants indicated that they gained knowledge from the program or at least one program feature. Slightly fewer (13 of 22) still use some type of tools or the knowledge that they learned from the program.

Table 4-47 shows some of the key aspects that the interviewees found helpful. The variation in their responses likely reflects the breadth of information and diversity of services and features that the REN WE&T and C&S programs offer. Generally, participants appreciated the new skills they learned, being kept apprised of best practices and current events, and the programs' efforts to make complex or obscure information and content more accessible.

In general, we found that some WE&T and C&S interviewees struggled to answer questions simply because 1) too much time had passed since they participated or 2) they had trouble distinguishing the REN program from other trainings. We also screened out some interviewees (not included in the table) because they did not recall participating at all. This finding may account for the fact that out of eight BayREN C&S participants interviewed, only three felt that the program had increased their knowledge or continued to use tools or knowledge they acquired during training.

Table 4-47. WE&T and C&S program helpfulness and impact according to participants

Program	Interviewees	Increased knowledge	Still use tools or knowledge	Helpful aspects
BayREN C&S	8	3	3	• Excel tool for calculating residential electrical load
BayREN Green Labeling	5	5	2	• Assessing smart homes • Importance of weatherization • Valuation of green properties • Availability of technology and rebates
SoCalREN WE&T	1	1	1	• Costs to consider in procurement • Better, newer, and easier ways to conduct business
3C-REN WE&T	3	3	3	• Knowledge of specific measures and materials • Learning best practices and installation techniques • Understanding regional implications of code changes
3C-REN C&S	5	4	4	• Real-time knowledge • Simplification of complex content
Total	**22**	**16**	**13**	

We gave WE&T and C&S participants the opportunity to share additional information about their overall experience in the program. As shown in Table 4-48, their comments were positive, applauding the value of the programs as resources for staying up to date on important information. They also remarked on the professionalism and knowledge of instructors and program staff. Only one interviewee seemed to have a negative experience, reporting a challenge contacting BayREN C&S program staff. Two BayREN C&S interviewees noted difficulty attending live training due to schedule constraints; one suggested on-demand training videos.

Table 4-48. WE&T and C&S program participant reported overall experiences

Program	Overall experience themes
BayREN C&S	• Useful for learning of industry and regional updates • Challenge contacting staff • Problems of live training conduciveness to schedules
BayREN Green Labeling	• Good training • Knowledgeable instructor
SoCalREN WE&T	• Gratefulness for program
3C-REN WE&T	• Organized • Superior to other workshops • Approachable and helpful staff
3C-REN C&S	• Excellent resource for learning • Knowledgeable staff

Table 4-49 shows interviewees' comparisons between the REN's WE&T and C&S training programs and other training programs. 3C-REN participants appeared to find 3C-REN program staff more knowledgeable and the 3C-REN content more relevant than that of other programs. Some interviewees' comments implied that the REN programs take a broader, higher-level approach than other programs, but this is likely due to the fact that trainings may be intended to focus on different topic areas.

Table 4-49. WE&T and C&S program participant reports of additional training

Program	Interviewees	Interviewees receiving outside training	Comparison to other training programs
BayREN C&S	8	8	• Less academic • Broader range of topics • Harder to reach staff
BayREN Green Labeling	5	0	N/A
SoCalREN WE&T	1	1	• Less specificity on a single topic
3C-REN WE&T	3	2	• More local knowledge
3C-REN C&S	5	1	• More current and relevant • More knowledgeable staff
Total	**22**	**12**	

Six of nine SoCalREN and 3C-REN participants confirmed that the WE&T and C&S programs expanded their professional and/or energy efficiency networks. A 3C-REN WE&T interviewee shared that in-person events, such as those hosted by California Green Business Network, offer a greater opportunity for networking.

We asked WE&T and C&S participants if the program has improved their ability to serve individuals who are HTR or disadvantaged or SMV/DBE contractors. Nine of 17 confirmed that it did. They explained how the programs brought information to local jurisdictions, enabled public agency staff to pass on knowledge to the workforce, as well as contributed to improving residential and community spaces. One dissenting 3C-REN interviewee stated that materials and webinars should be in other languages, including Spanish and Tagalog; moreover, from their perspective, hosting in-person trainings (versus virtual) may be more effective for reaching diverse communities.

4.4.4.1 Helpfulness and impact of trainings and resources

Many (16 of 22) WE&T and C&S program participants indicated that they gained knowledge from the program or at least one program feature. Slightly fewer (13 of 22) still use some type of tools or the knowledge that they learned from the program. Generally, participants appreciated the new skills that they learned, being kept apprised of best practices and current events, and the programs' efforts to make complex or obscure information and content more accessible.

BayREN C&S. When asked to identify the most helpful aspect of the program training, only one of the eight BayREN C&S participants interviewee was able to pinpoint something specific, recalling that it was helpful for learning about the latest code updates. BayREN's C&S program provided other services or tools as well besides the training. Three participants recalled using one of these. One interviewee recalled using BayREN's Excel tool for calculating residential electrical load, volunteering that the tool was useful. Three of the eight interviewees confirmed that they are still using the knowledge and tools they gained from the training.

BayREN Green Labeling. Participants' perceptions of the most helpful aspects of the Green Labeling training varied:

- One interviewee explained that it was helpful to learn about assessing smart homes.
- Another interviewee was appreciative of learning the importance of weatherization measures, "You can add smart devices to a house, but if it [has air] leaks, then you are defeating the purpose."
- One interviewee recalled that a specific breakout session involving valuating "green" properties was particularly helpful.
- Another interviewee thought that learning what technology and rebates were available was valuable.

Two of these interviewees added a caveat that all aspects of the training were helpful.

All five Green Labeling participants confirmed that the training increased their knowledge about residential energy efficiency. Two reported that they have used and still use that knowledge. They explained that the training gave them the ability to support their clients—they were now able to guide clients on ways to make their homes more efficient, recognize if actions will add value, and direct clients to resources for getting started or to the availability of programs. Among those who have not used their new knowledge, one interviewee explained it is because their clientele are commercial entities—this interviewee later suggested that the program offer trainings geared towards commercial appraisers.

SoCalREN WE&T. The SoCalREN WE&T program interviewee recalled learning about green building standards, public sector bidding and estimating principles, procurement processes, contract and labor compliance, and project management through the WE&T training. The participant reported that they still use the knowledge and tools that they gained for all topics, generally reflecting how the training opened her eyes to new, easier, and better ways of getting the work done. The interviewee was impressed with the revelations around procurement building, "You learn the cost of business. Transparency is phenomenal." She noted that she uses the information she learned about contract and labor compliance "almost daily."

3C-REN WE&T. All three 3C-REN WE&T interviewees found the topics covered increased their knowledge and confirmed that they still use the information that they learned. Table 4-50 shows the aspects of the trainings that they identified as helpful. One interviewee shared, "I've had to reiterate some of this information to public county employees, so understanding it well has been very helpful." The three interviewees appreciated that they were able to learn about specific measures and materials, best practices, renewable energy, proper installation techniques, regional implications of code changes, and more. In the words of one interviewee, "Understanding the new changes that are happening in the [county and city has been helpful] – more standards than just what the state is doing, and understanding what that that means in terms of housing development or renovations or upgrades that are more than 'x' amount of square feet of market expansion of the house."

Table 4-50. 3C-REN WE&T helpfulness according to participants

Training topics	Received training	Increased knowledge	Still use	Helpful aspects to learn
Energy efficiency	3	3	3	• Basics of HVAC • Identifying simple measures • Electrification details
High-performance buildings	3	3	3	• Characteristics of materials for high-performance building • New construction best practices • Inspection and "starting" requirements
ZNE-readiness	1	1	1	• Renewable energy
Building science	3	3	3	• How installation works • Moisture management and thermal bridging
Energy codes	3	3	3	• New changes in region • Implications on housing development, renovations, or upgrades

3C-REN C&S. As shown in Table 4-51, the 3C-REN C&S participant interviewees valued how program resources provide them with timely information and help them interpret dense code content. One remarked, "One of the things that helps is that [the Energy Code Coaches] grab information from the book or code and translate it into 'English.' It can be hard to understand the book or code."

Table 4-51. 3C-REN C&S helpfulness according to participants

Feature	Used	Increased knowledge	Still use	Helpful aspects
Energy Code Coach	1	1	1	• Responsiveness • Simplify challenging content • Guidance for handling unique situations
Training webinars	3	3	2	• Timely topics • Staying apprised of Title 24 and building envelope
Energy code forums	1	1	1	• Learn what is happening in the field • Real-time knowledge
Online code resources	2	2	2	• Ability to access content from past trainings • "Central hub"

4.4.4.2 Overall experience

We gave WE&T and C&S participants the opportunity to share additional information about their overall experience in the program. Their comments were positive, applauding the value of the programs as resources for staying up to date on important information. They also remarked on the professionalism and knowledge of instructors and program staff.

BayREN C&S. BayREN C&S program participant interviewees generally had positive comments about the program, referring to it as "a great outfit" and "an important interface" for staying in tune with regional changes. Some C&S participants identified opportunities for improvement or negative feedback. One interviewee was frustrated with the trouble they had reaching BayREN staff for support. This same interviewee also made a general observation about BayREN, saying that "BayREN is asking for more but giving less"—assessing that the program rebates are low, but requirements are high. The interviewee opined, "Training is never going to be successful if the program is not attractive." Two other interviewees noted the challenge of attending live training, and one suggested on-demand training videos.

BayREN Green Labeling. Three of the five BayREN Green Labeling interviewees volunteered information when given the opportunity to share additional comments about their overall experience. One interviewee summarized, "It was a good training… It was nice that it was put on," and another applauded the instructors' knowledge and ability to explain concepts. A third interviewee observed gaps in instruction about heat pump installation, usage, and rebate instruction, but it appeared that this interviewee may have been, in part, commenting on their own experience in a residential rebate program.[76]

SoCalREN WE&T. The SoCalREN WE&T program interviewee simply expressed gratitude for the program: "Thank you for being there for us."

3C-REN WE&T. 3C-REN WE&T participants had great overall experiences. One interviewee referred to the program as the "best organized" program that is "superior to any other workshop." That interviewee was also impressed with the extent of the offerings. Another interviewee shared, "the staff are very approachable and helpful."

[76] We only interviewed realtors or real estate appraisers who completed the certification training.

3C-REN C&S. When given the opportunity to comment on their overall experiences, 3C-REN C&S participant interviewees provided positive feedback. In the words of one, “I’m really impressed with it. It's my ‘go-to’ for codes and standards information.” Another interviewee applauded the depth of the instructors’ knowledge and professionalism, concluding “I really hope they can continue funding these programs as they are greatly needed.”

4.4.4.3 Additional training

Twelve of the WE&T and C&S program participant interviewees reported receiving additional training through their employer or another program. Some offered comparisons:

- One said that the PG&E electrical code training was more academic than BayREN’s C&S program coursework.
- One observed that BayREN’s training is more of an “umbrella wise spanning” than that of PG&E—it is likely that the interviewee thought that BayREN’s covers many topics but not as in depth on a single topic as PG&E
- The interviewee who previously mentioned that BayREN staff were harder to reach also noted that it was much easier to gain support from staff from another program they attended.
- The SoCalREN WE&T program interviewee recalled participating in SCE’s metering program, noting that SCE delved into greater details on a very specific topic while SoCalREN addressed “a little bit of everything.” Given the narrow focus of SCE’s training, this assessment is unsurprising.
- A 3C-REN WE&T program participant who attended the PG&E training shared, “Other programs are not as local. They feel like outsiders coming in. 3C-REN is applicable to our area, [and is attended] by folks on the central coast.
- A 3C-REN C&S participant concluded that 3C-REN training topics are more current and relevant than other trainings.
- Another 3C-REN C&S participant interviewee remarked at the benefits of how 3C-REN instructors are builders themselves, “Other programs teach from the book, but there is nothing better than an instructor who does the building. I relate to them.”

4.4.4.4 Expanding networks

We asked SoCalREN and 3C-REN participants if the WE&T and C&S programs expanded their professional and/or energy efficiency networks. As shown in Table 4-52, six of nine confirmed that it did. A couple 3C-REN interviewees expressed appreciation; in the words of one 3C-REN Building Performance Training Program participant commented, “Even on Zoom, there's a nice informality and good chance to meet and see people.” However, another 3C-REN Building Performance Training Program participant shared that in-person events, such as those hosted by California Green Business Network, offer a greater opportunity for networking.

Table 4-52. WE&T and C&S program participant observations of expanded networks

Program	Count of interviewees	Expanded network
SoCalREN WE&T	1	1
3C-REN WE&T	3	2
3C-REN C&S	5	3
Total	**9**	**6**

4.4.4.5 Benefits to community

As shown in Table 4-53, 9 of 17 WE&T and C&S participants agreed that the program has improved their ability to serve individuals who are HTR or disadvantaged or SMVDBE contractors. They explained how the programs brought information to local jurisdictions, enabled public agency staff to pass on knowledge to the workforce, and contributed to improving residential and community spaces.

One dissenting 3C-REN WE&T interviewee opined that materials and webinars should be in other languages, including Spanish and Tagalog; moreover, from their perspective, hosting in-person trainings (vs. virtual) may be more effective for reaching diverse communities. This participant clarified that they believe that 3C-REN, overall, benefits these communities and remarked at the extent of effort 3C-REN has spent on reaching out to youth and non-English speaking professionals.

Table 4-53. WE&T and C&S program participant observations of benefits to communities

Program	Count of interviewees	Observed community benefits	Explanations provided
BayREN C&S	8	2	Program has an electrification pioneering role, pointing to training materials for local jurisdictions coupled with incentives available in other programs
SoCalREN WE&T	1	1	Participant can now pass on training to SMVDBE contractors
3C-REN WE&T	3	2	Program's multifamily and affordable housing focus assists those populations
3C-REN C&S	5	4	Program focuses on improving code compliance in community buildings
Total	**17**	**9**	

Given the nature of the Green Labeling program, we did not ask participants this question

4.5 Impact

In this section, we provide impact estimates of REN single-family and multifamily programs with savings claims in PY2022. We provide energy impact estimates per household for the single-family program and total energy impact estimates for both single-family and multifamily programs. We also estimate peak demand impacts for the single-family program. As part of our effort to estimate peak demand impact, we developed load shapes. We also provide these shapes because they depict energy use patterns and how programs affect them.

4.5.1 Summary findings

BayREN single-family gross energy savings exceeded claimed levels.	The BayREN Home + single-family program achieved more gross savings than claimed. Largely driven by fuel substitution, single-family participants achieved 142% of claimed electric savings and 104% of claimed gas savings.
The BayREN single-family program did not achieve overall peak demand savings.	The BayREN Home + single-family program did not achieve overall demand savings during the DEER peak period. Participants, on average, used 0.006 kW more during the peak period. However, participants who received only non-fuel substitution measures did achieve average peak period demand savings of 0.04 kW.

BayREN single-family program attribution was lower than claimed.	The BayREN Home + single-family program achieved an NTGR of 58% of electric savings and 49% of gas savings, indicating the program led to nearly half of the savings that occurred. The other half would have likely happened in absence of the program.
BayREN and SoCalREN multifamily gross energy savings were in-line with claimed levels.	BayREN and SoCalREN multifamily programs achieved nearly all the savings claimed. Program participants saved 96% of claimed electric saving and 87% of claimed therm savings.
BayREN and SoCalREN multifamily program attribution was also in-line with claimed levels.	BayREN and SoCalREN multifamily programs also had high levels of attribution, between 75-96% for electric savings and 92-97% for gas savings. Most of the savings from this program would not have likely occurred in absence of the program.

4.5.2 Single family impact

4.5.2.1 Gross energy savings

We developed savings estimates for three PY2022 BayREN SF participant groups: participants who installed only fuel substitution measures, participants who installed both fuel substitution and other measures, and participants who installed only other (non-fuel substitution) measures. The estimated energy savings per household for the first and last group reflected savings associated with fuel substitution (FS) or non-electrification measure (Other) installations only, respectively. For the middle group, the savings include impacts of both FS and Other measures. Impacts for these two groups of measures are shown separately for this group. Table 4-54 summarizes the gross energy savings for these groups and the program overall. The table includes the number of households that installed each measure type and the impact estimates per customer, including the electric (kWh) and gas (therm) changes per customer. The model estimates that are the sources for these impact estimates are provided in Appendix I: Impact model results.

Table 4-54. BayREN SF program first-year gross energy per customer and total savings, PY2022

Customer group	Measure group	Number of customers		Savings per customer				Total savings*	
		Electric	Gas	kWh	Therms	FS therms in kWh	Overall kWh	kWh	Therms
Electrification only	FS	1,014	NA	-1,222	193	5,655	4,433	4,498,922	NA
Electrification + other	FS	315	261	-1,422	226	6,626	5,204	1,640,164	NA
	Other				55	NA	NA	NA	14,463
Other only	Other	4,234	4,298	-0.64	38		-0.64	-2,690	161,573
							Evaluated	6,136,396	176,036
							Claimed	4,331,840	168,539
							GRR	142%	104%

*kWh for FS includes therms converted to kWh plus the increase in kWh. Therm savings shown are for non-FS measures only.

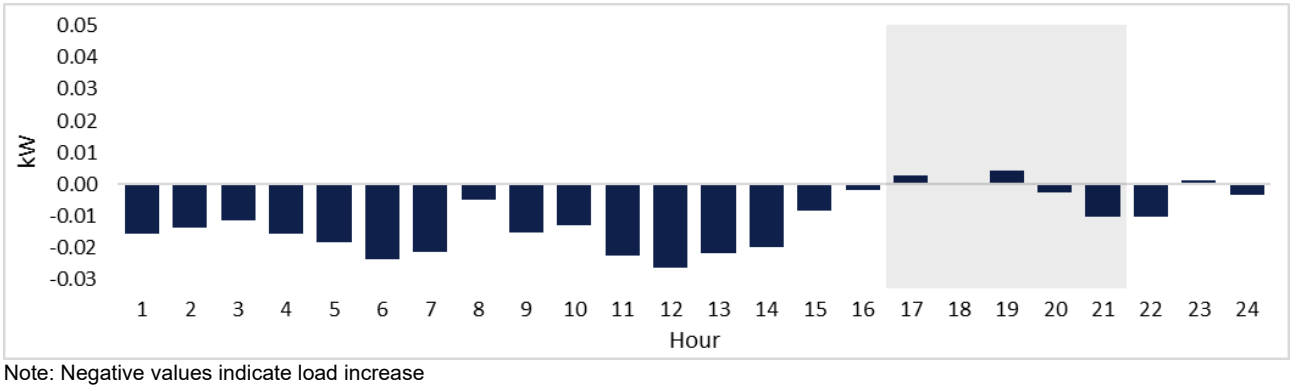
BayREN Home+ single-family participants with fuel substitution measures increased their electricity consumption by replacing gas-using equipment with an electric equivalent (for example, a gas water heater with an electric heat pump water heater). Since CPUC D.19-08-009, which authorized the inclusion of fuel substitution measures in the energy efficiency portfolio, requires the conversion of energy savings for fuel substitution measures into the replacing fuel units for reporting, we converted the reduction in gas consumption of these participants into kWh.[77] We used the site energy conversion value of 29.3001 kWh per therm[78] to calculate the conversion.

We combined the kWh increase (negative savings) of the new electric load with the converted kWh (positive savings) from gas load reduction (FS therms in kWh) for participants with fuel substitution measures. The overall kWh impact per household is the sum of these two terms for these participants. For participants with Other measures only, the estimated electric and gas changes per customer reflected only the effect of non-fuel substitution measures. The electric-saving measures installed by this group did not reflect any savings, while the gas-saving measures reflected savings of 38 therms per customer. In all cases, we multiplied the per-unit change in electricity and gas by the number of participants who installed each measure type to obtain the total electric and gas impacts for the group. We added the total impacts across groups to get program-level electric and gas savings. The result indicates that the program had more electric savings than claimed (142%) and about the same gas savings as claimed. Additionally, the breakdown by FS and Other measure groups shows that most of the gross electric savings' impact was primarily due to fuel substitution measures. For example, savings from participants with fuel substitution-only installations accounted for 73% of the evaluated electric savings. Those without fuel substitution did not have electric savings but had significant gas savings.

4.5.2.2 DEER peak period hourly load and savings

To assess the peak demand impact of the BayREN Home+ single-family program, which is the primary interest of our load analysis, we initially examined peak day impacts by hour. Specifically, we investigated hourly savings shapes during the DEER-defined peak period relevant to the participant CZs. As indicated in the methods section, the DEER-defined peak period includes the 5 hours between 4 p.m. (hour ending 17) and 9 p.m. (hour ending 21) during three heatwave days as defined by DEER. Figure 4-7 summarizes the average hourly load reduction for BayREN single-family participants with all installation types on those days during all hours, including the peak hours shaded in grey. On average, participants did not achieve peak demand savings.[79] However, participants who received only non-fuel substitution had peak demand savings.

Figure 4-7. DEER peak days average load savings shapes for all BayREN single-family participants



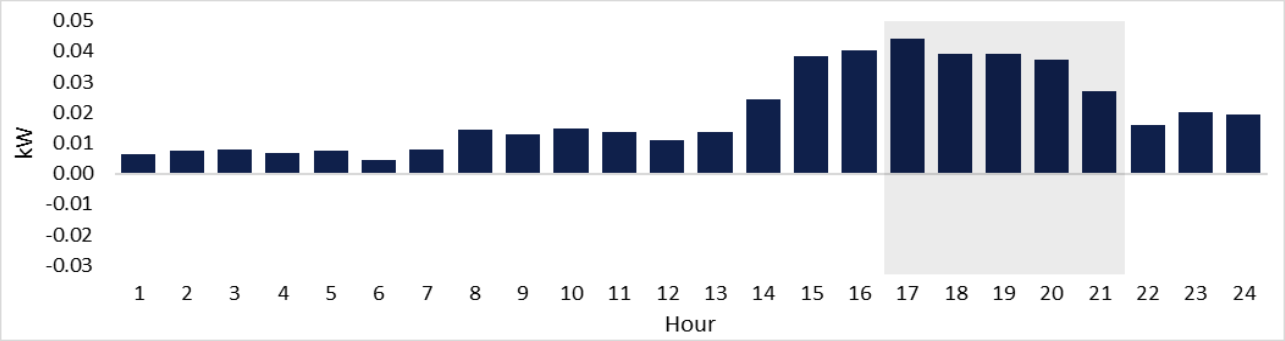
Note: Negative values indicate load increase

[77] In the current case, since electric measures replaced gas-using measures, per CPUC D. 19-08-009, the site energy savings need to be reported in kWh. The data reported in CEDARS reflects conversion into this unit.

[78] The CPUC Fuel Substitution Technical Guide v11 provides this conversion factor for site energy savings calculations. A link to the document is https://www.cpuc.ca.gov/about-cpuc/divisions/energy-division/building-decarbonization/fuel-substitution-in-energy-efficiency.

[79] The participants had negative kW savings, which indicate load increase driven by fuel substitution measures, during other hours.

Figure 4-8. DEER peak days average load savings shapes for non-fuel substitution participants



We also estimated average peak load (kW) reduction based on the model specification we used to determine energy impacts. We investigated peak period impact for participants who installed only fuel substitution measures, those who installed both fuel substitution and other measures, and those who installed only other measures. Table 4-55 summarizes the average hourly load reduction during the 4 p.m. to 9 p.m. period generated based on the peak demand model we estimated. Details of the model estimates are in Appendix I: Impact model results.

Table 4-55. DEER peak period average hourly (4 p.m. – 9 p.m.) load reductions

Customer group	Household counts	Savings (kW)	
		Per household	Total
Electrification only	1,014	-0.161	-163.3
Electrification + other	315	-0.085	-26.8
Other measures only	4,234	0.037	156.7
All participants	**5,563**	**-0.006**	**-33.4**

On average, the participants used 0.006 kW more during the peak period. Participants who received only fuel substitution measures saw peak load increases of 0.16 kW. Participants who received both fuel substitution and other measures saw an average load increase of 0.08 kW, reflecting the combined effect of both types plus an interactive effect (the sum of the three estimated coefficients provided in the table). Participants who received non-fuel substitution measures, which included more efficient HVAC replacements (SEER-rated AC and non-fuel substitution heat pump equipment) and insulation and duct sealing, only saw a load decrease of 0.04 kW during the peak period.[80]

4.5.2.3 Annual and seasonal load shapes

We developed the savings shapes presented in the previous section from individual pre- and post-period load shapes. To understand the sources of the savings, we examine these separate load shapes in this section. We start by reviewing the average daily electric and gas load shapes for all participants and those participants who received fuel substitution measures. Figure 4-9 shows the average annual electric load shape for all BayREN Home+ single-family participants during the pre-treatment and post-treatment periods. As previously stated, fuel substitution drives the savings for this program. As a result, throughout the winter months (December through February), we see higher post than pre-period electric load due to the addition of electric heating. We also see minimal differences over the summer months, consistent with the peak period savings shapes.

[80] While these participants had peak load reduction, as we indicated in the previous section, they did not have an overall reduction in electricity consumption. Our investigation revealed that this result is due to seasonal differences in savings for these participants. While they reduced summer electricity consumption, they used more energy in the winter post-program intervention. Their hourly winter savings shape indicated these participants experienced higher load during the early hours. We did not collect information to determine the reason for this increase. It could be related to takeback (gains in energy efficiency and lower costs leading to increased energy consumption) or an increase associated with non-fuel substitution heat pump installations.

Figure 4-9. All BayREN single-family participant annual electric load shape

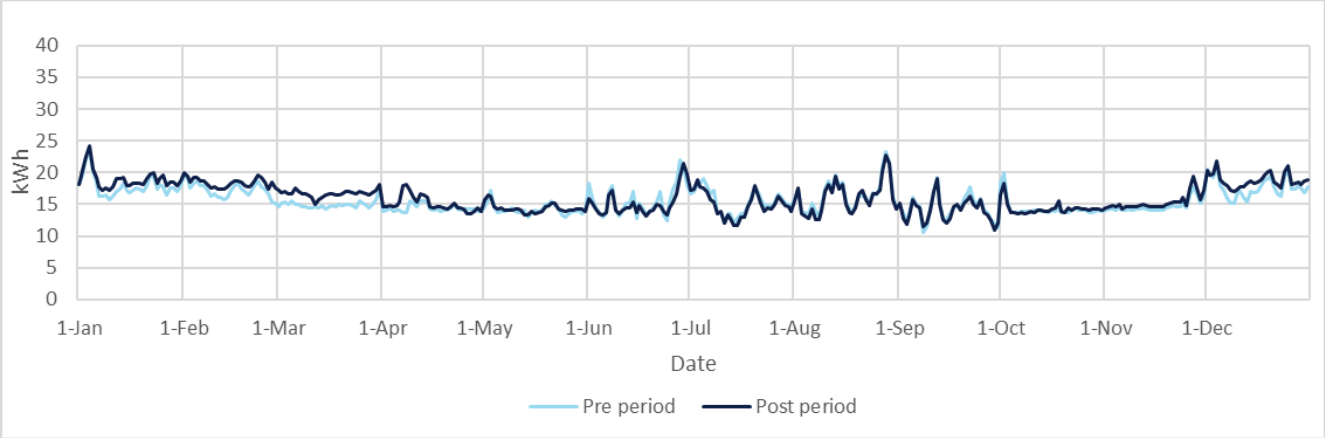
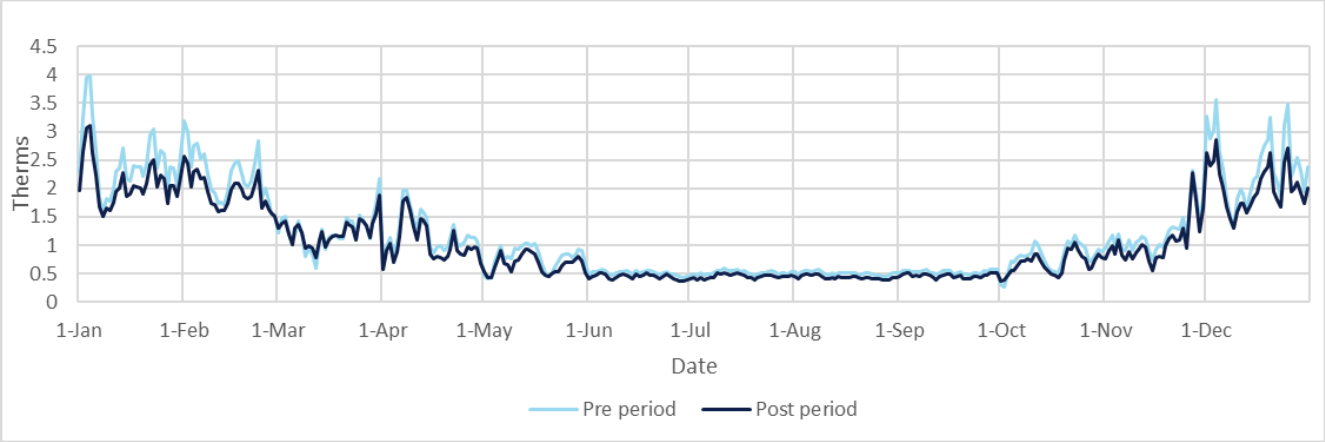


Figure 4-10 shows the average annual gas load shape for all single-family participants during the pre-treatment and post-treatment periods. We observe lower post than pre-period gas load due to displacement gas heating load in the winter and minimal change during the summer.

Figure 4-10. All BayREN single-family participants annual gas load shape



When we look specifically at the customers who received fuel substitution measures only, these trends become even more apparent. Figure 4-11 shows the electric load shape for participants who received only fuel substitution measures. The post-period load exceeds the pre-period load throughout the year. During the heating season, the electric load post-period greatly exceeds the pre-period due to the fuel substitution of heating equipment. Throughout the year, the post load remains slightly above the pre-period due to the addition of fuel substitution measures such as induction cooktops, water heaters, and clothes dryers that affect baseload.

Figure 4-11. Fuel substitution only participants annual electric load shapes

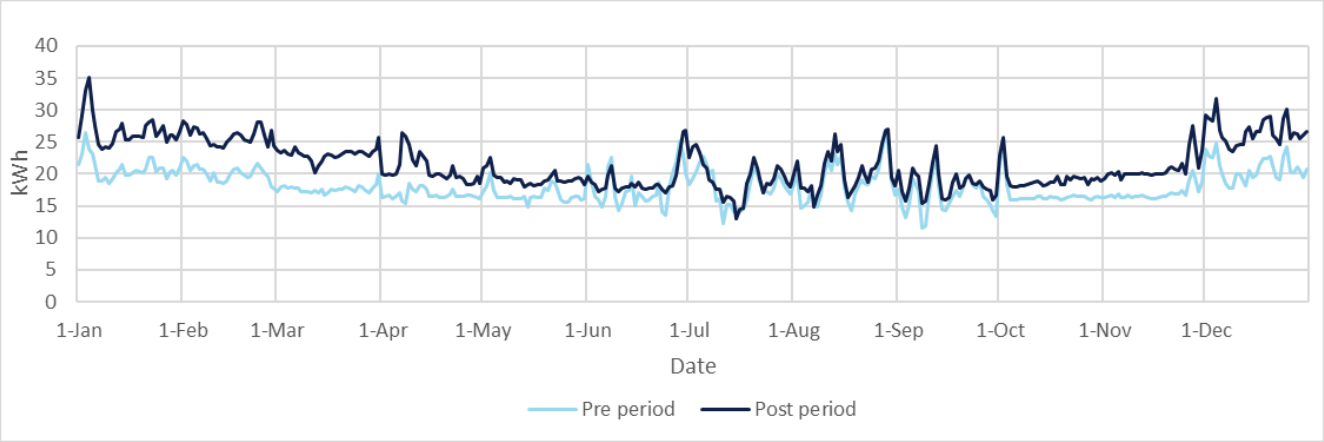
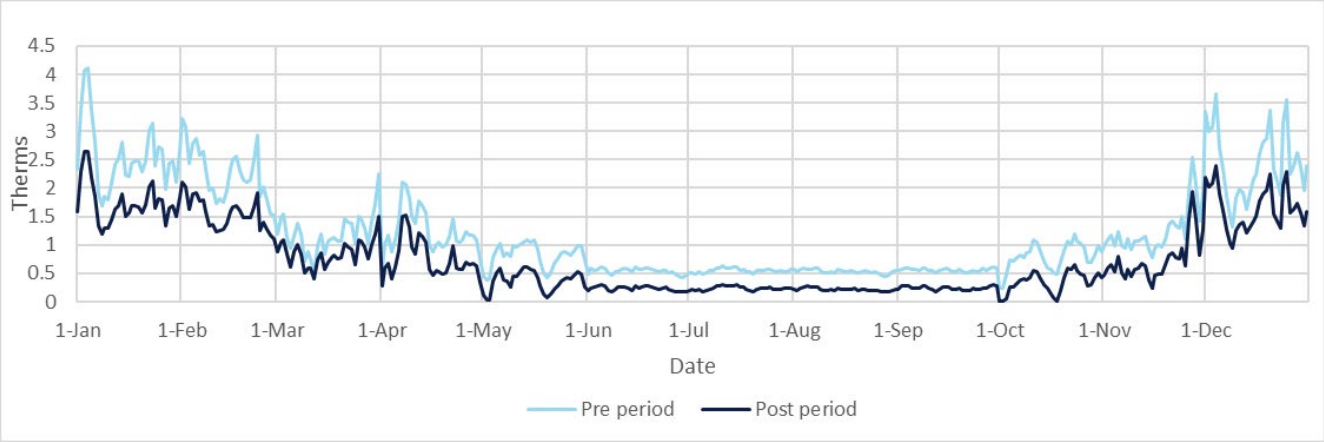


Figure 4-12 shows the annual gas load shapes for participants who received only fuel substitution measures. Throughout the year, the post-period gas usage remains below the pre-period due to the displacement of gas using equipment, including heating, cooking, and dryers.

Figure 4-12. Fuel substitution only participants annual gas load shapes



We also looked at seasonal average electric load shapes, provided in Figure 4-13. Overall, on average, the BayREN single-family program saw summer load reduction between 3 p.m. and 10 p.m. However, on average, the program had winter load increases throughout the day, driven by fuel substitution measures.

Figure 4-13. All participant average seasonal electric hourly load (kW) shapes

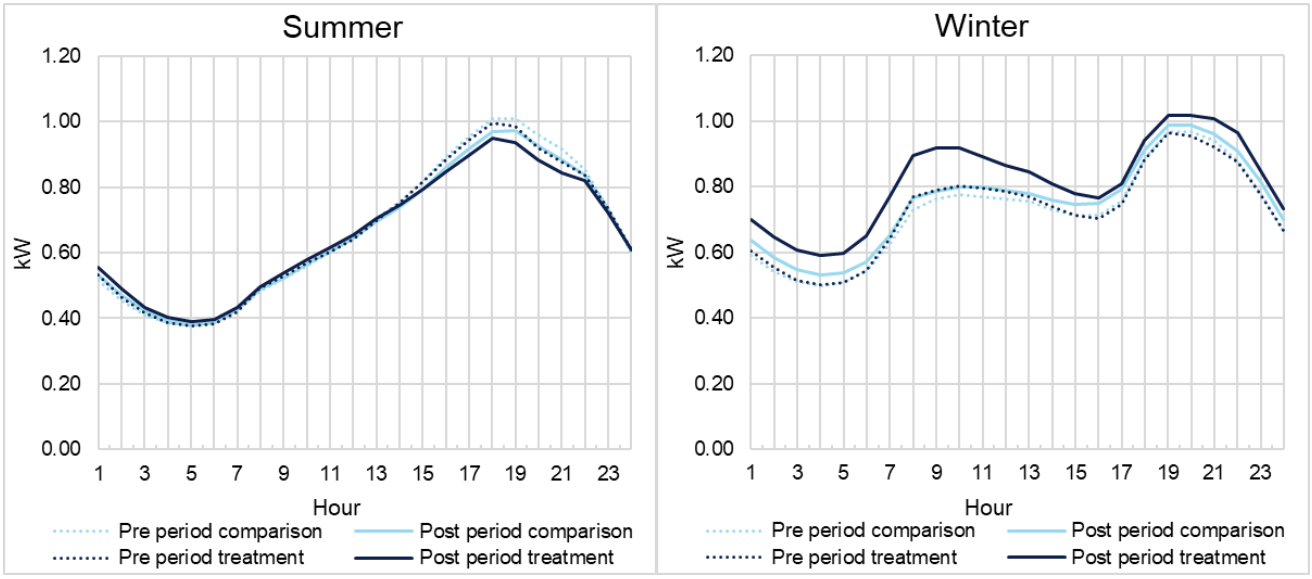
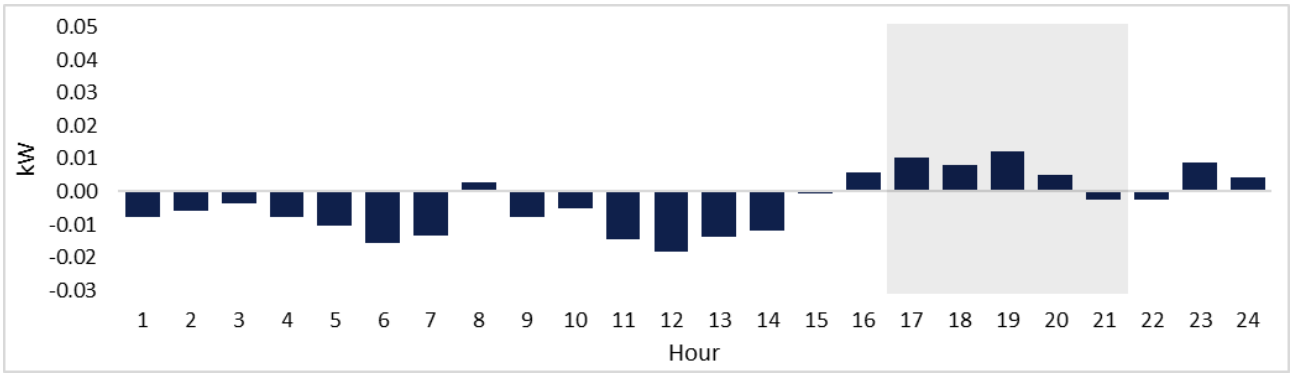


Figure 4-14 shows the average savings shape across all BayREN single-family participants for the summer, June through September. Across all participants, there were slight demand savings between 3 p.m. (hour ending 16) and 8 p.m. (hour ending 20) but increased average demand the rest of the day.

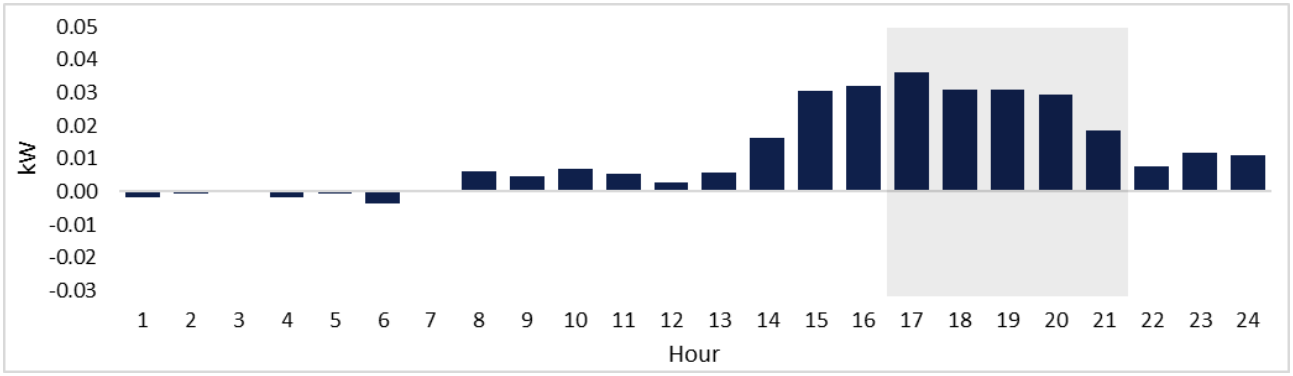
Figure 4-14. All BayREN single-family participant average summer savings shape



Note: Negative values indicate load increase

Looking only at participants who received non-fuel substitution, there were demand savings through most of the day in the summertime. Figure 4-15 shows the summer savings shape for these participants. These participants had noticeable demand savings of 0.02 kW to 0.04 kW between 2 p.m. (hour ending 25) and 9 p.m. (hour ending 21) and minimal load increase through the summer.

Figure 4-15. Non-fuel substitution measure participant average summer savings shape



Note: Negative values indicate load increase

4.5.3 Multifamily program impact

4.5.3.1 Document review adjustments

We reviewed all project documents and calculations associated with the PY2022 BayREN and SoCalREN multifamily program claims. Table 4-56 summarizes the discrepancies between the tracking data and the project document or deemed measure package savings values. We found differences in savings values for 301 out of 349 claimed measures. We adjusted savings to reflect project documents or deemed measure savings values. Additionally, we observed unclear measure characterization in the project documents for two claimed measures. These documents did not provide adequate descriptions of the measures that would allow us to characterize the installation as the measure in the referenced deemed measure package ID. We assigned no savings for these two claimed measures, both variable speed drive (VSD) recirculation pumps, due to information that suggested the installed items were not the same as the measure in the referenced deemed measure packages used to arrive at the claimed savings.

Table 4-56. Summary of PY2022 multifamily program measure-level document review discrepancies

Program	Document review findings	Number of measures
BayREN	No discrepancies	36
	Updated based on project documents or deemed measure packages	51
	Measure characterization problems	2
SoCalREN	No discrepancies	10
	Updated based on project documents or deemed measure packages	250

We calculated the ratios of evaluated to claimed savings by fuel that reflected our findings from the document reviews. Table 4-57 summarizes these ratios or document adjustment factors. While the level of adjustment varied by program, overall, we found close to 100% of claimed savings for electric and gas savings. BayREN had a slightly lower document review adjustment factor, mostly due to the two measures with characterization problems.

Table 4-57. Summary of PY2022 multifamily program document review adjustment factors

Program	kWh		Therms	
	Number of measures	Document adjustment factor	Number of measures	Document adjustment factor
BayREN	58	87%	59	79%
SoCalREN	169	106%	141	114%
Overall	227	104%	200	98%

4.5.3.2 In-service rates

We determined in-service rates through site visits. We visited sites where property managers indicated a willingness to allow site inspection after completing the phone survey. During the visit, DNV's engineer inspected claimed in-unit and common area measures to see if they were still in place and operational or in service. For in-unit measures, we randomly inspected five tenant units. Table 4-58 contains the resulting in-service rates at the program level and overall. The results reflect the 13 site visits we conducted, 12 of which had electric savings measures and 10 of which had gas savings measures. The following summarizes measures that we did not find installed, either due to removal or having never been installed:

- **In-unit faucet aerators** – Building staff removed some due to issues with the pipes, and tenants removed some either because they did not like the flow restriction or to add their own filters.
- **In-unit low flow showerheads** – Tenants replaced some with showerheads they preferred.
- **In-unit smart thermostats** – A nonprogrammable thermostat was in place instead of a smart thermostat in one unit of a building, potentially indicating the smart thermostat was never installed.
- **In-unit power strips** – Power strips were in a property with high tenant turnover. When tenants moved out, they presumably took the power strips with them.
- **Common area lighting** – The site manager was unfamiliar with the installation and unable to show us the equipment.
- **Common area water heating and control/recirculation pump** – Neither maintenance staff nor building management was familiar with the measures, and they were not in the boiler spaces.

Table 4-58. Multifamily in-service rates

Program	kWh			Therms		
	Number of measures	Installation rate	90% CI +/-	Number of measures	Installation rate	90% CI +/-
BayREN	8	94%	2%	8	89%	16%
SoCalREN	4	92%	1%	2	88%	0%
Overall	12	92%	1%	10	88%	7%

Overall, we found 92% of electric and 88% of gas measures to be in service. The electric in-service rate was slightly higher than the gas in-service rate, likely due to the types of measures installed. Large in-unit measures that required special installation, such as refrigerators, dishwashers, and cooktops, were rarely uninstalled. On the other hand, smaller measures such as faucet aerators, showerheads, and power strips, which tenants could easily remove, were more frequently not found in service.

4.5.3.3 Gross energy impacts

Table 4-59 contains the gross savings adjustment (GSA) factor after combining the document review adjustment factor with the in-service rate at the program level. Overall, multifamily programs achieved approximately 96% of their claimed electric savings and 86% of their claimed gas savings.

Table 4-59. Multifamily gross savings adjustment factors

Program	kWh		Therms	
	GSA factor	90% CI +/-	GSA factor	90% CI +/-
BayREN	81%	1%	69%	12%
SoCalREN	97%	2%	100%	0%
Overall	96%	1%	87%	6%

4.5.4 Free-ridership and program attribution

Figure 4-16 provides the NTGR for energy efficiency measures targeted at BayREN Home+ single-family participants. The NTGR varied by measure type, ranging from a low of 16% for duct sealing to 83% for faucet aerators. The overall program-level NTGR estimate (53%) has a relative precision of 19% at the 90% confidence interval. The BayREN single-family program had a lot of influence on either small measures (such as aerators and power strips) or large, expensive fuel substitution measures (such as central heat pumps and heat pump water heaters). On the other hand, the program motivated low proportions of the envelope, furnace, and less expensive fuel substitution measures. For example, the program had limited influence on attic insulation and duct sealing because most respondents reported that they would have installed these measures within 12 months.

Figure 4-16. BayREN single-family measure- and program-level attribution for BTU

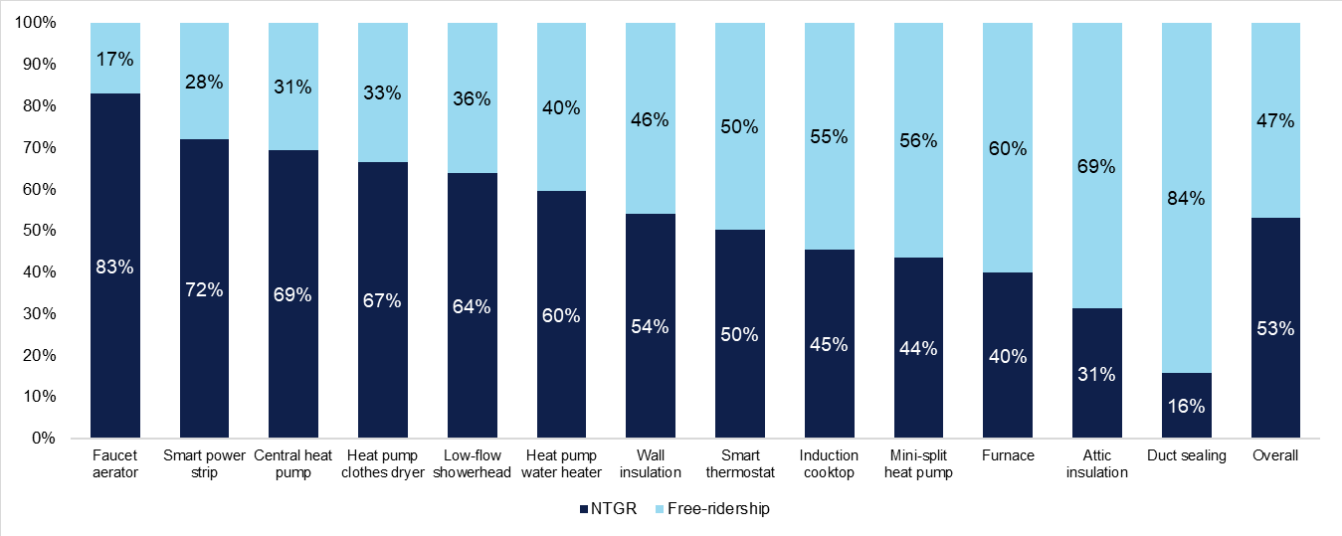


Figure 4-17 provides the NTGR for multifamily programs. Results show that the NTGR for multifamily is high, at 85% for BayREN and 96% for SoCalREN. These higher NTGRs for the multifamily sector are in line with recent multifamily NTGR estimates from other recent CPUC evaluations. We evaluated NTGR for the multifamily programs at the project level. For projects with multiple measures, we calculated savings-weighted average project-level attribution. While the sample sizes for multifamily were smaller than for single-family, the estimated program-level NTGRs had a small standard error. As a result,

the program-level relative precision for the estimated NTGR (93%) was 6%. We provide additional details on the NTGR findings, including the number of respondents and precision levels for the responses, in Appendix J: NTGR findings.

Figure 4-17. Multifamily program level free-ridership and program attribution for BTU

4.5.5 Total gross and net savings

Table 4-60 provides the total gross claimed and achieved (evaluated) electric savings for the three REN single- and multifamily resource programs with claims in PY2022. These residential programs achieved total gross electric savings of 13.9 GWh or 111% of the gross claimed electric savings (GRR). The electric savings GRR for the single-family program was high (142%), primarily due to fuel substitution technologies, which approximately a quarter of the program's participants installed.

The BayREN single-family program influenced 58% of gross electric savings (net to gross ratio [NTGR]), which is lower than the claimed level for the program. The BayREN and SoCalREN multifamily programs influenced almost all gross savings, indicating the programs reached populations that benefited from the interventions significantly.

Table 4-60. REN gross and net electric savings by program, PY2022

Program	Total gross claimed savings (kWh)	Total gross evaluated savings (kWh)	GRR	Claimed NTGR	Evaluated NTGR	Total net evaluated savings (kWh)
BayREN SF	4,331,840	6,136,396	142%	97%	58%	3,559,110
BayREN MF / MF Electrification	1,234,506	1,003,757	81%	84%	75%	752,818
SoCalREN MF	7,033,773	6,809,763	97%	76%	96%	6,537,372
All	**12,600,119**	**13,949,916**	**111%**	**84%**	**78%**	**10,849,300**

Table 4-61 provides the total gross claimed and evaluated gas savings for REN residential programs. The programs achieved 319,379 therms of gross gas savings or 96% of gross claimed savings (GRR). Like the electric case, the single-family program influenced approximately half of the gross gas savings. Additionally, as in the electric case, multifamily program attribution was high and above claimed levels, indicating that the programs succeeded in serving the right population segments.

Table 4-61. REN gross and net gas savings by program, PY2022

Program	Total gross claimed savings (therms)	Total gross evaluated savings (therms)	GRR	Claimed NTGR	Evaluated NTGR	Total net evaluated savings (therms)
BayREN SF	168,539	176,036	104%	47%	49%	86,247
BayREN MF / MF Electrification	62,407	43,355	69%	75%	92%	39,887
SoCalREN MF	100,164	99,988	100%	75%	97%	96,988
All	**331,110**	**319,379**	**96%**	**61%**	**70%**	**223,123**

4.6 Key findings

Successful outreach approaches varied by sector but required direct outreach or partnerships. The residential PA/Implementer interviewees indicated that direct outreach (such as mail campaigns, phone calls, and site visits) and partnerships were the most effective strategies for marketing and outreach. Public sector program success relied on forming partnerships with organizations that provided introductions for "warm leads," ultimately leading to participant acquisition. For example, SoCalREN program staff reported that the PA used its network of more than 230 public agencies and partners with established relationships with a variety of public agency departments to convert warm leads into program enrollments. Out of the 214 public agencies that SoCalREN served in PY2022, 13 were new to public agency programs, and SoCalREN enrolled seven of these new agencies through collaboration with regional partners. During PA/Implementer interviews, the WE&T and C&S program managers stated that targeted outreach (e.g., through email) and partnerships were successful strategies. For example, BayREN's Green Labeling program partnered with local realtor associations for outreach.

REN programs demonstrated unique value by serving HTR populations and engaging in many energy efficiency activities not provided by other PAs. Most programs targeted populations in DACs or those traditionally far from IOU energy efficiency outreach efforts. Strategies included focusing on HTR populations in multifamily housing, moderate-income households in single-family programs, and public agencies that serve such populations. REN programs made significant efforts to support decarbonization through electrification projects in multifamily housing and single-family homes. Collaborations with city governments and local contractors further enhanced these efforts. REN residential programs differentiated themselves by providing hands-on support, such as Energy Advisors and direct measure recommendations, to fill market gaps. The programs emphasized customized service, including incremental installation phases and contractor selection autonomy. The programs also offered avenues for additional funding and incentives including layering incentives with other organizations' efforts and providing higher incentives to historically underserved populations, such as HTR/DAC communities.

The JCMs do not capture the full extent of the complex and nuanced coordination and collaboration between RENs and utilities. Day-to-day interactions, often conducted through ad-hoc means such as emails, phone calls, and smaller meetings, were not adequately reflected in the JCMs. Additionally, specific REN programs requiring frequent communication, partnerships with CCAs, and the prevalence of third-party implementers managing programs were significant aspects of coordination that the JCMs did not adequately address. Therefore, there is a clear need for more comprehensive and inclusive mechanisms to document and guide coordination efforts between RENs, utilities, and other stakeholders involved in energy efficiency programs.

Residential participants observed impacts from the program and had high levels of satisfaction. Many single-family participants observed energy savings (61%) and bill reductions (42%) after participating in the program. A slight majority (58%) confirmed they had experienced improved comfort from the program. However, one-fifth of single-family participants

said that they did not see any benefits from participating in the program or were uncertain if they did. Three-quarters of multifamily participants noted energy and bill savings from their participation, and close to one-half (49%) saw decreased operation and maintenance costs. Most single-family (84%) and multifamily (91%) participants were satisfied with their overall program experience. Single-family participants were most satisfied with the information with which they were provided, while multifamily participants expressed the highest satisfaction with their energy and/or cost changes. Teachers in the Kits for Kids program were satisfied with all aspects of the program; they were noticeably satisfied with the support that they received from the program implementer, but they wished that the program offered more educational resources (and recalled some problems with the postcard submittal process).

Public agency and commercial program participants had positive experiences, valuing the programs' hands-on support and other benefits. Public agency program participants remarked on the extent of support that they received. Some reflected that they would not have been able to complete projects in the absence of the program's support, underscoring the value of the programs' willingness to dive into details. The participants found program staff to be "great partners" and the "utmost professional," applauding staff responsiveness and technical expertise. Some participants voiced enthusiasm to participate again in the future. In reference to their overall experience, they reiterated their appreciation of the program's helpfulness in terms of services and support, which compensated for their agencies' limited capacities. Two-thirds of public agency participant interviewees confirmed that the program services and offerings expanded their professional and/or energy efficiency networks. Many of the interviewees agreed that REN public agency and commercial programs benefit members of their communities that face a combination of economic, health, and environmental burdens.

WE&T and C&S participants reported increased knowledge, good overall experiences, and improved ability to help the underserved. Many WE&T and C&S program participants indicated that they gained knowledge from the program, and some still use the tools or knowledge that they learned. Generally, participants appreciated their new skills, being kept apprised of best practices and current events, and the programs' efforts to make complex or obscure information and content more accessible. Participants remarked on the professionalism and knowledge of instructors and program staff. One interviewee reported a challenge contacting BayREN C&S program staff, and two BayREN C&S interviewees noted difficulty attending live training due to schedule constraints. Some WE&T and C&S participants confirmed that the program improved their ability to serve individuals who are HTR or disadvantaged or SMV/DBE contractors. However, one interviewee saw a shortcoming in terms of program efforts to reach non-English speaking and diverse communities.

The BayREN single-family and BayREN and SoCalREN multifamily programs achieved more or the same level of claimed gross electric and gas savings. The BayREN Home+ single-family program achieved significantly more electricity savings than claimed, mainly driven by fuel substitution measures, while gas savings were consistent with the claims. The BayREN and SoCalREN multifamily programs saved almost all the claimed electric savings but fell somewhat short in gas savings. This shortfall in gas savings is due to discrepancies in the values used to claim savings and the absence or removal of some installed tenant measures**.**

BayREN single-family attribution was lower than claimed while BayREN and SoCalREN multifamily attribution was high. Multifamily programs saw high levels of attributable savings (more than 90%), while the single-family program could only be attributed for 53% of savings. This result is significantly lower than the claimed attribution for the single-family segment (97%). Particularly, attribution was low for building envelope measures like duct sealing and insulation. Meanwhile, multifamily attribution was high, which was consistent with or higher than claimed attribution.

BayREN single-family program participants increased peak demand usage. While the BayREN Home+ single-family program achieved energy savings, it did not lead to peak demand savings. On average, program participants had higher electric load during the DEER-defined peak period. Electric use increased during the peak period, likely due to less weather-dependent fuel substitution measures, like cooktops and water heaters. Because of the lack of energy consumption data for multifamily participants, we could not develop savings shapes for the multifamily programs.

5 CONCLUSIONS AND RECOMMENDATIONS

Table 5-1 summarizes DNV's key findings, implications, and recommendations for this evaluation.

Table 5-1. Key findings and recommendations

Key findings	Implications and recommendations
DNV process evaluators found that all REN programs approached decarbonizing through electrification to contribute to state GHG reduction goals. As a result, they encountered similar issues and challenges related to electrification such as a lack of understanding about electrification and fuel-substitution measures among program participants and contractors, low incentives relative to the high equipment and installation costs, and complicated coordination.	RENs are in the unique position of being able to support more effectively CPUC policies and California's larger decarbonization goals through innovative solutions and scalable activities. For this reason, RENs should consider increasing efforts to create a pathway to electrification such as higher incentives and rebates, varying levels of incentives, and equity-focused multipliers that target low-income participants, DACs, and environmental justice areas.
The REN multifamily programs catered to the unique needs of their customers by allowing for greater customization and flexibility with measure and eligibility requirements. The programs also confronted split incentives by increasing benefits for property owners and helping achieve renter equity by requiring certain core measures or providing larger incentives for projects that included in-unit measures.	Given their mandate to pilot activities where there is no current utility or CCA program offering, specifically where there is potential for scalability to a broader geographic reach, we recommend that the RENs consider sharing their successes serving the multifamily sector (including best practices for addressing split incentives and renter equity) during their coordination meetings with utilities. This type of sharing could expand useful approaches beyond the RENs.
Providing additional hands-on support addressed unique challenges faced by multifamily property owners and public agencies, such as lack of in-house technical expertise and administrative burdens associated with energy efficiency upgrades. The RENs embedded staff to provide services such as project management, procurement, financial, and construction management.	We recommend that the RENs collaborate with the utilities and other stakeholders to share best practices and lessons learned from their experience and to identify opportunities for coordination and alignment of programs and incentives, particularly for programs that traditionally experience challenges serving the multifamily sector.
In accordance with their JCMs, RENs coordinated with utilities and CCAs for most of their programs. However, third-party implementers managed a majority of both REN and utility programs and the JCMs did not mention the role that third-party implementers should play in coordination efforts. DNV found there was a variance in attendance by IOUs at regular coordination meetings but relied on the third-party implementers to attend the meetings in their place. As third-party implementers have performance-based contracts with the PAs, their interests may not always align with the need to	DNV recommends that the PAs (utilities, RENs, and CCAs) and/or their representatives (e.g., technical and regulatory consultants) continue or begin to attend all official coordination meetings as defined in the JCMs even when third-party implementers manage the programs. The PAs should attend the coordination meetings and then direct the program implementers to follow through with any necessary actions identified during the meetings. The PAs should consider including a RACI (responsible, accountable, consulted, informed) chart in the JCMs and PIPs that defines the role of PAs, implementers, and any other stakeholders. A RACI chart would help clarify who

Key findings	Implications and recommendations
coordinate or cooperate directly with other PAs or implementers.	needs to attend the coordination meetings, define their role, and help eliminate any confusion related to coordination efforts. The RACI chart should be a living document and an updated version of the RACI could be included with both the JCM and PIP documentation. DNV also recommends that attendance at the meetings be documented and made available to future evaluators.
The BayREN single-family program achieved gross savings at or above claimed levels. Program interventions included several electrification measures that contributed to achieving gross savings. However, while the program intended to benefit low- to moderate-income households (with the assumption that these households need the program), the attribution results indicate that the program served a relatively high proportion of households that would have installed the measures without program support.	The program should continue its successful effort to electrify and achieve realistic and ambitious single-family energy consumption reductions. However, the program should target more underserved populations that would not undertake similar upgrades without program support. To reach such customers, the program could increase incentives for populations unlikely to install expensive fuel substitution technologies without program support.

6 APPENDICES

6.1 Appendix A: Gross and net lifecycle savings

Gross and net lifecycle savings are in the attached pdf.

6.2 Appendix B: Per unit (quantity) gross and net energy savings

Per unit (quantity) gross and net energy savings are in the attached pdf.

6.3 Appendix C: IESR−Recommendations resulting from the evaluation research (final report only)

6.4 Appendix D: Program challenges and barriers

This section details the challenges and barriers the REN programs encountered in delivering energy-efficiency services to their target markets and the mitigation strategies and solutions they employed or suggested to overcome these issues. The analysis aims to 1) assess how the RENs ensured participant benefits to fulfill their missions and 2) identify opportunities for improvement. The analysis relies on program documentation reviews (PIPs, annual reports, and JCMs), PA and implementer IDIs, and residential single-family and multifamily surveys. We used the information to identify common and sector-level challenges and associated REN mitigation strategies.

6.4.1 Common challenges and barriers

The RENs faced some common challenges and barriers while meeting the needs of prospective and existing participants. At times, these challenges lengthened project completion times, affected program participation, prevented programs from fulfilling their energy savings goals, limited the programs' ability to determine program impact, and resulted in operational inefficiencies. Our findings indicate that despite differences in customer base and overall design, programs encountered similar barriers to achieving effective program delivery and participation. Program challenges ranged from financial hurdles to complex processes to resource constraints (including time and capacity). Some challenges were more prevalent among certain program types. For example, financial burdens affected residential programs most frequently, while resource constraints (limited time and capacity) were more common in the WE&T and C&S programs. Table 6-1 summarizes the sector-level challenges REN PY2022 programs faced.

Table 6-1. Sector-level REN PY2022 program challenges

Main challenges	Residential	Public agency and commercial	WE&T and C&S
Complex process	✓	✓	
Financing hurdles	✓	✓	
Information access	✓	✓	
Lack of customer awareness	✓		✓
Language and socioeconomic barriers			✓
Limited contractor availability/expertise	✓		
Post-pandemic transition			✓
Program management issues		✓	
Resource constraints	✓	✓	✓
Savings hurdle		✓	
Staff turnover		✓	✓
Supply chain issues	✓	✓	

The common challenges and barriers of residential programs were:

- **Financing hurdle** – Upfront installation costs or limited funding to accommodate all participation requests.
- **Lack of customer awareness** – Insufficient education about program benefits (e.g. electrification) or lack of program awareness.
- **Complex process** – Complex logistics or steep learning curve for implementing new approaches.
- **Limited contractor availability/expertise** – Shortage of contractors experienced in multifamily building and electrification installations.
- **Supply chain issues** – Lengthened project completion times due to supply chain issues.
- **Information access** – Difficulty obtaining confirmation of energy measure installation.

The common challenges and barriers of public agency and commercial programs were:

- **Complex process** – Cumbersome and time-consuming procurement, enrollment, and application processes.
- **Resource constraint** – Time and budget constraints that hinder project completion.
- **Financing hurdles** – Limited funding to accommodate desired level of participation.
- **Program management issue** – Delays processing incentives and participant enrollment difficulties impacting program progress.
- **Savings hurdle** – Achieving sufficient level of savings.
- **Information access** – Lack of submetering affecting savings calculation.
- **Staff turnover** – Turnover requiring ongoing education of new staff members.
- **Supply chain issues** – Delays in equipment delivery due to supply chain issues.

WE&T and C&S programs faced the following common challenges and barriers:

- **Resource constraint** – Limited capacity, time, and resources affecting energy efficiency activities.
- **Post-pandemic transition** – Challenges in adapting to the "new normal," impacting training activities.
- **Staff turnover** – Staff turnover affecting project continuity and implementation efficiency.
- **Lack of customer awareness** – Limited knowledge among customers about available services.
- **Language and socioeconomic barrier** – Participants facing challenges due to language and socioeconomic factors that impact participation.

6.4.2 Residential program challenges and barriers

Residential programs within the REN portfolio encountered multiple challenges, including a lack of program awareness, logistical complexities, supply chain disruptions, and financing barriers. They also encountered post-pandemic market barriers that impacted their efforts to scale up and boost program participation.

Programs faced challenges in attracting participants due to **limited financing opportunitie**s. For example, BayREN's MF / MF Electrification and BayREN's SF programs struggled with insufficient budget to meet the high demand for fuel substitution measures. Fixed incentives, such as $400 for a heat pump water heater, were overshadowed by installation costs, prompting consideration of incentive adjustments. To address this, BayREN adopted a layered incentive approach, leveraging external incentives from TECH Clean California and statewide programs. Similarly, SoCalREN's Kits for Kids program faced funding constraints. In response, program staff created a waitlist to accommodate participants in future program years. 3C-REN's MF program encountered barriers related to upfront costs, prompting the program to permit smaller-scale projects.

Lack of customer awareness created a barrier to attracting new participants and scaling up program efforts. Electrification measures, especially heat pumps, were a relatively new technology on offer by the programs. Customers generally had

limited information about the costs and benefits related to these measures. BayREN's MF / MF Electrification program staff indicated that limited customer awareness hindered participation in BayREN's multifamily programs.

To address this challenge, BayREN deployed Energy Advisors who offered personalized one-on-one support, clarifying program benefits and assisting residents in navigating the programs' website. In the BayREN SF program Energy Advisors provided individualized assistance. 3C-REN's MF program launched a successful mailer campaign targeting County Boards of Supervisors to generate a substantial number of leads and counteract lack of awareness about the program that launched in late 2021.

The **complex processes and logistics** in delivering programs within the multifamily sector presented significant challenges. The SoCalREN MF program cited the complex logistics of organizing upgrades throughout multifamily properties as a barrier to program participation. The program proactively worked with contracts to communicate and coordinate the activities for a seamless delivery.

BayREN's MF / MF Electrification program and 3C-REN's SF NMEC program interviewees found that **limited contractor availability/expertise** hindered program delivery. The RENs reported a shortage in contractor expertise stalled several large electrification projects across program years. BayREN's MF proactively used a BayREN member grant for contractor training to fill this gap. It used a grant to support contractor training to reduce this barrier.

Finally, residential program staff reported **pandemic-related challenges.** For example, BayREN's MF Electrification subprogram faced several challenges stemming from site access restrictions due to the lingering effects of the pandemic.

Table 6-2 summarizes the challenges and mitigation strategies used and proposed by REN residential programs in PY2022.

Table 6-2. Challenges and mitigation strategies of PY2022 REN residential programs

Program	Overarching challenges and barriers	Specific challenges and barriers	REN mitigation strategies
BayREN MF / MF Electrification	Financing hurdle	Lack of effective and scalable financing opportunities to help with upfront installation costs	N/A
	Lack of customer awareness	Lack of customer education around electrification	Targeted outreach and technical assistance
	Limited contractor availability / expertise	Limited supply of contractors experienced in multifamily buildings and/or electrification measure	Used grant held by a BayREN member to support contractor training
	Supply chain issues	Supply chain issues that lengthened project completion times	Communication and collaboration with contractors to set expectations and mitigate dissatisfaction
BayREN SF	Financing hurdle	Limited program budget to accommodate all participation requests	Layered incentives by leveraging all available incentives, including TECH Clean California and statewide fuel substitution program incentives
	Lack of customer awareness	Lack of understanding of the program	Employed Energy Advisors who worked individually with customers to overcome these challenges

Program	Overarching challenges and barriers	Specific challenges and barriers	REN mitigation strategies
SoCalREN MF	Complex process	Complex logistics of organizing upgrade projects throughout multifamily properties	Communication and collaboration with contractors
	Supply chain issues	Residual supply chain issues preventing the program from achieving its savings goals	Communication and collaboration with contractors to set expectations and mitigate dissatisfaction
SoCalREN Kits for Kids	Financing hurdle	More requests for participation than existing funding levels could cover	Implementer added classrooms to a waitlist for the next program cycle
	Information access	Challenges obtaining confirmation of energy measure installation from student households	Implementer included less questions to alleviate response burden
3C-REN MF	Financing hurdle	Available capital for up-front costs and costly high-performance equipment such as heat pump limited participation	Worked to build flexibility into the program design
	Lack of customer awareness	Lack of awareness about the program that launched in late 2021	Developed a comprehensive outreach strategy deploying mailer campaign
	Complex process	Requirement for comprehensive projects	Built flexibility to encourage uptake of smaller-scale projects
3C-REN SF NMEC	Financing hurdle	Available capital for up-front costs and costly high-performance equipment such as heat pump limited participation	Offered payments based on performance to decrease participation barriers
	Complex process	Steep learning curve for the REN and contractors to implement the new NMEC approach in place for the program	N/A
	Information access	Difficulty accessing energy usage data vital for program performance assessment	Ongoing communication with IOUs to obtain the required data
	Limited contractor availability / expertise	Ramp-up associated with recruiting experienced contractors	Leveraged available programs (TECH and 3C-REN BPT programs) to offer electrification training opportunities

6.4.3 Public agency and commercial program challenges and barriers

Public agencies and commercial programs encountered various challenges that affected program participation and delivery. The most common challenge centered around **complex processes**. BayREN's WUSave program found water utility enrollment to be a time-consuming process. As of the end of PY2022, the program had enrolled two participating local water utilities. The process included two phases: engaging elected and staff champions and completing required steps for official approval, such as obtaining the program master agreement and adopting the rate and fee schedule. Enrolling the second partner utility took just over one year, from introducing the program to city decision-makers to launching customer services. Collaboration with BayREN County representatives to support utility enrollment helped ease the barrier.

Complex procurement requirements also pose an obstacle to public agency program participation. For example, required public bidding processes reportedly consumed much of staff time and compounded other barriers. As a remedy, SoCalREN's EE PDP offered procurement services and technical assistance to help public agencies navigate bureaucratic

procedures and move projects forward effectively. As another example, because public-sector projects take an average of 3 years to complete, agencies may select code-compliant equipment rather than an energy-efficient model. SoCalREN's PA SSP programs offered expedited project incentive application reviews and approvals to ensure program participation and efficient equipment installation.

Both participant time- and budget-related **resource constraints** also challenged the public agency and commercial programs' success. For example, the lack of time and budget to complete projects and track performance affected BayREN's SMB program. The program re-opened for enrollment in Q4 of PY2022 after pausing for a redesign early in the year. However, the program had insufficient time and budget to complete projects and to track energy and performance of installed measures. As a result, it paused operations in Q4 for a second time in PY2022. In response to this challenge, program staff reported altering many design elements, including tracking processes, to ensure future success.

Public agency programs also faced resource constraint-related challenges. Managing energy efficiency projects is one of many agency staff responsibilities. Public sector projects are also time-consuming. On average, such projects take three years from identification through completion. Additionally, agency **staff turnover** disrupted project continuity, necessitating the re-education of new staff. These issues affected all of SoCalREN's public agency programs, including EE PDP, DER DAC, PA NMEC, and PA SSP programs. SoCalREN addressed these by conducting presentations and outreach to identify new contacts and re-engage stalled projects.

Financial hurdles also affected public sector energy efficiency programs. Such programs often face significant difficulty securing funding. Public agencies have competing priorities and rigid funding priorities planned years ahead, making it challenging to incorporate new projects. They also often struggle to access short-term capital for construction, as funding options like on-bill financing require installation verification first. The SoCalREN RLF program bridges this public agency funding requirement gap by providing short-term capital without requiring installation verification. However, the program's $2.2 million in funding was insufficient to meet the demand for financing in PY2022.

The SoCalREN DER DAC program faced a similar funding shortfall in PY2022, making it difficult for the program to support public agency DER projects (such as electric vehicle, solar, and battery storage projects) for public agencies in DACs. The program delivered the last DER and Pathway to Zero reports in January and June 2022, respectively. In both cases, the SoCalREN implementation team guided participants by identifying alternative funding sources, like on-bill financing and the DOE's Energy Efficiency and Conservation Block Grant (EECBG), to help agencies secure financial support.

Supply chain delays of up to one year, particularly for electrical equipment and chiller components, persisted, delaying project construction. Table 6-3 summarizes the challenges and mitigation strategies used and proposed by REN public agency and commercial programs in PY2022.

Table 6-3. Challenges and mitigation strategies of PY2022 REN public agency and commercial programs

Program	Overarching challenges and barriers	Specific challenges and barriers	Mitigation strategies and suggested solutions
BayREN WUSave	Complex process	Time consuming utility enrollment process	Collaborate with BayREN County representatives to support utility enrollment
	Savings hurdle	Low water rates hinder qualification for on-bill tariff by limiting savings from reduced water usage	N/A
BayREN SMB	Resource constraint	Insufficient time and budget for project completion and performance tracking	Altered eligibility criteria, incentive levels, and streamlined tracking processes

Program	Overarching challenges and barriers	Specific challenges and barriers	Mitigation strategies and suggested solutions
	Program management issues	A single contractor unable to enroll a sufficient number of participants to achieve the targeted savings	Transitioned to multiple contractors
SoCalREN RLF	Financing hurdle	Limited funding emerged as a significant barrier to participation	Implementation team guided participants to secure project funding
SoCalREN EE PDP	Complex process	Complex and cumbersome procurement processes, involving public bidding, which requires significant staff time	Provided procurement services and technical assistance
	Resource constraint*	Time constraints among public agency staff to oversee energy efficiency projects	Tackled issue through presentations and outreach to identify new contacts, and re-engage stalled projects
	Staff turnover*	Staff turnover requiring education for new staff members on energy efficiency and ongoing projects	Tackled issue through presentations and outreach to identify new contacts, and re-engage stalled projects
	Supply chain issues*	Delays caused by supply chain issues with certain equipment taking up to a year to be delivered	N/A
	Program management issues	Delays caused by SCE processing leading to dissatisfaction among stakeholders and lowering anticipated savings	Coordinated with a new SCE management team to improve responsiveness
SoCalREN DER DAC	Financing hurdle	Absence of funding hindered the program from continuing to provide DER and technical assistance	Assisted in identifying alternative funding sources like on-bill financing and DOE grants
SoCalREN PA NMEC	Savings hurdle	Need to achieve predictable savings that are at least 10% of baseline energy use can also be a challenge	N/A
	Information access	Lack of submetering to carry out savings calculation	N/A
SoCalREN PA SSP	Complex process	Given lengthy custom applications, agencies select code-compliant equipment instead of an efficient one	Offered expedited project incentive application reviews and approvals
	Resource constraint	Insufficient time to identify and complete projects to meet energy savings goals as program started in March 2022	N/A

* These challenges also affected SoCalREN Public DER (SCR-PUBL-B2), NMEC (SCR-PUBL-B3), and Streamlined Savings (SCR-PUBL-B4) programs

6.4.4 WE&T and C&S program challenges and barriers

The REN WE&T and C&S program staff cited **resource constraints** as one of the most frequent barriers to increasing program participation. WE&T and C&S REN programs interact routinely with public and government agencies. The agencies are already resource-constrained, so participating in additional efforts becomes challenging. In 2021, the BayREN C&S program surveyed Bay Area building departments to gather data on department characteristics and interest in code compliance resources. The survey results indicated that only 57% of surveyed agencies had fully staffed departments, with smaller departments being less likely to engage in code-related activities due to limited capacity. The staff of the building departments highlighted that they had limited time for reviewing projects for code compliance and prioritized safety over such compliance.

BayREN's Green Labeling program also suffered from resource constraints. The uneven distribution of Home Energy Score assessors, especially in rural areas and the northern and southern counties of the Bay Area, posed a substantial barrier to participation. Assessors were less inclined to travel long distances, resulting in increased expenses or logistical challenges for Home Energy Score assessments in regions with fewer assessors. 3C-REN's C&S program also noted that limited staff time to attend training and forums was a major barrier to program delivery.

Adapting and transitioning to market needs in the **post-pandemic climate** was also challenging for the programs. During the pandemic, WE&T and C&S programs shifted to virtual webinars, forums, and classes. During the post-pandemic period, the programs struggled to attract participants to in-person classes and training. In PY2022, the transition from in-person to online training and forums presented advantages, such as increased accessibility for staff from small departments and the inclusion of speakers from diverse locations. However, drawbacks emerged, including reduced customization of training and challenges in fostering networking connections via virtual meetings. As a result, the RENs pivoted to offering in-person and online training.

Non-residential IDI respondents reported three additional issues: **staff turnover, lack of customer awareness, and socio-economic barriers**. For example, 3C-REN's C&S program staff pointed to the heavy staff turnover in PY2022 at the primary implementation partner's business as a challenge. The new hires had "insufficient code knowledge to effectively lead the service." As a result, 3C-REN staff quickly issued an RFP to find a new capable partner to take over in PY2023. Additionally, the program staff noted a lack of customer awareness about available services like the Energy Code Coach and the new Reach Code service. Annual meetings with cities were instrumental in informing new staff about 3C-REN and the types of energy code services the program offered. Prior relationships also helped address this challenge. Table 6-4 summarizes the challenges and mitigation strategies used and proposed by REN WE&T and C&S programs in PY2022.

Table 6-4. Challenges and mitigation strategies of PY2022 REN WE&T and C&S programs

Program	Overarching challenges and barriers	Specific challenges and barriers	Mitigation strategies and suggested solutions
BayREN C&S	Post-pandemic transition	Adapting to the post-pandemic "new normal" reduced training customization and networking opportunities	Program staff experimented with hybrid formats to mitigate this
	Resource constraint	Limited capacities of small departments led to prioritization of safety concerns and reduced engagement in code-related activities	Program provided policy support and technical assistance
BayREN Green Labeling	Post-pandemic transition	Handling training needs amidst the ongoing pandemic created challenges	Devised virtual and in-person (hybrid) training sessions
	Resource constraint	Uneven distribution of Home Energy Score Assessors over the service area increased expenses and logistical challenges	N/A
SoCalREN WE&T	Language and socioeconomic barriers	Participants faced language and socioeconomic barriers	Program provided translated materials and financial support for training, and collaborated with community organizations to broaden accessibility
3C-REN WE&T	Resource constraint	Time constraints faced by contractors and low-income workers limited participation	Program offered training with certification to help participants fulfill the continuing education requirements of their profession
3C-REN C&S	Resource constraint	Limited staff time to attend trainings and forums	Used different strategies to engage

Program	Overarching challenges and barriers	Specific challenges and barriers	Mitigation strategies and suggested solutions
	Lack of customer awareness	Lack of awareness about available services like the Energy Code Coach	Annual meetings with cities to ensure staff are aware of 3C-REN energy code services
	Staff turnover	Heavy staff turnover at the primary implementation partner	Issued RFP to find new capable partner

6.5 Appendix E: Sampling

As described in section 3.1.4.2, we attempted a census of the REN single-family program through a web survey by sending invitations to all participants with valid email addresses. We employed a stratified random sampling approach for the multifamily programs and contacted a subset of participants for phone surveys and on-site visits. This section provides details on the sampling procedures used for each program type.

6.5.1 Single family sample

Although the single-family survey effort followed a census approach, with the full population of participants contacted after an initial soft launch to test the survey, DNV ran scenarios under a stratified ratio model to estimate the number of completed measure responses of each type required to achieve reasonable precision at the 90% confidence level during analysis. Our goal was to attain at least 10% relative precision for combined electric and gas MMBTU NTGRs for each climate zone covered by the program. Where possible, we also aimed for a 20% or better relative precision for combined electric and gas MMBTU NTGRs for each measure category. While we anticipated enough survey completions to achieve better than that target for several measures, we also determined it would be unlikely for a few categories (e.g., ductless mini-split heat pumps), which had small populations, to reach the necessary response rates.

Based on this analysis, we estimated that we would need at least 560 measure-response completes to meet our targets, with additional attempts to recruit uncommon measures, like ductless mini-split heat pumps and storage water heaters. Since we needed to implement the survey at the customer level, we rolled the measures up to define new customer-level strata based on the least-common measure installed. For example, if participants had installed faucet aerators and an induction cooktop, they would be placed into the induction cooktop stratum to implement and track the survey, with the primary goal of achieving our quota of information for induction cooktops. We considered all other measure information captured in that survey for later weighting and variance estimation. Given the aggregation of responses to primary measures, achieving the 560-measure target sample required completing surveys with at least 560 participants. Table 6-5 shows the climate zone-level scenario planning.

Table 6-5. Single-family NTGR precision estimates by climate zone at 90% confidence, ER = 0.5

Climate Zone	Combined MMBTU	kWh	Therms	Sample	Population	Total MMBTU
CZ02	10%	13%	13%	115	2,569	4,732
CZ03	10%	12%	14%	209	4,952	12,455
CZ04	10%	16%	11%	116	2,007	6,526
CZ12	10%	13%	11%	120	2,243	6,793
Overall	**5%**	**7%**	**8%**	**560**	**11,771**	**30,506**

Table 6-6 below show this measure-level scenario planning.

Table 6-6. Single-family NTGR precision estimates by measure category at 90% confidence, ER = 0.5

Measure Category	Combined MMBTU	kWh	Therms	Sample	Population	Total MMBTU
Attic Insulation	12%	13%	12%	47	1,284	1,865
Central Heat Pump	13%	12%	24%	61	548	4,889
Duct Sealing	14%	16%	14%	35	693	1,508
Ductless Mini-Split Heat Pump	20%	20%	N/A	15	81	1,633
Faucet Aerator	10%	36%	11%	63	2,086	2,351
Furnace	13%	118%	13%	37	597	1,560
Heat Pump Clothes Dryer	20%	20%	N/A	14	66	22
Heat Pump Water Heater	12%	12%	N/A	57	810	5,298
Induction Cooktop	20%	20%	N/A	16	218	158
Low-Flow Showerhead	11%	34%	11%	60	1,951	493
Smart Power Strip	10%	10%	10%	66	2,191	1,350
Smart Thermostat	20%	19%	283%	26	770	169
Storage Water Heater	18%	18%	18%	20	119	1,119
Wall Insulation	15%	12%	15%	43	357	8,091
Overall	**5%**	**7%**	**8%**	**560**	**11,771**	**30,506**

6.5.2 Multifamily sample

The multifamily survey used stratified ratio estimation to define the sample sizes needed to achieve 10% overall relative precision at the 90% confidence level for combined electric and gas MMBTU GRRs, assuming an error ratio of 0.5. Stratified ratio estimation allowed us to take advantage of the likely relationship between the savings provided in the program tracking data and the evaluated savings to reduce the number of completed sampling units necessary to achieve our target level of precision. We reduced the target sample size through an optimal stratification scheme, where we oversampled sites with higher savings to gather as much information as possible about population savings while completing fewer site visits.

While we planned to capture the in-service rates required to calculate the program's GRRs through on-site research, we first needed to complete phone surveys to recruit participants, during which we would ask participants questions relevant to the process and NTGR analyses. Since the process results would not be savings-weighted and not necessarily correlated with the savings in the tracking data, we needed to define a larger sample assuming a stratified random sampling scheme that would still meet precision targets. For this purpose, an additional sample was distributed among the smaller strata previously defined by the impact sample, with estimated precisions recalculated assuming no benefit from the optimal size stratification.

We accounted for the finite population effects of sampling a large proportion (~70%) of the population in estimating the precisions to define our target sample sizes.

Table 6-7 shows the results of the impact and process stratification schemes. Based on the two sampling strategies, we estimated it would be necessary to complete 28 site visits and 54 phone surveys to achieve our desired levels of precision. Given the target of 54 phone interviews, we would need to convert approximately 50% of those interviews to site visits, which we thought reasonable based on our prior experience with similar programs.

Table 6-7. Multifamily optimal sampling scheme with on-site and phone-interview sample targets

Program	Size Stratum	Population	On-site Target	Phone Interview Target
BayREN	1	14	3	10
BayREN	2	4	3	3
BayREN	3	1	1	1
SoCalREN	1	36	7	24
SoCalREN	2	13	7	9
SoCalREN	3	8	6	6
SoCalREN	4	1	1	1
Total			**28**	**54**

Table 6-8 shows the precision estimates for BayREN, SoCalREN, and overall, under the impact stratified ratio sample.

Table 6-8. Multifamily impact precision estimates by program at 90% confidence, ER=0.5

Program	Combined MMBTU	kWh	Therms	Sample	Population	Total MMBTU
BayREN	18%	21%	21%	7	19	10,516
SoCalREN	12%	13%	21%	21	58	37,208
Overall	**10%**	**11%**	**15%**	**28**	**77**	**47,724**

Table 6-9 provides the precision estimates for BayREN, SoCalREN, and overall, under the process stratified random sample.

Table 6-9. Multifamily process precision estimates by program at 90% confidence, CV=0.5

Program	Combined MMBTU	kWh	Therms	Sample	Population	Total MMBTU
BayREN	20%	31%	19%	14	19	10,516
SoCalREN	12%	17%	13%	40	58	37,208
Overall	**10%**	**16%**	**11%**	**54**	**77**	**47,724**

6.6 Appendix F: NTGR survey scoring

For the REN PY2022 single-family and multifamily programs with claimed savings, DNV used a standard NTGR approach that assesses three dimensions of free-ridership to determine program attribution: timing, quantity, and efficiency. The programs induce savings if they accelerate the timing of measure installation, increase the number of measures installed, or raise the efficiency level of installations.

The timing dimension is relevant to all measures. Quantity and efficiency are applicable for some measures and not for others. For example, it is almost always the case that the entire duct system is treated at once, so quantity would always be one for single-family programs. Similarly, the ducts are either sealed or not, so there is not a variable efficiency level as there would be for a furnace. The following provides measures and dimensions covered by participant type in the PY2022 REN evaluation:

- **Advanced power strip (timing, quantity)** – There are no varying levels of efficiency for advanced power strips, but the quantity dimension is applicable in both the single-family and multifamily programs.
- **Attic/wall/crawlspace insulation (timing, quantity for multifamily)** – There are no varying levels of efficiency for attic/wall insulation, which the single-family program incentivizes for the entire home, so only timing is applicable for single-family survey respondents. Survey respondents who are multifamily property managers could be responsible for common areas and multiple units and could have decided to install attic/wall/crawlspace insulation in more or fewer units. Thus, the timing and quantity dimensions apply to multifamily survey respondents.
- **Central heat pump (timing, efficiency)** – The single-family program incentivizes the installation of high-efficiency central heat pumps. Thus, the efficiency dimension applies for this measure.
- **Dishwasher (timing, quantity, efficiency)** – Dishwashers can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for multifamily program dishwashers. Multifamily program participants may have installed more than one, so the quantity dimension is also applicable
- **Duct sealing (timing)** – As noted above, duct sealing happens for the entire home and there are no variable levels of efficiency and quantity for single-family programs.
- **Ductless mini split (timing, efficiency) –** The single-family program incentivizes the installation of high-efficiency ductless mini splits. Thus, the efficiency dimension applies for this measure.
- **Electric cooktop (timing, quantity for multifamily, efficiency)** – Electric cooktops can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for electric cooktops for single-family and multifamily. For multifamily programs, participants may have installed induction cooktops in multiple tenant units, so the quantity dimension is also applicable.
- **Faucet aerator (timing, quantity)** – There are no varying levels of efficiency for faucet aerators, but the quantity dimension is applicable in both the single-family and multifamily programs.
- **Furnace (timing, efficiency)** – Furnaces in single-family programs could be replaced with standard or high efficiency furnaces. Thus, the efficiency dimension applies for this measure.
- **Heat pump clothes dryer (timing, efficiency)** – The single-family program incentivizes the installation of high-efficiency heat pump clothes dryers. Thus, the efficiency dimension applies for this measure.

- **Heat pump HVAC systems (timing, quantity, efficiency)** – HVAC systems can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for heat pump HVAC systems. Multifamily programs participants may have installed more than one, so the quantity dimension is also applicable.
- **HVAC unit (timing, quantity)** – HVAC systems can be replaced with a standard or efficient version. Therefore, the efficiency dimension is relevant for HVAC unit replacements. Multifamily programs participants may have installed more than one, so the quantity dimension is also applicable.
- **Heat pump water heater (timing, quantity for multifamily, efficiency)** – Water heaters can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for heat pump water heaters for single-family and multifamily. For multifamily programs participants may have installed more than one so the quantity dimension is also applicable.
- **Lighting (timing, quantity, efficiency)** – Lighting can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for lighting. The quantity dimension is also applicable for multifamily programs.
- **Lighting controls (timing, quantity)** – There are no varying levels of efficiency for lighting controls, but the quantity dimension is applicable for multifamily programs.
- **Pipe Insulation (timing, quantity)** – There are no varying levels of efficiency for pipe insulation. Survey respondents who are multifamily property managers could be responsible for common areas and multiple homes and could have decided to install pipe insulation in more or fewer units. Thus, the quantity dimension is applicable to multifamily survey respondents.
- **Pool or spa heater/pump (timing, quantity, efficiency)** – Pool or spa heaters or pumps can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for pool or spa heaters pumps. Multifamily programs participants may have installed more than one, so the quantity dimension is also applicable.
- **Pool or spa timer (timing, quantity)** – There are no varying levels of efficiency for pool or spa timers, but the quantity dimension is applicable for multifamily programs.
- **Radiator controls (timing, quantity)** – There are no varying levels of efficiency for radiator controls, but the quantity dimension is applicable for multifamily programs.
- **Refrigerator (timing, quantity, efficiency)** – Refrigerators can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for multifamily program refrigerators. Multifamily program participants may have installed more than one, so the quantity dimension is also applicable.
- **Showerhead (timing, quantity)** – For showerheads, there are no varying levels of efficiency, but the quantity dimension is applicable in both the single-family and multifamily programs.
- **Smart thermostats (timing, quantity for multifamily, efficiency)** – For smart thermostats, the single-family and multifamily property manager surveys asked about “efficiency” in terms of the type of thermostats that would otherwise have been installed but rated these at only 2 levels—smart (efficient) or not. For multifamily programs participants may have installed more than one so the quantity dimension is also applicable.
- **Washing machine (timing, quantity, efficiency)** – Washing machines can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for washing machines. Multifamily programs participants may have installed more than one, so the quantity dimension is also applicable

- **Water heating controls (timing, quantity)** – There are no varying levels of efficiency for water heating controls, but the quantity dimension is applicable for multifamily programs.
- **Water heater/boiler (timing, quantity for multifamily, efficiency)** – Water heaters can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for single-family and multifamily program water heaters. Multifamily program participants may have installed more than one, so the quantity dimension is also applicable.
- **Windows (timing, quantity, efficiency)** – Windows can be replaced with a standard or an efficient version. Therefore, the efficiency dimension is relevant for multifamily program windows. Multifamily program participants may have installed more than one, so the quantity dimension is also applicable.

The NTGR survey scoring elements are summarized below in Table 6-10 on the following page.

Table 6-10. Free-ridership elements by survey respondent type

Free-ridership dimension	Measures applicable	Question wording	Answer	Free-ridership score
Likelihood	All measures	**Multifamily** The program provided you a rebate of [REBATE] to purchase energy efficient equipment for your property. Without the program, how likely would you have been to purchase and install the equipment at your own expense? Would you say…? **Single-family** The project you completed through the program had a maximum rebate of $[REBATE]. Without BayREN's Home+ Program, how likely would you have been to have initiated and completed the project at your own expense? Would you say…	Very Likely	1
			Somewhat likely	.75
			A 50/50 Chance	.5
			Somewhat unlikely	.25
			Very Unlikely	0
Timing - (FR_t)	All measures	**Multifamily** Next can you tell me, without the program's rebate, when do you think you would have purchased and installed **Single-family** Without the BayREN's program offering on [INSTALL DATE], when would you have completed this project?	At the same time or sooner	1
			1 to 24 months later	(24 - # of months)/24
			More than 24 months later	0
			Never	0
			Don't know	Average of non-Don't know answers
Efficiency - (FR_e)	Smart thermostats (both program types)	Smart thermostats come in a variety of models. There are BASIC models that cost about $130 (e.g., Nest E and Ecobee 3 lite) and UPGRADED models that offer additional sensing technology and cost about $210 (e.g., Nest Learning 3rd Gen and Ecobee 4). There are also	Would have purchased the BASIC model smart thermostat(s)	1
			Would have purchased the UPGRADED model smart thermostat(s)	1
			Would have purchased standard programmable	0

Free-ridership dimension	Measures applicable	Question wording	Answer	Free-ridership score
		programmable and non-programmable thermostats that cost from $20-$100. If the program didn't offer a smart thermostat in 2022, which model would you have likely purchased?	thermostat(s); (e.g., without smart capabilities)	
			Would NOT have purchased any thermostat(s)	0
	Electric cooktop (both program types)	We would also like to know what influence the program had, if any, on the decision to install a MEASURE. Without the program, which of the following would you have done?	Would have purchased STANDARD efficiency MEASURE	0
			Would have purchased HIGH EFFICIENCY MEASURE	1
			Would NOT have purchased any MEASURE	0
	All other efficiency measures (both program types)	We would also like to know what influence the program had, if any, on the decision to install the new MEASURE equipment. Without the program, which of the following would you have done?	Would have purchased STANDARD EFFICIENCY (minimum or required by code) MEASURE	0
			Would have purchased INTERMEDIATE EFFICIENCY (above minimum but lower than program requirement) MEASURE	.5
			Would have purchased HIGH EFFICIENCY (same or higher than program requirement) heat pump MEASURE	1
			Would NOT have purchased any MEASURE	0
Quantity- (FR_q)	Faucet aerators, showerheads, and power strips (both program types)	Without the program, how many of the following upgrades you would have completed on your own?	None	0
			1	1 – ((n - answer)/n), where n is the number of measures installed through the program
			2	
			3	
			4	
			5 or more	
			Don't know	Average of non-Don't know answers
	All multifamily measures	Without the program's rebate, about what percentage of the following common area upgrades would you have completed at your own expense? Please estimate the portion that would have been completed as a percent for each type of equipment.	0%	0
			1%-10%	.05
			11% - 20%	.15
			21% - 30%	.25
			31% - 40%	.35

Free-ridership dimension	Measures applicable	Question wording	Answer	Free-ridership score
			41% - 50%	.45
			51% - 60%	.55
			61% - 70%	.65
			71% - 80%	.75
			81% - 90%	.85
			91% - 100%	.95
			100% (All)	1
			Don't know	Average of non-Don't know answers

Using these metrics in combination allowed us to fully assess the amount of savings that could be attributed to measures that participants would have installed absent program support. We assigned each respondent a score for each free-ridership metric based on their survey responses and combined those scores into an overall free-ridership score using the algorithms in Equations 1 through 5.

Equation 1: Free-ridership Scoring Algorithm if likelihood score is 0

Free-ridership= 0

Equation 2: Free-ridership Scoring Algorithm for measures with only timing component

Free-ridership= FR_timing score

Equation 3: Free-ridership Scoring Algorithm for measures with relevant efficiency component

*Free-ridership= FR_timing score * FR_efficiency score*

Equation 4: Free-ridership Scoring Algorithm for measures with relevant quantity component

*Free-ridership= FR_timing * FR_quantity*

Equation 5: Free-ridership Scoring Algorithm for measures with relevant efficiency and quantity component

*Free-ridership= FR_timing * FR_quantity * FR_efficiency score*

Program attribution or NTGRs are simply the complement of free-ridership and estimated as: NTGR = 1- Free-ridership.

Measure and program level NTGRs derived from participant surveys are weighted by savings claims to compute measure and program attribution estimates.

6.7 Appendix G: Sample weights

Following the end of the single-family and multi-family data collection efforts, DNV calculated weights applied to each completed survey result for use in the impact, net-to-gross, and process analyses. The weighting methodology followed the procedure described in Chapter 11: Sample Design Cross-Cutting Protocols of the NREL Uniform Methods Project, where the weight for each respondent reflects the proportion of the population they represent. This section describes the calculation process and provides the weights used for each analysis.

6.7.1 Single-family analysis weights

For the measure-level single-family NTGR analysis, we post-stratified the survey responses based on the customer-level scheme we developed, described in the sampling section. The post-stratification separated the measures into strata by climate zone, measure category, and the amount of savings in MMBTU based on the least common measure installed by each customer. We calculated weights applicable to a participant's primary (least common) measure for each of these strata as the ratio of 1 to the assumed probability of selection based on the number of completes achieved. We unit-weighted all secondary measures to avoid participants with less common measures over-representing those measures in the sample. Once weighted, we collapsed some strata with only a single completed response to allow us to estimate variance for each stratum. Table 6-11 shows the results of this process.

Table 6-11. Single-family NTGR post-stratification and weighting

Weighting strata	Variance strata	Weight
CZ02 - Attic Insulation - 1	CZ02 - Attic Insulation - 1	7.9
CZ02 - Central Heat Pump - 1	CZ02 - Central Heat Pump - 1	13.5
CZ02 - Central Heat Pump - 2	CZ02 - Central Heat Pump - 2	6.5
CZ02 - Duct Sealing - 1	CZ02 - Duct Sealing - 1	18.5
CZ02 - Ductless Mini-Split Heat Pump - 1	CZ02 - Ductless Mini-Split Heat Pump - 1	5.0
CZ02 - Faucet Aerator - 1	CZ02 - Faucet Aerator - 1	51.8
CZ02 - Faucet Aerator - 2	CZ02 - Faucet Aerator - 2	43.4
CZ02 - Faucet Aerator - 3	CZ02 - Faucet Aerator - 3	34.2
CZ02 - Furnace - 1	CZ03 - Furnace - 1	24.0
CZ02 - Heat Pump Clothes Dryer - 1	CZ03 - Heat Pump Clothes Dryer - 1	4.0
CZ02 - Heat Pump Water Heater - 1	CZ02 - Heat Pump Water Heater - 1	5.0
CZ02 - Heat Pump Water Heater - 2	CZ02 - Heat Pump Water Heater - 2	2.8
CZ02 - Heat Pump Water Heater - 3	CZ02 - Heat Pump Water Heater - 3	5.6
CZ02 - Induction Cooktop - 1	CZ02 - Induction Cooktop - 1	3.6
CZ02 - Low-Flow Showerhead - 1	CZ02 - Low-Flow Showerhead - 1	22.4
CZ02 - Low-Flow Showerhead - 2	CZ02 - Low-Flow Showerhead - 2	27.4
CZ02 - Low-Flow Showerhead - 3	CZ02 - Low-Flow Showerhead - 3	72.3
CZ02 - Smart Power Strip - 1	CZ02 - Smart Power Strip - 1	236.0
CZ02 - Smart Power Strip - 2	CZ02 - Smart Power Strip - 2	37.8
CZ02 - Smart Power Strip - 3	CZ02 - Smart Power Strip - 3	16.5
CZ02 - Wall Insulation - 1	CZ02 - Wall Insulation - 1	4.7
CZ02 - Wall Insulation - 2	CZ02 - Wall Insulation - 2	6.0
CZ03 - Attic Insulation - 1	CZ03 - Attic Insulation - 1	10.6
CZ03 - Attic Insulation - 2	CZ03 - Attic Insulation - 2	11.5

Weighting strata	Variance strata	Weight
CZ03 - Attic Insulation - 3	CZ03 - Attic Insulation - 3	18.6
CZ03 - Central Heat Pump - 1	CZ03 - Central Heat Pump - 1	12.8
CZ03 - Central Heat Pump - 2	CZ03 - Central Heat Pump - 2	4.7
CZ03 - Duct Sealing - 1	CZ03 - Duct Sealing - 1	7.4
CZ03 - Duct Sealing - 2	CZ03 - Duct Sealing - 2	14.6
CZ03 - Duct Sealing - 3	CZ03 - Duct Sealing - 3	54.0
CZ03 - Ductless Mini-Split Heat Pump - 1	CZ03 - Ductless Mini-Split Heat Pump - 1	4.0
CZ03 - Ductless Mini-Split Heat Pump - 2	CZ03 - Ductless Mini-Split Heat Pump - 1	16.0
CZ03 - Faucet Aerator - 1	CZ03 - Faucet Aerator - 1	21.7
CZ03 - Faucet Aerator - 2	CZ03 - Faucet Aerator - 2	33.3
CZ03 - Faucet Aerator - 3	CZ03 - Faucet Aerator - 3	16.6
CZ03 - Furnace - 1	CZ03 - Furnace - 1	18.8
CZ03 - Furnace - 2	CZ03 - Furnace - 2	23.3
CZ03 - Heat Pump Clothes Dryer - 1	CZ03 - Heat Pump Clothes Dryer - 1	6.7
CZ03 - Heat Pump Clothes Dryer - 2	CZ03 - Heat Pump Clothes Dryer - 2	3.0
CZ03 - Heat Pump Water Heater - 1	CZ03 - Heat Pump Water Heater - 1	5.7
CZ03 - Heat Pump Water Heater - 2	CZ03 - Heat Pump Water Heater - 2	4.5
CZ03 - Heat Pump Water Heater - 3	CZ03 - Heat Pump Water Heater - 3	5.3
CZ03 - Induction Cooktop - 1	CZ03 - Induction Cooktop - 1	3.8
CZ03 - Induction Cooktop - 2	CZ03 - Induction Cooktop - 2	3.8
CZ03 - Low-Flow Showerhead - 1	CZ03 - Low-Flow Showerhead - 1	15.1
CZ03 - Low-Flow Showerhead - 2	CZ03 - Low-Flow Showerhead - 2	24.4
CZ03 - Low-Flow Showerhead - 3	CZ03 - Low-Flow Showerhead - 3	27.6
CZ03 - Smart Power Strip - 1	CZ03 - Smart Power Strip - 1	40.9
CZ03 - Smart Power Strip - 2	CZ03 - Smart Power Strip - 2	19.8
CZ03 - Smart Power Strip - 3	CZ03 - Smart Power Strip - 3	18.7
CZ03 - Smart Thermostat - 1	CZ03 - Smart Thermostat - 1	37.7
CZ03 - Smart Thermostat - 2	CZ03 - Smart Thermostat - 2	25.1
CZ03 - Wall Insulation - 1	CZ03 - Wall Insulation - 1	21.0
CZ03 - Wall Insulation - 2	CZ03 - Wall Insulation - 2	19.3
CZ04 - Attic Insulation - 1	CZ04 - Attic Insulation - 1	23.3
CZ04 - Attic Insulation - 2	CZ04 - Attic Insulation - 2	28.2
CZ04 - Attic Insulation - 3	CZ04 - Attic Insulation - 3	26.0
CZ04 - Central Heat Pump - 1	CZ04 - Central Heat Pump - 1	17.0
CZ04 - Central Heat Pump - 2	CZ04 - Central Heat Pump - 2	3.0
CZ04 - Duct Sealing - 1	CZ04 - Duct Sealing - 1	10.0
CZ04 - Duct Sealing - 2	CZ04 - Duct Sealing - 2	12.3
CZ04 - Ductless Mini-Split Heat Pump - 1	CZ03 - Ductless Mini-Split Heat Pump - 1	10.0
CZ04 - Faucet Aerator - 1	CZ04 - Faucet Aerator - 1	25.2
CZ04 - Furnace - 1	CZ04 - Furnace - 1	1.0
CZ04 - Furnace - 2	CZ04 - Furnace - 2	31.5

Weighting strata	Variance strata	Weight
CZ04 - Heat Pump Clothes Dryer - 1	CZ04 - Heat Pump Clothes Dryer - 1	6.5
CZ04 - Heat Pump Water Heater - 1	CZ04 - Heat Pump Water Heater - 1	9.7
CZ04 - Heat Pump Water Heater - 2	CZ04 - Heat Pump Water Heater - 2	3.6
CZ04 - Heat Pump Water Heater - 3	CZ04 - Heat Pump Water Heater - 3	7.5
CZ04 - Induction Cooktop - 1	CZ04 - Induction Cooktop - 1	2.9
CZ04 - Low-Flow Showerhead - 1	CZ04 - Low-Flow Showerhead - 1	10.1
CZ04 - Smart Power Strip - 1	CZ04 - Smart Power Strip - 1	9.3
CZ04 - Smart Power Strip - 2	CZ04 - Smart Power Strip - 2	12.1
CZ04 - Storage Water Heater - 1	CZ04 - Storage Water Heater - 1	18.0
CZ04 - Storage Water Heater - 2	CZ04 - Storage Water Heater - 2	17.0
CZ04 - Wall Insulation - 1	CZ04 - Wall Insulation - 1	12.4
CZ04 - Wall Insulation - 2	CZ04 - Wall Insulation - 2	77.0
CZ12 - Attic Insulation - 1	CZ12 - Attic Insulation - 1	20.3
CZ12 - Attic Insulation - 2	CZ12 - Attic Insulation - 2	13.0
CZ12 - Central Heat Pump - 1	CZ12 - Central Heat Pump - 1	22.2
CZ12 - Central Heat Pump - 2	CZ12 - Central Heat Pump - 2	13.0
CZ12 - Central Heat Pump - 3	CZ12 - Central Heat Pump - 3	16.0
CZ12 - Duct Sealing - 1	CZ12 - Duct Sealing - 1	8.9
CZ12 - Duct Sealing - 2	CZ12 - Duct Sealing - 2	36.5
CZ12 - Duct Sealing - 3	CZ12 - Duct Sealing - 3	29.5
CZ12 - Ductless Mini-Split Heat Pump - 1	CZ12 - Ductless Mini-Split Heat Pump - 1	9.0
CZ12 - Faucet Aerator - 1	CZ12 - Faucet Aerator - 1	18.4
CZ12 - Faucet Aerator - 2	CZ12 - Faucet Aerator - 2	27.3
CZ12 - Furnace - 1	CZ12 - Furnace - 1	31.7
CZ12 - Furnace - 2	CZ12 - Furnace - 2	32.3
CZ12 - Furnace - 3	CZ12 - Furnace - 3	22.8
CZ12 - Heat Pump Clothes Dryer - 1	CZ04 - Heat Pump Clothes Dryer - 1	8.0
CZ12 - Heat Pump Water Heater - 1	CZ12 - Heat Pump Water Heater - 1	21.6
CZ12 - Heat Pump Water Heater - 2	CZ12 - Heat Pump Water Heater - 2	9.9
CZ12 - Induction Cooktop - 1	CZ12 - Induction Cooktop - 1	4.6
CZ12 - Low-Flow Showerhead - 1	CZ12 - Low-Flow Showerhead - 1	28.0
CZ12 - Low-Flow Showerhead - 2	CZ12 - Low-Flow Showerhead - 2	86.0
CZ12 - Smart Power Strip - 1	CZ12 - Smart Power Strip - 1	29.3
CZ12 - Smart Power Strip - 2	CZ12 - Smart Power Strip - 2	17.4
CZ12 - Smart Thermostat - 1	CZ12 - Smart Thermostat - 1	24.4
CZ12 - Smart Thermostat - 2	CZ12 - Smart Thermostat - 2	57.0
CZ12 - Storage Water Heater - 1	CZ12 - Storage Water Heater - 1	8.0
CZ12 - Wall Insulation - 1	CZ12 - Wall Insulation - 1	17.0
CZ12 - Wall Insulation - 2	CZ12 - Wall Insulation - 1	12.0

For the single-family process analysis, the survey asked one set of questions covering program experience versus the NTGR analysis, which gathered information at the measure level. Given this, we followed a similar procedure to the development of the NTGR weights described above, with the weight for each customer based on the assumed probability of selection of their primary (least-common) measure. Table 6-12 shows the results of this weighting procedure.

Table 6-12. Single-family process post-stratification and weighting

Weighting Strata	Variance Strata	Weight
CZ02 - Attic Insulation - 1	CZ02 - Attic Insulation - 1	4.75
CZ02 - Central Heat Pump - 1	CZ02 - Central Heat Pump - 1	11
CZ02 - Central Heat Pump - 2	CZ02 - Central Heat Pump - 2	5
CZ02 - Duct Sealing - 1	CZ03 - Duct Sealing - 1	14
CZ02 - Ductless Mini-Split Heat Pump - 1	CZ02 - Ductless Mini-Split Heat Pump - 1	4.75
CZ02 - Faucet Aerator - 1	CZ02 - Faucet Aerator - 1	18
CZ02 - Faucet Aerator - 2	CZ02 - Faucet Aerator - 2	17.2
CZ02 - Faucet Aerator - 3	CZ02 - Faucet Aerator - 3	13.33
CZ02 - Furnace - 1	CZ03 - Furnace - 1	18
CZ02 - Heat Pump Clothes Dryer - 1	CZ03 - Heat Pump Clothes Dryer - 1	4
CZ02 - Heat Pump Water Heater - 1	CZ02 - Heat Pump Water Heater - 1	4.17
CZ02 - Heat Pump Water Heater - 2	CZ02 - Heat Pump Water Heater - 2	2.7
CZ02 - Heat Pump Water Heater - 3	CZ02 - Heat Pump Water Heater - 3	4.4
CZ02 - Induction Cooktop - 1	CZ02 - Induction Cooktop - 1	3.36
CZ02 - Low-Flow Showerhead - 1	CZ02 - Low-Flow Showerhead - 1	8.2
CZ02 - Low-Flow Showerhead - 2	CZ02 - Low-Flow Showerhead - 2	11
CZ02 - Low-Flow Showerhead - 3	CZ02 - Low-Flow Showerhead - 3	25.67
CZ02 - Smart Power Strip - 1	CZ02 - Smart Power Strip - 2	88
CZ02 - Smart Power Strip - 2	CZ02 - Smart Power Strip - 2	12.33
CZ02 - Smart Power Strip - 3	CZ02 - Smart Power Strip - 3	5.64
CZ02 - Wall Insulation - 1	CZ02 - Wall Insulation - 1	4.67
CZ02 - Wall Insulation - 2	CZ02 - Wall Insulation - 1	9
CZ03 - Attic Insulation - 1	CZ03 - Attic Insulation - 1	6.71
CZ03 - Attic Insulation - 2	CZ03 - Attic Insulation - 2	8.4
CZ03 - Attic Insulation - 3	CZ03 - Attic Insulation - 3	12.2
CZ03 - Central Heat Pump - 1	CZ03 - Central Heat Pump - 1	10.25
CZ03 - Central Heat Pump - 2	CZ03 - Central Heat Pump - 2	4.33
CZ03 - Duct Sealing - 1	CZ03 - Duct Sealing - 1	5.54
CZ03 - Duct Sealing - 2	CZ03 - Duct Sealing - 2	8.2
CZ03 - Duct Sealing - 3	CZ03 - Duct Sealing - 2	33
CZ03 - Ductless Mini-Split Heat Pump - 1	CZ03 - Ductless Mini-Split Heat Pump - 1	4
CZ03 - Ductless Mini-Split Heat Pump - 2	CZ03 - Ductless Mini-Split Heat Pump - 1	16
CZ03 - Faucet Aerator - 1	CZ03 - Faucet Aerator - 1	8.53
CZ03 - Faucet Aerator - 2	CZ03 - Faucet Aerator - 2	11.33
CZ03 - Faucet Aerator - 3	CZ03 - Faucet Aerator - 3	6.41

Weighting Strata	Variance Strata	Weight
CZ03 - Furnace - 1	CZ03 - Furnace - 1	11
CZ03 - Furnace - 2	CZ03 - Furnace - 2	14
CZ03 - Heat Pump Clothes Dryer - 1	CZ03 - Heat Pump Clothes Dryer - 1	6.33
CZ03 - Heat Pump Clothes Dryer - 2	CZ03 - Heat Pump Clothes Dryer - 2	2.71
CZ03 - Heat Pump Water Heater - 1	CZ03 - Heat Pump Water Heater - 1	4.96
CZ03 - Heat Pump Water Heater - 2	CZ03 - Heat Pump Water Heater - 2	4.29
CZ03 - Heat Pump Water Heater - 3	CZ03 - Heat Pump Water Heater - 3	4.54
CZ03 - Induction Cooktop - 1	CZ03 - Induction Cooktop - 1	3.41
CZ03 - Induction Cooktop - 2	CZ03 - Induction Cooktop - 2	3.56
CZ03 - Low-Flow Showerhead - 1	CZ03 - Low-Flow Showerhead - 1	6.16
CZ03 - Low-Flow Showerhead - 2	CZ03 - Low-Flow Showerhead - 2	9.92
CZ03 - Low-Flow Showerhead - 3	CZ03 - Low-Flow Showerhead - 3	9.91
CZ03 - Smart Power Strip - 1	CZ03 - Smart Power Strip - 1	17.25
CZ03 - Smart Power Strip - 2	CZ03 - Smart Power Strip - 2	7.35
CZ03 - Smart Power Strip - 3	CZ03 - Smart Power Strip - 3	7.35
CZ03 - Smart Thermostat - 1	CZ03 - Smart Thermostat - 1	12.29
CZ03 - Smart Thermostat - 2	CZ03 - Smart Thermostat - 2	8.22
CZ03 - Wall Insulation - 1	CZ03 - Wall Insulation - 1	12.75
CZ03 - Wall Insulation - 2	CZ03 - Wall Insulation - 2	14
CZ04 - Attic Insulation - 1	CZ04 - Attic Insulation - 1	16.22
CZ04 - Attic Insulation - 2	CZ04 - Attic Insulation - 2	19.17
CZ04 - Attic Insulation - 3	CZ04 - Attic Insulation - 3	16.6
CZ04 - Central Heat Pump - 1	CZ04 - Central Heat Pump - 1	10.2
CZ04 - Central Heat Pump - 2	CZ04 - Central Heat Pump - 2	2.8
CZ04 - Duct Sealing - 1	CZ04 - Duct Sealing - 1	4.7
CZ04 - Duct Sealing - 2	CZ04 - Duct Sealing - 2	6.33
CZ04 - Ductless Mini-Split Heat Pump - 1	CZ03 - Ductless Mini-Split Heat Pump - 1	8
CZ04 - Faucet Aerator - 1	CZ04 - Faucet Aerator - 1	7.6
CZ04 - Furnace - 1	CZ04 - Furnace - 1	36.5
CZ04 - Heat Pump Clothes Dryer - 1	CZ04 - Heat Pump Clothes Dryer - 1	6.5
CZ04 - Heat Pump Water Heater - 1	CZ04 - Heat Pump Water Heater - 1	8
CZ04 - Heat Pump Water Heater - 2	CZ04 - Heat Pump Water Heater - 2	3.13
CZ04 - Heat Pump Water Heater - 3	CZ04 - Heat Pump Water Heater - 3	7.5
CZ04 - Induction Cooktop - 1	CZ04 - Induction Cooktop - 1	2.88
CZ04 - Low-Flow Showerhead - 1	CZ04 - Low-Flow Showerhead - 1	4.44
CZ04 - Smart Power Strip - 1	CZ04 - Smart Power Strip - 1	6.78
CZ04 - Smart Power Strip - 2	CZ04 - Smart Power Strip - 2	8.25
CZ04 - Storage Water Heater - 1	CZ04 - Storage Water Heater - 1	16
CZ04 - Storage Water Heater - 2	CZ04 - Storage Water Heater - 2	15
CZ04 - Wall Insulation - 1	CZ04 - Wall Insulation - 1	10.4

Weighting Strata	Variance Strata	Weight
CZ04 - Wall Insulation - 2	CZ04 - Wall Insulation - 1	62
CZ12 - Attic Insulation - 1	CZ12 - Attic Insulation - 1	11.14
CZ12 - Attic Insulation - 2	CZ12 - Attic Insulation - 2	7.11
CZ12 - Central Heat Pump - 1	CZ12 - Central Heat Pump - 1	7.36
CZ12 - Central Heat Pump - 2	CZ12 - Central Heat Pump - 2	11
CZ12 - Central Heat Pump - 3	CZ12 - Central Heat Pump - 3	14
CZ12 - Duct Sealing - 1	CZ12 - Duct Sealing - 1	5.3
CZ12 - Duct Sealing - 2	CZ12 - Duct Sealing - 2	21
CZ12 - Duct Sealing - 3	CZ12 - Duct Sealing - 3	19.5
CZ12 - Ductless Mini-Split Heat Pump - 1	CZ03 - Ductless Mini-Split Heat Pump - 1	9
CZ12 - Faucet Aerator - 1	CZ12 - Faucet Aerator - 1	5.2
CZ12 - Faucet Aerator - 2	CZ12 - Faucet Aerator - 2	10
CZ12 - Furnace - 1	CZ12 - Furnace - 1	21
CZ12 - Furnace - 2	CZ12 - Furnace - 2	21
CZ12 - Furnace - 3	CZ12 - Furnace - 3	19.67
CZ12 - Heat Pump Clothes Dryer - 1	CZ04 - Heat Pump Clothes Dryer - 1	8
CZ12 - Heat Pump Water Heater - 1	CZ12 - Heat Pump Water Heater - 1	19.4
CZ12 - Heat Pump Water Heater - 2	CZ12 - Heat Pump Water Heater - 2	9.7
CZ12 - Induction Cooktop - 1	CZ12 - Induction Cooktop - 1	4.2
CZ12 - Low-Flow Showerhead - 1	CZ12 - Low-Flow Showerhead - 1	11.33
CZ12 - Low-Flow Showerhead - 2	CZ12 - Low-Flow Showerhead - 1	28
CZ12 - Smart Power Strip - 1	CZ12 - Smart Power Strip - 1	11.33
CZ12 - Smart Power Strip - 2	CZ12 - Smart Power Strip - 2	7.6
CZ12 - Smart Thermostat - 1	CZ12 - Smart Thermostat - 1	15.67
CZ12 - Smart Thermostat - 2	CZ12 - Smart Thermostat - 2	19.5
CZ12 - Storage Water Heater - 1	CZ04 - Storage Water Heater - 1	7
CZ12 - Wall Insulation - 1	CZ12 - Wall Insulation - 1	16
CZ12 - Wall Insulation - 2	CZ12 - Wall Insulation - 1	11

6.7.2 Multifamily analysis weights

For the multifamily impact analysis, we post-stratified and weighted the results based on the initial stratified sampling plan. Post-stratification was necessary due to the lack of completes in SoCalREN's size stratum 3, which we collapsed with size stratum 2. Since no facilities from SoCalREN's size stratum 3 participated, the analysis results may reflect some amount of non-response bias if that unreached population differed in some way from the population for which we were able to conduct on-site research. As with the single-family weights, weighting strata with only a single complete had to be collapsed to allow for variance calculations, except for census strata with a population of 1 (the variance for those strata will be 0).

For the multifamily process and NTGR analyses, we calculated weights similarly based on the number of phone interview completes achieved instead of the number of site visits. Since we completed an interview with at least one participant in each original sample stratum, no collapsing or other post-stratification was necessary. Table 6-13 provides the multifamily impact analysis weights by measure type.

Table 6-13. Multifamily impact post-stratification and weighting

Weighting strata	Variance strata	Weight
CZ02 - Attic Insulation - 1	CZ02 - Attic Insulation - 1	4.8
CZ02 - Central Heat Pump - 1	CZ02 - Central Heat Pump - 1	11.0
CZ02 - Central Heat Pump - 2	CZ02 - Central Heat Pump - 2	5.0
CZ02 - Duct Sealing - 1	CZ03 - Duct Sealing - 1	14.0
CZ02 - Ductless Mini-Split Heat Pump - 1	CZ02 - Ductless Mini-Split Heat Pump - 1	4.8
CZ02 - Faucet Aerator - 1	CZ02 - Faucet Aerator - 1	18.0
CZ02 - Faucet Aerator - 2	CZ02 - Faucet Aerator - 2	17.2
CZ02 - Faucet Aerator - 3	CZ02 - Faucet Aerator - 3	13.3
CZ02 - Furnace - 1	CZ03 - Furnace - 1	18.0
CZ02 - Heat Pump Clothes Dryer - 1	CZ03 - Heat Pump Clothes Dryer - 1	4.0
CZ02 - Heat Pump Water Heater - 1	CZ02 - Heat Pump Water Heater - 1	4.2
CZ02 - Heat Pump Water Heater - 2	CZ02 - Heat Pump Water Heater - 2	2.7
CZ02 - Heat Pump Water Heater - 3	CZ02 - Heat Pump Water Heater - 3	4.4
CZ02 - Induction Cooktop - 1	CZ02 - Induction Cooktop - 1	3.4
CZ02 - Low-Flow Showerhead - 1	CZ02 - Low-Flow Showerhead - 1	8.2
CZ02 - Low-Flow Showerhead - 2	CZ02 - Low-Flow Showerhead - 2	11.0
CZ02 - Low-Flow Showerhead - 3	CZ02 - Low-Flow Showerhead - 3	25.7
CZ02 - Smart Power Strip - 1	CZ02 - Smart Power Strip - 2	88.0
CZ02 - Smart Power Strip - 2	CZ02 - Smart Power Strip - 2	12.3
CZ02 - Smart Power Strip - 3	CZ02 - Smart Power Strip - 3	5.6
CZ02 - Wall Insulation - 1	CZ02 - Wall Insulation - 1	4.7
CZ02 - Wall Insulation - 2	CZ02 - Wall Insulation - 1	9.0
CZ03 - Attic Insulation - 1	CZ03 - Attic Insulation - 1	6.7
CZ03 - Attic Insulation - 2	CZ03 - Attic Insulation - 2	8.4
CZ03 - Attic Insulation - 3	CZ03 - Attic Insulation - 3	12.2
CZ03 - Central Heat Pump - 1	CZ03 - Central Heat Pump - 1	10.3
CZ03 - Central Heat Pump - 2	CZ03 - Central Heat Pump - 2	4.3
CZ03 - Duct Sealing - 1	CZ03 - Duct Sealing - 1	5.5
CZ03 - Duct Sealing - 2	CZ03 - Duct Sealing - 2	8.2
CZ03 - Duct Sealing - 3	CZ03 - Duct Sealing - 2	33.0
CZ03 - Ductless Mini-Split Heat Pump - 1	CZ03 - Ductless Mini-Split Heat Pump - 1	4.0
CZ03 - Ductless Mini-Split Heat Pump - 2	CZ03 - Ductless Mini-Split Heat Pump - 1	16.0
CZ03 - Faucet Aerator - 1	CZ03 - Faucet Aerator - 1	8.5
CZ03 - Faucet Aerator - 2	CZ03 - Faucet Aerator - 2	11.3
CZ03 - Faucet Aerator - 3	CZ03 - Faucet Aerator - 3	6.4
CZ03 - Furnace - 1	CZ03 - Furnace - 1	11.0
CZ03 - Furnace - 2	CZ03 - Furnace - 2	14.0
CZ03 - Heat Pump Clothes Dryer - 1	CZ03 - Heat Pump Clothes Dryer - 1	6.3
CZ03 - Heat Pump Clothes Dryer - 2	CZ03 - Heat Pump Clothes Dryer - 2	2.7

Weighting strata	Variance strata	Weight
CZ03 - Heat Pump Water Heater - 1	CZ03 - Heat Pump Water Heater - 1	5.0
CZ03 - Heat Pump Water Heater - 2	CZ03 - Heat Pump Water Heater - 2	4.3
CZ03 - Heat Pump Water Heater - 3	CZ03 - Heat Pump Water Heater - 3	4.5
CZ03 - Induction Cooktop - 1	CZ03 - Induction Cooktop - 1	3.4
CZ03 - Induction Cooktop - 2	CZ03 - Induction Cooktop - 2	3.6
CZ03 - Low-Flow Showerhead - 1	CZ03 - Low-Flow Showerhead - 1	6.2
CZ03 - Low-Flow Showerhead - 2	CZ03 - Low-Flow Showerhead - 2	9.9
CZ03 - Low-Flow Showerhead - 3	CZ03 - Low-Flow Showerhead - 3	9.9
CZ03 - Smart Power Strip - 1	CZ03 - Smart Power Strip - 1	17.3
CZ03 - Smart Power Strip - 2	CZ03 - Smart Power Strip - 2	7.4
CZ03 - Smart Power Strip - 3	CZ03 - Smart Power Strip - 3	7.4
CZ03 - Smart Thermostat - 1	CZ03 - Smart Thermostat - 1	12.3
CZ03 - Smart Thermostat - 2	CZ03 - Smart Thermostat - 2	8.2
CZ03 - Wall Insulation - 1	CZ03 - Wall Insulation - 1	12.8
CZ03 - Wall Insulation - 2	CZ03 - Wall Insulation - 2	14.0
CZ04 - Attic Insulation - 1	CZ04 - Attic Insulation - 1	16.2
CZ04 - Attic Insulation - 2	CZ04 - Attic Insulation - 2	19.2
CZ04 - Attic Insulation - 3	CZ04 - Attic Insulation - 3	16.6
CZ04 - Central Heat Pump - 1	CZ04 - Central Heat Pump - 1	10.2
CZ04 - Central Heat Pump - 2	CZ04 - Central Heat Pump - 2	2.8
CZ04 - Duct Sealing - 1	CZ04 - Duct Sealing - 1	4.7
CZ04 - Duct Sealing - 2	CZ04 - Duct Sealing - 2	6.3
CZ04 - Ductless Mini-Split Heat Pump - 1	CZ03 - Ductless Mini-Split Heat Pump - 1	8.0
CZ04 - Faucet Aerator - 1	CZ04 - Faucet Aerator - 1	7.6
CZ04 - Furnace - 1	CZ04 - Furnace - 1	36.5
CZ04 - Heat Pump Clothes Dryer - 1	CZ04 - Heat Pump Clothes Dryer - 1	6.5
CZ04 - Heat Pump Water Heater - 1	CZ04 - Heat Pump Water Heater - 1	8.0
CZ04 - Heat Pump Water Heater - 2	CZ04 - Heat Pump Water Heater - 2	3.1
CZ04 - Heat Pump Water Heater - 3	CZ04 - Heat Pump Water Heater - 3	7.5
CZ04 - Induction Cooktop - 1	CZ04 - Induction Cooktop - 1	2.9
CZ04 - Low-Flow Showerhead - 1	CZ04 - Low-Flow Showerhead - 1	4.4
CZ04 - Smart Power Strip - 1	CZ04 - Smart Power Strip - 1	6.8
CZ04 - Smart Power Strip - 2	CZ04 - Smart Power Strip - 2	8.3
CZ04 - Storage Water Heater - 1	CZ04 - Storage Water Heater - 1	16.0
CZ04 - Storage Water Heater - 2	CZ04 - Storage Water Heater - 2	15.0
CZ04 - Wall Insulation - 1	CZ04 - Wall Insulation - 1	10.4
CZ04 - Wall Insulation - 2	CZ04 - Wall Insulation - 1	62.0
CZ12 - Attic Insulation - 1	CZ12 - Attic Insulation - 1	11.1
CZ12 - Attic Insulation - 2	CZ12 - Attic Insulation - 2	7.1
CZ12 - Central Heat Pump - 1	CZ12 - Central Heat Pump - 1	7.4

Weighting strata	Variance strata	Weight
CZ12 - Central Heat Pump - 2	CZ12 - Central Heat Pump - 2	11.0
CZ12 - Central Heat Pump - 3	CZ12 - Central Heat Pump - 3	14.0
CZ12 - Duct Sealing - 1	CZ12 - Duct Sealing - 1	5.3
CZ12 - Duct Sealing - 2	CZ12 - Duct Sealing - 2	21.0
CZ12 - Duct Sealing - 3	CZ12 - Duct Sealing - 3	19.5
CZ12 - Ductless Mini-Split Heat Pump - 1	CZ03 - Ductless Mini-Split Heat Pump - 1	9.0
CZ12 - Faucet Aerator - 1	CZ12 - Faucet Aerator - 1	5.2
CZ12 - Faucet Aerator - 2	CZ12 - Faucet Aerator - 2	10.0
CZ12 - Furnace - 1	CZ12 - Furnace - 1	21.0
CZ12 - Furnace - 2	CZ12 - Furnace - 2	21.0
CZ12 - Furnace - 3	CZ12 - Furnace - 3	19.7
CZ12 - Heat Pump Clothes Dryer - 1	CZ04 - Heat Pump Clothes Dryer - 1	8.0
CZ12 - Heat Pump Water Heater - 1	CZ12 - Heat Pump Water Heater - 1	19.4
CZ12 - Heat Pump Water Heater - 2	CZ12 - Heat Pump Water Heater - 2	9.7
CZ12 - Induction Cooktop - 1	CZ12 - Induction Cooktop - 1	4.2
CZ12 - Low-Flow Showerhead - 1	CZ12 - Low-Flow Showerhead - 1	11.3
CZ12 - Low-Flow Showerhead - 2	CZ12 - Low-Flow Showerhead - 1	28.0
CZ12 - Smart Power Strip - 1	CZ12 - Smart Power Strip - 1	11.3
CZ12 - Smart Power Strip - 2	CZ12 - Smart Power Strip - 2	7.6
CZ12 - Smart Thermostat - 1	CZ12 - Smart Thermostat - 1	15.7
CZ12 - Smart Thermostat - 2	CZ12 - Smart Thermostat - 2	19.5
CZ12 - Storage Water Heater - 1	CZ04 - Storage Water Heater - 1	7.0
CZ12 - Wall Insulation - 1	CZ12 - Wall Insulation - 1	16.0
CZ12 - Wall Insulation - 2	CZ12 - Wall Insulation - 1	11.0

Table 6-14 provides the multifamily process analysis weights by measure type.

Table 6-14. Multifamily process post-stratification and weighting

Weighting strata	Variance strata	Weight
BayREN - 1	BayREN - 1	1.4
BayREN - 2	BayREN - 1	4.0
BayREN - 3	BayREN - 3	1.0
SoCalREN - 1	SoCalREN - 1	3.3
SoCalREN - 2	SoCalREN - 2	1.9
SoCalREN - 3	SoCalREN - 3	2.7
SoCalREN - 4	SoCalREN - 4	1.0

6.8 Appendix H: Matching results

DNV used a quasi-experimental design to identify comparison group customers that served as matches for the REN single-family electric and gas participants. The following section provides the results from the two-phase matching we undertook to select the matched comparison households. Tests of balance between participants and selected non-participants show improvements in matches in each phase.

6.6.1 First-phase matching results

Table 6-15 shows results based on the metrics used to test balance for first-phase electric and gas matches. These metrics are based on the annual consumption of participants and selected candidate matches after matching. The standardized mean differences and the variance ratios for the matched groups show that the selected 20:1 matches are relatively well-balanced. The standardized difference for the matched electric group is 0.00, and for the matched gas group is 0.001. The variance ratio for both fuel types is close to 1, generally indicating the variance of annual usage of the matched groups is similar.

Table 6-15. Metrics to test balance for first-phase matching

Fuel type	Standardized mean difference	Variance ratio
Electric	0.0	1.0
Gas	0.0	1.0

6.6.2 Second-phase matching results

Interval data were the basis of the second phase 1:1 matches. These matches make it possible to control for non-program-related changes and provide the conditions for a robust analysis of the effect of REN single-family program installations on energy consumption changes.

The metrics used to test balance, shown in Table 6-16, indicate that the selected 1:1 matches in phase two matching are well-balanced. As in the first-phase matching, we used the annual consumption of the matched groups to compute the balance metrics. The standardized mean differences are near zero, and variance ratios are near 1 for both fuels.

Table 6-16. Metrics to test balance for second-phase matching

Fuel type	Standardized mean difference	Variance ratio
Electric	0.006	1.0
Gas	0.007	1.0

Tests of balance on all other matching variables, including tenure, indicate that the two groups used in the analysis had well-balanced data. Figure 6-1 and Figure 6-2 demonstrate the quality of matches for both electric and gas graphically. The panels provide the distribution of variables for the participant and matched non-participant homes. They indicate that the distributions are very similar and that the data for the groups are well-balanced.

Figure 6-1. Electric match distributions

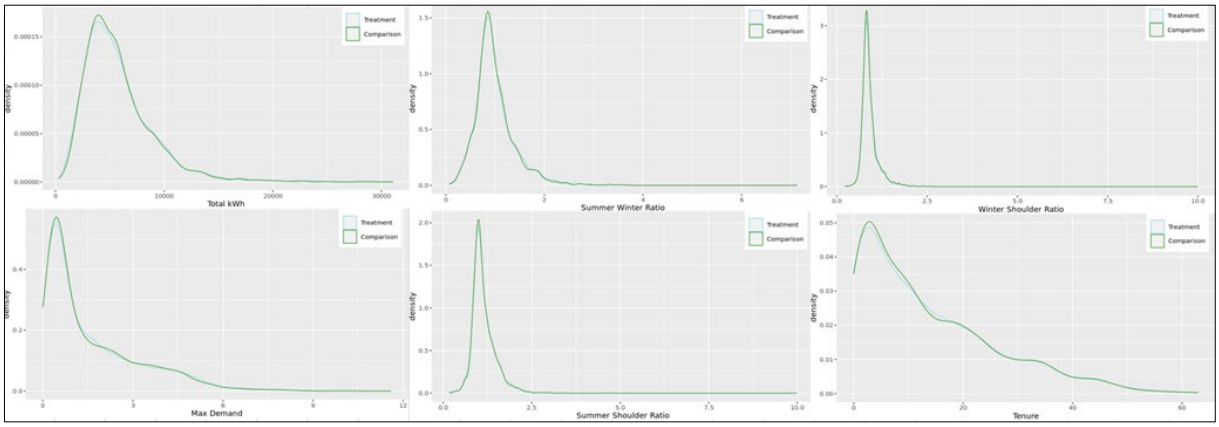
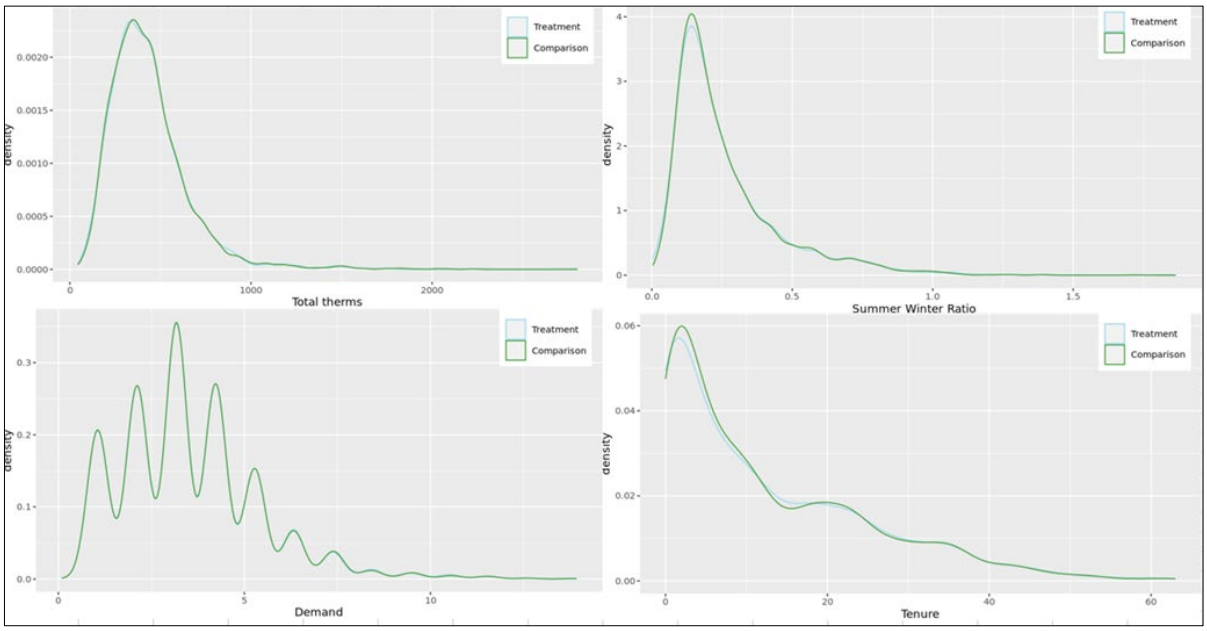


Figure 6-2. Gas match distributions



6.6.3 Quality of matches from additional variables

In addition to testing the balance on energy consumption and tenure used for the matching, we tested the condition of balance based on additional household characteristics not used in matching. Figure 6-3 and Figure 6-4 show the distributions of these characteristics for the electric and gas participants and their matches. The figures show good correspondence between the participants and matched comparison groups on these additional dimensions.

Figure 6-3. Balance of additional characteristic data for electric participants

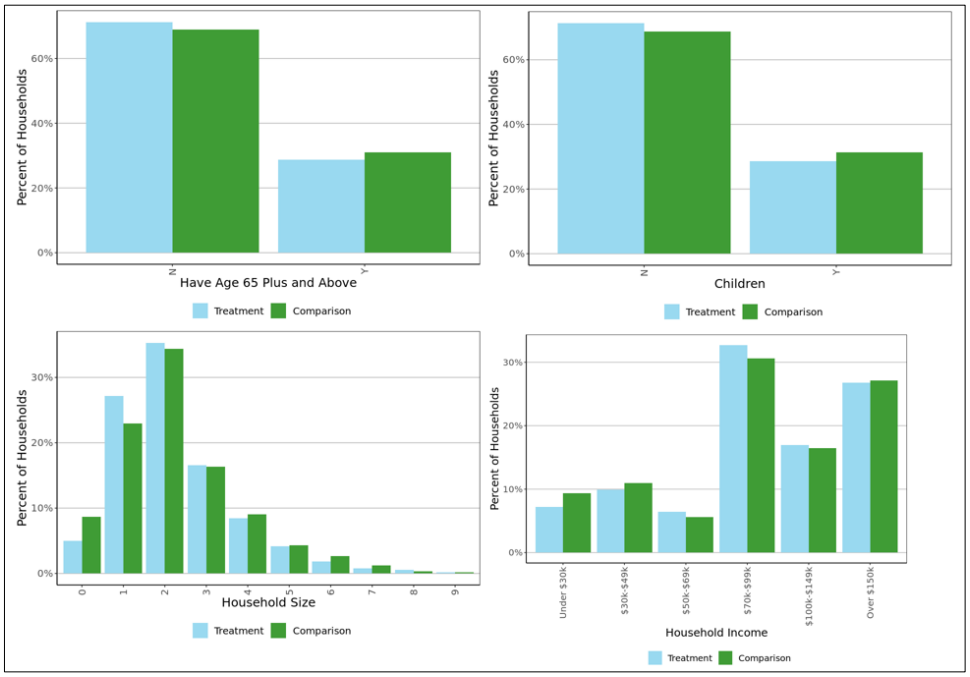
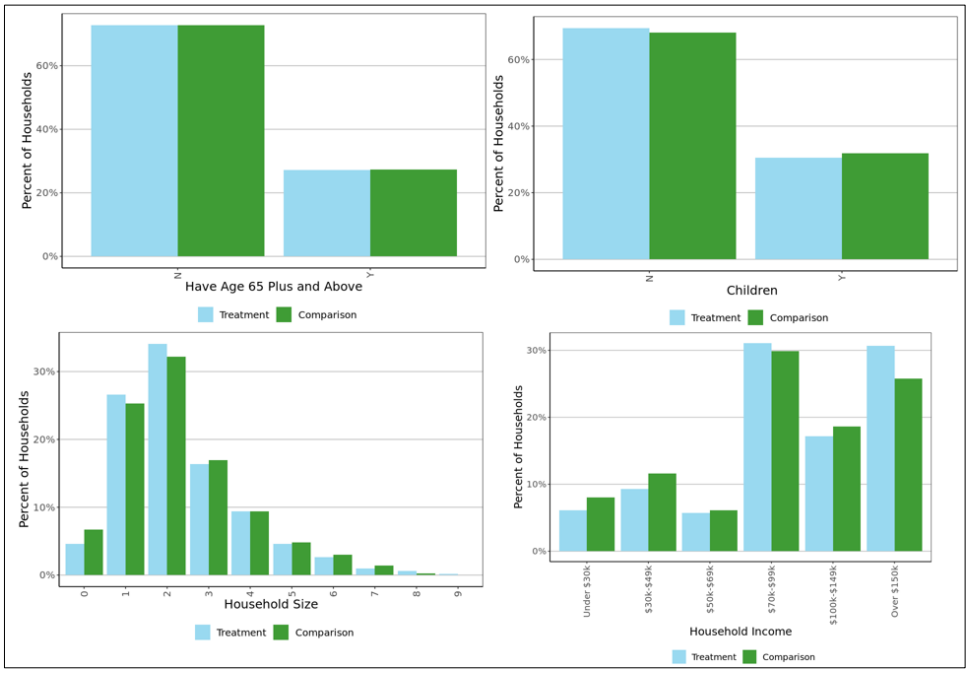


Figure 6-4. Balance of additional characteristic data for gas participants



6.9 Appendix I: Impact model results

The impact models estimate average consumption change for participants while controlling for comparison group trends. Table 6-17 provides the electric and gas model results in two ways: as an interactive model and a partitioned model. In the interactive model, the groups include the following:

- Participants who installed fuel substitution with or without other measures
- Participants who installed a non-fuel substitution measure with or without measures
- Participants who installed both fuel substitution and other measures

The parameter estimates for participants who installed both fuel substitution and non-fuel substitution measures indicate the interactive effects of installing both measure types.

In the partitioned model, we defined mutually exclusive groups composed of the following:

- Participants who installed fuel substitution measures only
- Participants who installed non-fuel substitution measures
- Participants who installed both types

These two models resulted in the same overall savings. However, they enabled us to determine the portion of the savings from fuel substitution versus other measures for people with both measures. The energy impact estimates table in section 3.3.1.1 uses the electric parameter estimates of the partitioned model and the gas savings estimates of the interactive model to calculate impact.

In particular, we apportioned the gas savings estimate from the interactive model (51 therms per customer) into savings due to electrification measures based on the proportion of claimed electric savings (65%) associated with fuel substitution measures. Overall gas reduction from electrification measures equal:

$$193\ therms\ +\ 65\%\ *\ 51\ therms\ =\ 226\ therms$$

We converted this value into kWh and combined it with the electric load increase for the group to obtain combined kWh savings per household. We assigned the remaining 35% of the interactive gas savings estimates to non-fuel substitution gas-saving measures installed by this group. Overall gas reduction from non-electrification measures equal:

$$38\ therms\ +\ 35\%\ *\ 51\ therms\ =\ 55\ therms$$

Table 6-17. Single-family electric and gas savings models, PY2022

Model type	Fuel	Variable	N	Estimate	Standard error	P-value
Interactive	Electric	Intercept	2,056	-1,222	158	0.27
		All fuel substitution	187	-199	327	0.00
		Fuel substitution + other measures	46	-0.6	41	0.54
		All other measures	1,915	-16	2	0.99
	Gas	Intercept	3,414	193	8	0.00
		All fuel substitution	652	51	19	0.00
		Fuel substitution + other measures	151	38	6	0.01
		All other measures	2,913	-31	28	0.00
Partitioned	Electric	Intercept	2,056	-1,222	158	0.27
		Fuel substitution only	141	-1,422	286	0.00
		Fuel substitution + other measures	46	-0.6	41	0.00

Model type	Fuel	Variable	N	Estimate	Standard error	P-value
		Other measures only	1,869	-16	2	0.99
	Gas	Intercept	3,414	193	8	0.00
		Fuel substitution only	501	282	17	0.00
		Fuel substitution + other measures	151	38	6	0.00
		Other measures only	2,762	-1,222	158	0.00

Table 6-18 provides the model results during the DEER peak demand period. Like the energy models, we ran these models using both interactive and partitioned data. We also ran a model that provides an estimate of overall peak impact. As indicated in the peak impact results section (4.5.2.2), the models indicate peak demand increases associated with fuel substitution measures and peak demand savings associated with other measures. Driven by the fuel substitution measures, the single-family program did not lead to overall peak demand savings.

Table 6-18. Single-family DEER peak savings models, PY2022

Model type	Variable	N	Estimate	Standard error	P-value
Interactive	Intercept	2,056	0.03	0.01	0.00
	All fuel substitution	187	-0.16	0.04	0.00
	Fuel substitution + other measures	46	0.04	0.06	0.52
	All other measures	1,915	0.04	0.01	0.00
Partitioned	Intercept	2,056	0.03	0.01	0.00
	Fuel substitution only	141	-0.16	0.04	0.00
	Fuel substitution + other measures	46	-0.09	0.05	0.08
	Other measures only	1,869	0.04	0.01	0.00
Overall	Intercept	2,056	0.03	0.00	0.00
	Overall peak impact	2,056	-0.01	0.01	0.26

6.10 Appendix J: NTGR findings

6.10.1 Single-family

Table 6-19 presents the NTGRs for measures installed by participants in BayREN's single-family program. It includes the number of respondents (n) used to derive the NTGR values and their variability.

Table 6-19. Overall BTU Measure-level NTGRs for BayREN's single-family program, PY2022

Measure	n	Attribution	Std Error	Lower CI	Upper CI
Attic insulation	86	31%	7%	19%	43%
Central heat pump	32	69%	20%	35%	104%
Duct sealing	62	16%	10%	-1%	32%
Ductless mini-split heat pump	15	44%	12%	22%	66%
Faucet aerator	127	83%	4%	77%	89%
Furnace	34	40%	12%	19%	61%
Heat pump clothes dryer	5	67%	18%	29%	104%
Heat pump water heater	137	60%	3%	54%	65%

Measure	n	Attribution	Std Error	Lower CI	Upper CI
Induction cooktop	51	45%	6%	35%	56%
Low-flow showerhead	130	64%	7%	52%	76%
Smart power strip	145	72%	4%	65%	79%
Smart thermostat	51	50%	15%	26%	75%
Storage water heater	6	2%	0%	1%	3%
Wall insulation	28	54%	16%	27%	82%
Overall	909	53%	6%	44%	63%

6.10.2 Multifamily

Table 6-20 presents the program level NTGRs for installations by participants in REN multifamily programs. It includes the number of respondents (n) used to derive the NTGR values and their variability.

Table 6-20. Overall BTU program-level NTGRs for REN Multifamily programs, PY2022

PA	n	Attribution	Std Error	Lower CI	Upper CI
BayREN	12	85%	8%	70%	100%
SoCalREN	20	96%	2%	92%	101%
Overall	32	93%	3%	88%	99%

6.11 Appendix K: Details on HTR definition

We used geographic-level information from the American Community Survey (ACS) and premise-level information from utility CIS data to determine HTR status based on the conditions defined by the California Public Utilities Commission (CPUC).[81] We determined single-family and multifamily participants/non-participants (sites) to be HTR if they met all three of the following:

1. Limited English Proficiency: in the 25% of block groups with the highest percent of limited English proficiency in the ACS.
2. Multifamily/Mobile home Renter: in the 25% of block groups with the highest percent of households that rented AND were in mobile home or multifamily building types in the ACS.
3. Low-income: If the billing data premise identifier had the CARE/FERA flag, we determined the site was low-income.

Alternatively, if the site met only one of the above criteria and met the geographic requirement, we determined it to be HTR. It met the geographic requirement if it was in a DAC Census tract or a non-metro area.

[81] Specific details are in the Statewide Deemed Workpaper Rulebook, p. 22.

6.12 Appendix L: Survey and interview guides

Survey and interview guides are in the attached pdf.

6.12.1 Initial PA/Implementer interview instruments

6.12.2 Final PA/Implementer interview instruments

6.12.3 Non-residential participant interview instruments

6.12.4 Single-family residential participant survey guide

6.12.5 Multifamily property manager survey guide

6.12.6 Single-family residential onsite instrument

6.12.7 Multifamily residential onsite instrument

6.13 Appendix M: Comment matrix (final report only)

The comment matrix is in the attached pdf.

About DNV

DNV is an independent assurance and risk management provider, operating in more than 100 countries, with the purpose of safeguarding life, property, and the environment. Whether assessing a new ship design, qualifying technology for a floating wind farm, analyzing sensor data from a gas pipeline, or certifying a food company's supply chain, DNV enables its customers and their stakeholders to manage technological and regulatory complexity with confidence. As a trusted voice for many of the world's most successful organizations, we use our broad experience and deep expertise to advance safety and sustainable performance, set industry standards, and inspire and invent solutions.