Opinion Dynamics

BUILDING INITIATIVE FOR LOW-EMISSIONS DEVELOPMENT (BUILD) PROGRAM

IMPACT ANALYSIS REPORT

SEPTEMBER 2, 2025

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I. EXECUTIVE SUMMARY

The Building Initiative for Low-Emissions Development (BUILD) Program encourages the design and construction of all-electric, energy-efficient buildings by providing incentives for the construction of all-electric, low-income residential housing and offering technical assistance to support project planning and educate new construction professionals, including builders, developers, architects, and engineers, about electric technologies and all-electric building design. The program's primary goal is to engage with new construction market actors to raise awareness of building decarbonization technologies and encourage all-electric residential housing design, development, and construction.

This report summarizes the methods and results of the BUILD Impact Evaluation. The evaluation included desk reviews and on-site verification of all three BUILD projects completed at the time of the evaluation (Q4 2024). The primary objectives of this study are to estimate ex post greenhouse gas (GHG) reductions in BUILD Program projects compared to a mixed fuel baseline,[1] recommend how ex ante GHG and bill impact estimation protocols, processes, and tools could be improved to increase accuracy, and calculate cost per metric ton of avoided GHG.

I.I KEY FINDINGS AND RECOMMENDATIONS

Based on our research, we offer several key findings and recommendations to ensure the BUILD Program can effectively improve on past, current, and future projects.

- **Finding: Cost-efficient reductions in emissions relative to a deemed baseline.** Relative to a deemed code-compliant mixed fuel baseline, the three reviewed projects are estimated to have collectively reduced lifetime GHG emissions over the course of an assumed 30-year measure life by approximately five million metric tons of carbon dioxide equivalent (MT CO2e). Based on a review of project costs, this reduction was achieved at a cost per MT similar to that of the United States Environmental Protection Agency (EPA)'s social cost of carbon.
- **Finding: Equipment alignment between the project files and on-site.** All HVAC and water heating equipment counts, types, sizes, and efficiencies were consistent between project files, invoices, energy models[2], and the on-site verification visits.
- **Finding: Non-Intuitive Custom Path Tool (CPT) Process.** Applicants were not able to complete the process themselves, and a third party was needed specifically to aid applicants through the application process. We had initial trouble interpreting results from the CPT, as well.
  - **Recommendation:** Improve the application by adding definitions for each section of the CPT. Consider including an example completed application.
- **Finding: Not all heat pump water heaters (HPWHs) operated in Heat Pump mode.** Two of the three sites we visited had HPWHs operating in the High Demand mode, the least energy-efficient mode.
  - **Recommendation:** Discuss with sites why they are operating in this mode and assess if there's a way to transition to Heat Pump mode. Investigate the energy implications of operating in High Demand mode instead of Heat Pump mode and adjust energy and GHG calculations accordingly. Alternatively, BUILD (or other future new construction decarbonization programs) could require participants who receive program incentives for the installation of HPWH to operate them in heat pump mode.

[1] The CPUC directed that "[t]he standard practice, or reference baseline, for residential new buildings shall be assumed to be a building built for dual fuel usage for […] the BUILD Program" in Decision (D.) 20-03-027 (March 26, 2020).

[2] All three reviewed projects used EnergyPro, a CEC-approved energy model, to estimate CBECC- Res 2019.2.0 compliant expected energy use profiles for baseline and as-built modeling scenarios. Throughout the report, we refer to these as energy models.

- **Finding: Non-JA13 compliant HPWHs at two of the three sites.** We found that all three sites installed HPWHs which are only JA-13 compliant when installed with thermostatic mixing valves (TMVs) as they do not conform to UL 60730-1, ASSE 1082, or ASSE 1084.[3] Two of the three sites have HPWHs installed without TMVs, representing 177 of 212 HPWHs, and as such are not JA13 compliant and should not have received a kicker incentive.
  - **Recommendation:** Ensure installation of HPWH equipment intended to qualify for equipment kickers meets all necessary JA13 requirements.
- **Finding: Insufficient photovoltaic (PV) kW capacity installed at one of the three projects resulted in buildings that did not meet the program's required estimated 5% bill savings.** We used the PV system plans and permission to operate (PTO) forms to source verified PV kW generation values because these forms, in conjunction with the VNEM forms, represent the most up-to-date PV generation capacity (kWdc) that is available to tenants. Updating the CPT to rely on these values resulted in one of the three projects we evaluated having some buildings fail to meet the program's required minimum of 5% expected bill savings.
  - **Recommendation:** Ensure sufficient PV system capacities are installed and allocated to tenants through a VNEM agreement at the building-level to ensure program requirements are met.
- **Finding: Building management was unable to verify solar generation at every site.** During some of the on-site visits, we learned that staff were not able to live-monitor the electric generation of the installed solar equipment.
  - **Recommendation:** Implement solar monitoring software to enable sites to track solar electricity generation. With this capability, sites could correlate generated electricity to earned solar credits, observe the effects of changes in electric-usage behaviors, and gain general transparency into the solar electricity generated.

[3] Appendix JA13 – Qualification Requirements for Heat Pump water Heater Demand Management Systems: https://www.energy.ca.gov/sites/default/files/2022-12/JA13_2022_Qualification_Requirement_HPWH_DM_ADA.pdf

2. INTRODUCTION

The BUILD Program is an $80 million program that aims to put California on a path to zero-emission homes. The BUILD Program encourages the design and construction of all-electric buildings. The BUILD Program provides incentives for the construction of all-electric, new residential housing using near-zero emission building technologies to significantly reduce GHG emissions beyond what would be expected to result from a code-compliant mixed-fuel building. Eligible applicants must demonstrate that their project will result in at least a five percent reduction of residents' utility bills compared to mixed-fuel homes. The BUILD Program also offers technical assistance to support project planning and educate developers, architects, builders, contractors, and other stakeholders about new technologies and all-electric building design. The primary goal is to engage with new construction market actors to raise awareness of building decarbonization technologies and encourage them to design, develop, and build all-electric new construction. Currently, all program funding will be directed toward new low-income housing.

The BUILD Program, along with the Technology and Equipment for Clean Heating (TECH) Initiative, was authorized under Senate Bill (SB) 1477 (Stern, 2018). SB1477 required the California Public Utilities Commission (CPUC) to develop and supervise the administration of the BUILD Program. Subsequently, in CPUC D. 20-03-027, the CPUC ordered the California Energy Commission (CEC) to serve as the administrator of the BUILD Program and authorized the CEC, at its discretion, to solicit a third-party contractor to provide technical assistance or to implement any part of the BUILD Program. In May 2021, following a competitive bidding process, the CEC selected the Association for Energy Affordability (AEA), supported by a team of subcontractors, to serve as the Technical Assistance Provider (TAP).[4]

The BUILD Program offers the following incentives:

- **Base GHG incentive**: Base electrification incentive calculated as $150 per metric ton of avoided GHG emissions.
- **Building Efficiency incentive**: Projects built to achieve efficiency beyond the applicable energy code, using the performance method as specified by the Residential and Nonresidential Alternative Calculation Method Reference Manuals,[5] will receive an additional incentive of up to $1,000 per bedroom.
- **Incremental PV incentive**: An incentive per watt of additional PV installed beyond what is required by the applicable energy code. This incentive will not be provided for PV installed to meet code or additional PV beyond what is required to meet the modeled resident energy cost requirement. This incentive is also capped at the cost of the PV system.
- **Kicker incentives**: The program provides kicker incentives for specific high-efficiency technologies, including smart thermostats, unitary JA13-compliant HPWHs,[6] use of equipment with low (<150) or lower (<750) global warming potential refrigerants, induction cooktops, heat pump clothes dryers (HPCDs), on-site energy storage, and electric vehicle supply equipment.

Additionally, the BUILD Program offers a New Adopter Design Award,[7] which offers eligible applicants up to $100,000 to cover design costs for their first all-electric, low-income multifamily building.

[4] The TAP team led by AEA includes TRC, The California Housing Partnership, Highlands, Celery, SmithGroup, Integral, David Baker Architects, and Mithun.

[5] Accessible at https://www.energy.ca.gov/publications/2019/2019-nonresidental-alternative-calculation-method-reference-manual.

[6] JA13 compliant HPWH is certified by the CEC as a heat pump water heater demand management system.

[7] BUILD Program Guidelines, Second Edition, https://www.energy.ca.gov/publications/2024/building-initiative-low-emissions-development-build-program-second-edition.

2.1 IMPACT EVALUATION OBJECTIVES

Key objectives of the BUILD Program impact evaluation are to complete the following:

- Estimate ex post GHG reductions in BUILD Program projects compared to a mixed fuel baseline.
- Recommend ways to improve the accuracy of ex ante GHG and bill impact estimation protocols, processes, and tools.
- Calculate the cost per metric ton of avoided GHG.

3. METHODS

The impact evaluation included reviewing program tracking data, reviewing detailed project documentation for all three projects evaluated, collecting on-site data at each site, and analyzing bill impacts.

3.1 TRACKING DATA REVIEW

The evaluation team receives BUILD Program tracking data from the CEC on an ongoing basis to support multiple ongoing evaluation activities. The tracking data identifies the current participation stage and review status for all projects that have submitted a BUILD application. The data identified the three completed projects that would be subject to our evaluation and provided key data fields used in the analysis, such as California Climate Zone, zip code, BUILD incentive, projected utility bill savings, estimated ex ante GHG savings (MT/year), building type, kicker technologies installed, and the number of buildings at the site. The data also included contact information such as company name, organization type, contact name, job title, contact email, contact phone, and address used in the primary data collected to support the ex post impact analysis for each site.

3.2 PROJECT DOCUMENTATION AND DESK REVIEW

We conducted documentation and desk reviews for all sampled projects to inform ex post GHG impacts, site outreach, and subsampling processes.

We reviewed multiple types of project documentation files for each site, including building simulation models, CPT input files,[8] CPT output files, Home Energy Rating System (HERS) files, invoices (including proof of purchase and installation for equipment eligible for kicker incentives), utility permission to operate (PTO) documentation, and virtual net energy metering (VNEM) agreements. We used the findings from this review and comparison process to generate a Project Summary document, a site map of the buildings, and an equipment mapping file of the HVAC and water heating equipment. Each of the project file types is detailed in Appendix A.

The desk review includes the analysis of both the baseline (planned) and as-built energy models. Our review also verified that the baseline model conforms with the applicable energy code, based on the permit date of the project. The data we collect from the on-site verification visits (discussed in Section 3.3) was incorporated into ex post energy models. As a part of this process, we also reviewed the mechanics of the CPT.

We relied on the time-dependent valuation (TDV) emissions factors[9] embedded in the California Building Energy Code Compliance (CBECC) Res 2019.2.0 building simulation model to estimate the lifetime GHG impacts associated with ex post energy impacts. The TDV emissions factors recognize that the GHG impacts of changes in electricity consumption are highly dependent on the time of the year and time of the day the impacts occur. Further, the TDV emissions factors consider that electric grid impacts are dynamic. Over the life of a new construction building, renewable generation and penetration are expected to increase, which impacts the relationship between changes in hourly electricity consumption and their associated GHG impacts.

We calculated emission reductions for each sampled project and compared the resulting total verified energy and emissions savings to the reported savings to determine the realization rates. We also calculate the cost per metric ton

[8] The BUILD Program CPT is an Excel-based application that calculates a project's incentives based on the performance of the project's energy model(s). Applicants can either run the CPT themselves or request assistance from the BUILD Program. In either case, they must submit the energy models that produce the output files that serve as inputs to the CPT and the results of the CPT itself in their incentive application package. The CPT also calculates expected tenant bill savings to verify that the project will meet the BUILD Program's bill impact requirements.

[9] Final 2022 TDV Methodology Report. CEC Docket 19-BSTD-03. June 5, 2020.

of avoided CO2-equivalent (CO_2e), relying on the total cost of BUILD Program implementation, evaluation, and administration.

3.3 ON-SITE DATA COLLECTION APPROACH

We conducted on-site verification visits with all sampled projects to confirm that the as-built buildings match the final project documentation. The on-site verification visits included detailed visual assessment, verification, and photos of all key building systems and design elements (i.e., PV, EV, HVAC, and water heating equipment, including the building electrical panels and their configuration). The site engineer visually verifies the nominal rated capacity and efficiency for all energy systems. The on-site visit includes a structured interview with building managers or operators. These interviews are conducted in person by the site evaluation team engineer and collect important information on building use, such as temperature set points, the system type, and usage patterns of primary and secondary HVAC equipment, ventilation strategies and schedules, domestic water heating equipment, and the use of renewable technologies for on-site generation. The site engineer also asked about important building characteristics that cannot be verified visually on-site. These characteristics include but are not limited to insulation levels for unexposed building components (e.g., exterior walls, slabs) and window performance ratings. On-site visits did not include metering, but we collected utility meter numbers and photos for all services provided to the site.

We identified property managers for each sampled project through review of project files, discussion with participants, and discussion with CEC staff. We then contacted the property managers to make introductions, request documents, and schedule the on-site visits. Some of the documents requested ahead of the visit included tenant utility bills, as-built electric/mechanical schedules, equipment specification sheets of installed equipment, as-built PV system specifications, and a current map showing the building layout with building names. We compared any newly received documents against the CEC-provided project documents to prepare for the on-site survey. In advance of the on-site visit, we requested that a facilities member be present or available. This was needed in case we required access to a locked utility room or closet, needed a ladder to reach the roof, or had questions for that person.

3.3.1 ON-SITE SURVEY INSTRUMENT DESIGN

The on-site survey instrument is divided into two sections: site-level and unit-level verification. Each of these sections is comprised of many subsections. The details of these sections and subsections are described below.

SITE-LEVEL VERIFICATION

- **Energy Services and Tenant Billing.** This section captures the electric metering layout at the site, building, and tenant levels. It also captures how tenants are metered and billed, how tenants receive solar generation credit, and what rates they pay.
- **Solar/PV Equipment.** This section captures details about the solar system. The information from the project documentation (VNEM, PTO) may not include specifics about the actual PV modules and arrays/configurations, so we capture this via on-site physical inspection, especially panel make/model, array configurations, and any shading issues.
- **Site/Building Electrical Service (Panels, Meter Banks, Infrastructure).** This section captures the utility room, metering & panel configurations that support tenant billing. This information provides examples of electrical configurations for new all-electrical developments, a significant general topic of interest for decarbonization/electrification. We focus on the site and building-level equipment (house meters, panels, switchgear, panelboards, etc.), the meters serving each tenant unit, and how the PV system is incorporated to share the PV generation with the tenants. We capture electrical panel characteristics for in-unit and common area

spaces elsewhere in this form. However, if the meter and main panel for the apartment are located in a "meter bank" in the utility room, then we access the main panel to photograph the meter and panel.

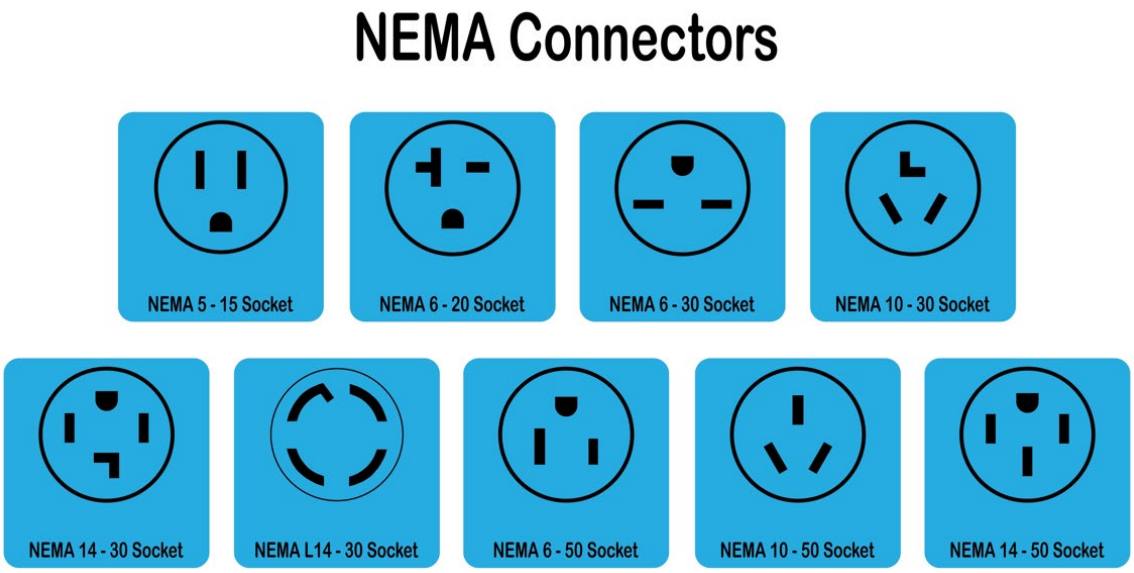
- **Equipment Kickers.** This section confirms or updates the number of units the BUILD tracking data claim for each kicker device. Some may require sampling while others require a census count by walking the entire site, and the on-site data collection form is set up to accommodate either approach. We record details on the equipment-specific (e.g., electric vehicle supply equipment, battery, HVAC) verification forms and then tally the project-level estimate.
- **EV Charging Equipment.** This section tracks on-site EV chargers, which are a kicker incentive technology. We check for their presence on-site, even if the kicker incentives are not claimed. The focus is on common area EV chargers that are part of the development design. We gather any resident-owned or added chargers for context.
- **Battery Equipment.** This section tracks on-site battery equipment, which is a kicker incentive technology. We check for its presence on-site, even if the battery equipment is not claimed for incentives. The focus is on building-level batteries that capture excess solar generation.
- **Other On-site Fuels & Equipment.** This section captures the presence of other on-site fossil fuels used for backup generators, outdoor BBQs, pool/spa heating, or any other natural gas equipment. We note any other advanced electric or heat pump applications, such as heat pump pool heaters.
- **Common Area Space Equipment.** This section confirms the presence of common area equipment such as HVAC systems, water heaters, and laundry equipment. We verify this equipment on-site and take photos of the equipment.
- **Building Shading.** This section notes any current or future sources of significant shading in these new construction sites. These would most typically be trees but could also be adjacent structures. We note locations on the satellite images of the site and support these with on-site photos. We note potential future shading of PV systems by trees.

IN-UNIT VERIFICATION

- **Electrical Panels.** This section shows the metering/panel configurations in use to support the in-unit equipment and tenant utility billing arrangement. We focus on the panels and meters serving each tenant unit and any panels and meters for common areas that are part of the BUILD project. We assume one panel and meter per space.
- **HVAC Equipment and Thermostat**. This section records details of the in-unit HVAC and thermostat equipment. We record the make/model of the observed equipment and note any discrepancies.
- **Water Heating Equipment.** This section deals with water heating equipment for each unit. We expect the use of HPWHs for all projects. We check the make/model of the observed equipment and note any discrepancies. HPWHs also have different control mode settings, which can significantly impact their energy use, so it is essential to determine the default setting and whether or not the tenants can alter the settings.
- **Laundry Equipment.** This section tracks in-unit laundry equipment. We collect information on the National Electrical Manufacturers Association (NEMA) socket configuration of the in-unit laundry.
- **Cooking Equipment**. This section tracks information on the installed cooktops. This may also help identify situations where the induction cooktops were installed but the incentives were not claimed.

Every on-site survey form includes the graphic shown in Figure 1. We used it on-site to identify NEMA socket types in various applications on the sites.

Figure 1. NEMA Connectors



3.3.2 CUSTOMIZED ON-SITE SURVEY PLAN

We developed a project sub-sampling plan to ensure representative coverage of key building areas, room types, and equipment types, and a robust method for extrapolating sub-sampled results to project-level results.

Due to the high number of buildings at each site and units within each building with unique heating and hot water configurations, we created a building sample and a unit sample. We grouped the buildings at each site by floor area, number of stories, and number of units, and grouped the units within the buildings by their respective unique combination of HVAC heat pump system sizes, HPWH configuration, and the apartment configuration. We then derived a representative sample of buildings and units for each site and shared this sampling plan with property managers to ensure the buildings and unit types we needed to visit to meet our sample were available. We share the details of the sample for each site in the site's respective section within Section 3.4.

3.4 BILL IMPACTS

The CPT estimates the changes in expected tenant energy costs due to the site's participation in the BUILD Program relative to the expected tenant energy cost of living in a code-compliant mixed fuel building. Senate Bill 1477 requires that participation in the BUILD Program not result in increased utility costs for tenants. To account for modeling uncertainty, the CEC requires all participating projects to demonstrate that modeled tenant energy bills will be at least five percent lower than the modeled tenant bills associated with the baseline building.

As part of the BUILD Program impact evaluation, we evaluate the program's utility bill impact estimation practices and methods. To that end, we took the following steps:

- Reviewed the method as laid out in the BUILD Program Guidelines, Second Edition.[10]
- Reviewed the CPT files, and based on our review of the CPT files and BUILD Program Guidelines, we further investigated the following:
  - Treatment of central heat pumps, HPWHs
  - The allocation of common area energy consumption to tenants
  - Allocation of solar generation to different tenants
  - Application of California Alternative Rate for Energy (CARE) discount as required
  - Adherence to the BUILD minimum 5% bill reduction at the site level
- Determined the verified solar kW value per building at each site from the PTO files and/or PV site plans.
- Applied the share of PV electric generation that the tenants of each building at each site are allocated as per the corresponding VNEM documents.
- Updated the PV columns of the various 8760 hourly result files from the energy models with the new kW values: PV allocated to tenants per VNEM.
- Reran the CPT files for each building at each site with the updated 8760 hourly files.
- Analyzed and compared the estimated changes in monthly bills against the estimated baseline bills to check whether the BUILD guideline of a minimum 5% bill reduction was achieved.

[10] Antonio, Marites, Erica Chac, Adriana Dominguez, Larry Froess, Calleagh Turner, and Steven Van. January 2025. Building Initiative for Low-Emissions Development Program: Guidelines Second Edition, California Energy Commission. Publication Number: CEC-300-2024-022. https://www.energy.ca.gov/publications/2024/building-initiative-low-emissions-development-build-program-second-edition

4. INDIVIDUAL PROJECT VERIFICATION RESULTS

Our sample included three sites: two multifamily sites and one single-family site. Total incentives, claimed and verified kicker incentives, and reported GHG impacts are shown in Table 1. Sites 001 and 002 have $0 of total verified kicker incentives due to the HPWHs at these sites not being JA13 compliant. We share details in the respective site sections.

Table 1. Tracking Data Totals

Site ID	Housing Type	Total Incentives	Total Claimed Kicker Incentives	Total Reported GHG (MT/year)	Total Verified Kicker Incentives
Site-001	Multifamily	$660,002	$53,000	77.53	$0
Site-002	Multifamily	$351,830	$36,000	48.66	$0
Site-003	Single-Family	$292,968	$18,000	37.86	$18,000

Project ID Site-001 (Climate Zone 6). This is a multifamily, multi-building site with different floor plans among those buildings. The site includes one- to four-bedroom units, dwelling HVAC heat pumps, and HPWHs serving each unit. The common area facilities include a site laundry room. Shared solar is rooftop-mounted.

Project ID Site-002 (Climate Zone 12). This is a multifamily, multi-building site with different floor plans among those buildings. The site includes one- to three-bedroom units, central HVAC heat pumps, and HPWHs serving each unit. The common area facilities include a site laundry room. Shared solar is rooftop-mounted.

Project ID Site-003 (Climate Zone 13). This is a single-family site with two-, three-, and four-bedroom configurations. Each home includes a central HVAC heat pump and an HPWH. There are no common area facilities. Solar is roof-top mounted on each individual home.

4.1 SITE-001

Project Site-001 is a low-rise (three or fewer floors) multifamily complex built in 2022. The complex is comprised of 12 buildings totaling 105 units, 22 of which are reserved for families experiencing homelessness. The 12 buildings are two to three stories tall with solar PV systems on the rooftops. There is also a solar carport on the premises that shades 14 parking bays. The individual apartments (tenant units) range from one bedroom to four bedrooms. Each building has a dedicated meter room containing the PV distribution equipment. In addition, the site offers a community space and a central laundry room, both available for tenant use.

4.1.1 PROJECT SUMMARY & ON-SITE VERIFICATION APPROACH

We sampled units through a two-stage sample design: first, we sampled buildings, and then we sampled units from within the sampled buildings described in Section 3.3.

BUILDING GROUP SAMPLING APPROACH

To guide site sampling, we grouped buildings into categories based on floor area, number of stories, and number of units. Buildings in category A are three stories and contain nine units, while buildings in category B are three stories and contain 12 units. Category C contains buildings outside the parameters of categories A and B. Our building sample includes one building from each category (A, B, C), depending on unit availability and tenant participation.

Table 2 summarizes the building sampling design for Site-001.

Table 2. Site-001 Building Sample Design Summary

Building Name	Building Categories	Building Floor Area	# of Stories	# of Units	# of Bedrooms
F1	A	10,872	3	9	21
F2	A	10,842	3	9	21
G3	A	10,872	3	9	21
G4	A	10,872	3	9	21
HA1	A	10,872	3	9	21
HA3	A	11,063	3	9	22
G1	B	14,548	3	12	28
G2	B	14,548	3	12	28
G5	B	14,881	3	12	28
G6	C	4,789	2	4	8
G7	C	7,390	3	6	15
HA2	C	3,931	2	5	8

UNIT SAMPLING APPROACH

The unit sampling approach for this site is based on the combinations of unique HVAC HP (HVHP) system sizes, HPWH configurations, and apartment configurations. The Site-001 complex has four unique HVHP configurations but only two HPWH configurations. One-bedroom units have one HVHP size, two-bedroom units have another HVHP size, and the three and four-bedroom units use the same size HVHP. The community space, which is in a building with tenant units, has the largest HVHP unit; none of the tenant units have an HVHP system of this size. The community space and all unit configurations, save for one, have a 50-gallon HPWH. The three- and four-bedroom units have the largest HPWH size, 80 gallons. As such, we sampled a one-bedroom, two-bedroom, four-bedroom, and the community space. This sample selection is shown in Table 3.

Table 3. Site-001 Unit Sample Design Summary

# of Bedrooms	HVHP Unit Name	HVHP Size (kBtu/hr)	HPWH Unit Name	HPWH Size (gallons)
1	HVHP-1	18	HPWH-1	50
2	HVHP-2	24	HPWH-1	50
3, 4	HVHP-3	30	HPWH-2	80
Common Area	HVHP-4	36	HPWH-1	50

4.1.2 PROJECT DOCUMENTATION REVIEW RESULTS SUMMARY

In this section, we summarize the primary documents and key information received for Site-001. For reference, a description of each document type is provided in Appendix A.

- **CEC CPT Quality Control (QC) and Changes.** The CEC review of the EnergyPro models and the CPT result files revealed two potential discrepancies.[11]
  - The file states that the decision was made not to run the CPT with a central laundry room included because each unit has its own laundry hookups. We flagged the central laundry room usage as an investigation point to discuss with the site contact.
- **Kickers.** The only kickers this site claims are the JA13 compliant water heaters.
- **Macro-Enabled CPT**. One full, macro-enabled CPT file corresponds to each of the 12 buildings. The CPT files all indicate that the site has a central laundry, which requires files FILE 1 through FILE 4, and we received all four of those files.[12] In addition, the number of JA13 compliant water heaters aligns with the number of units in each building.
- **CPT Reports**. One CPT report file corresponds to each of the 12 buildings. The CPT reports all state that the sites have a central laundry. In addition, the number of JA13 compliant water heaters aligns with the number of units in each building.
- **CBECC Energy Compliance Models**. The 12 energy model files correspond to the 12 buildings on site. We reviewed all 12 files in EnergyPro Version 8 and found that all information aligns with the rest of the project documentation.
- **HERS files**. We received 12 HERS documents (CF2Rs), one for each building. The make and model of all equipment in these files align with those in the energy model files.
- **Invoices**. The invoices show that the make, model, and quantity of water heaters purchased and delivered to the site align with the rest of the project documentation.
- **PTO forms**. The PTO files serve as an additional source to connect the 12 building numbers to their addresses. The PTO files inform questions regarding the on-site visit surrounding the solar energy allocation to the tenants of each building, Net Energy Metering (NEM), and the tenants' Time-of-Use (TOU) rate schedule.
- **VNEM forms**. The VNEM files provide an additional source for connecting the 12 building numbers to their addresses. We also use the VNEM files to inform the on-site visit questions about the TOU rate schedules applied to the tenant and common areas.

4.1.3 ON-SITE RESULTS SUMMARY

Below, we summarize the on-site verification results and present them in the same order as the survey instrument, with site-level results first, followed by in-unit results. We performed the on-site visit in mid-November 2024.

SITE-LEVEL VERIFICATION

Energy Services and Tenant Billing. Utilities meter and bill tenant units individually. Tenants must create an account with the utility companies upon moving into their units and are responsible for paying utility bills. We obtained copies of tenant bills for two properties. These bills list the utility provider as Southern California Edison (SCE). They show winter and summer TOU periods being in effect for the billing period of these bills. In addition, the bills show and track VNEM throughout the billing year. The bills of both tenants show year-to-date energy generation credits in the hundreds of dollars range.

[11] All product or company names that may be mentioned in this publication are tradenames, trademarks, or registered trademarks of their respective owners.

[12] The CEC provided missing files (FILE3 and FILE4) for each building at this site upon request.

Solar/PV Equipment. The site has solar panels installed on every building. Through the VNEM agreement the financial value of the electricity generated by the solar installation is evenly split between all the units of that building. If a unit does not have a tenant, that unit's allocation goes to the community account. Unused solar electricity generated that month shows up as a credit on the tenant account.

Site/Building Electrical Service (Panels, Meter Banks, Infrastructure). Unit meters in meter rooms align with the number of units in each building inspected. The meter rooms also contain the PV support equipment. Unused conduits with pull string labeled "Future EV" are present in each meter room, but no EV chargers are on-site. Our site contacts were unaware of whether and when the installation of EV chargers on-site would occur.

Equipment Kickers. There is alignment between the reported kickers and what we found on-site. The project documentation only claims JA13 compliant HPWHs as a kicker. We found no other measures eligible for kickers during the site visit.

EV Charging Equipment. As mentioned previously, the builders wired the site for future EV chargers. No chargers are currently installed, nor are there plans to install them in the near term.

Battery Equipment. No battery equipment is installed on site. Although the site's website states that a "Solar Battery System" is present, the staff confirmed that there are no batteries on-site.

Other On-Site Fuels & Equipment. Natural gas is not present on-site. The communal BBQ areas have charcoal grills, not gas-powered ones.

Common Area Space equipment. There is an on-site community space that regularly hosts community and seasonal events, as well as an adjacent central laundry room. The common space equipment includes HVAC and HPWH for the laundry room and the adjacent community space. The largest capacity HVAC on the property (36 kBtu/hr) serves both the community space and the laundry room. Our site contact told us that the central laundry room is rarely used, as most tenants have laundry equipment in their units.

The electrical receptacle for the laundry room is a NEMA 14-30 240V outlet, as shown in Figure 2.[13] The site installed Maytag combined washer/dryer machines (Model Number: MHN33PRCWW2) in the laundry room.

[13] Unless otherwise noted, all photographs included in this report were taken during on-site visits conducted by the evaluation team.

Figure 2. 240V Outlet for Community Laundry Room

Building Shading. There are no current issues with shading affecting the solar panels, which are on the second and third-story roofs. Future shading will also not affect the solar panels.

IN-UNIT VERIFICATION

Electrical Panels. The central hallways of each unit contain the in-unit electrical panels, which are accessible to the tenant. All panels inspected were rated for 125 amps. Clear labeling is present for all circuits, including 240V loads. The panels inspected had between three and five empty slots, and solar breakers were not present. These in-unit panels are not "smart" and do not have any load-sharing devices present. Figure 3 shows an example of an in-unit electrical panel.

Figure 3. In-Unit Electrical Panel

HVAC Equipment and Thermostat. All units inspected have a centrally ducted HVAC heat pump. The Honeywell thermostats in each unit are all in central hallways and programmable (not smart), see Figure 4.

Figure 4. In-Unit HVAC Thermostat Control

The builders installed the outdoor condensing units on ground-floor concrete pads on the side of the unit. The fan discharge is on the side of all units. Figure 5 shows an example of these units.

Figure 5. HVAC System Outdoor Condensing Unit

The indoor air handler units (AHU) are directly behind the return air filter, with no ducting between the filter and AHU. A metal grill on the AHU held the return air filters and acted as the access panel to the in-unit AHU. We had to seek the assistance of maintenance staff to remove specialized bolts on the metal grills at each of the four units we visited.

Please see Figure 6 for a visual of an in-unit AHU with the filter grill lowered. Figure 7 shows the actual in-unit, indoor AHU.

Figure 6. In-Unit HVAC Indoor Forced Air Unit (FAU) with Ceiling Access Cover

Figure 7. In-Unit HVAC Indoor Forced Air Unit (FAU) Exposed

Capacities of HVAC units align with project files. The nameplate stickers on the interior AHUs all indicate that no backup electric strip heating is present. HVAC equipment manufacturer and model information is in line with the project files, as shown in Table 4.

Table 4. Site-001 HVAC Unit Detail Comparison – Project File vs On-Site

Unit Name	Capacity (kBtu/hr)	Project Files Manufacturer	Project Files Model	On-Site Manufacturer	On-Site Model
HVHP-1	18	Carrier	38MARBQ18AA3	Carrier	38MARBQ18AA3
HVHP-2	24	Carrier	38MARBQ24AA3	Carrier	38MARBQ24AA3
HVHP-3	30	Carrier	38MARBQ30AA3	Carrier	38MARBQ30AA3
HVHP-4	36	Carrier	38MARBQ36AA3	Carrier	38MARBQ36AA3

Water Heating Equipment. The HPWHs inspected in the units serve between two and seven people, according to the number of tenants. The majority of the HPWHs on site operate from dedicated, exterior closets. Tenants have no access to the water heater closets. The HPWH for the one-bedroom unit we inspected operates from a locked bedroom closet (the tenant has no access to the water heater closet). In this case, an extra barrier to inspection and maintenance is added because staff would need to coordinate with the tenant before entering the HPWH closet.

The HPWH capacities from the on-site visit align with the project files. We found all HPWH on-site to not have thermostatic mixing valves (TMVs) installed, as such they are not JA13 compliant and are not eligible for a kicker incentive.

Table 5 compares the HPWH details from the project files with those from the on-site visit.

Table 5. HPWH Unit Detail Comparison – Project File vs. On-Site

# of Bedrooms	Unit Name	Capacity (gallon)	Project Files Manufacturer	Project Files Model	On-Site Manufacturer	On-Site Model	TMVs Present?
1	HPWH-1	50	Rheem	PROP H50 T2 RH375-30	Rheem	PROP H50 T2 RH375-30	No
2	HPWH-1	50	Rheem	PRO H50 T2 RH310 BM	Rheem	PRO H50 T2 RH310 BM	No
3, 4	HPWH-2	80	Rheem	PROP H80 T2 RH375-30	Rheem	PROP H80 T2 RH375-30	No
Community/ Laundry Room	HPWH-2	80	Rheem	PROP H80 T2 RH375-30	Rheem	PROP H80 T2 RH375-30	No

We found all HPWHs were in High Demand mode with a setpoint of 120°F.[14] Figure 8 shows the digital screen of an HPWH on-site.

[14] Use & Care Manual: https://media.rheem.com/blobazrheem/wp-content/uploads/sites/36/2024/07/AP23657-Rev-01-Manual-HPWH-GEN-V-UNIVERSAL-CONNECT-ENGLISH_HALF-SIZE-3.pdf: (1) Heat Pump: This mode will heat with compressor operation only and will not use any electric heat during typical heating and demand cycles. This mode will minimize power consumption. (2) Energy Saver: This mode optimizes compressor and electric heat that results in water heater performance that meets Energy Star requirements. (3) High Demand: This mode will maximize the performance of the water heater while still providing good energy savings. Water heater operates with simultaneous compressor and electric heat. (4) Electric: This Mode will heat with the electric resistance elements. This mode should only be used during compressor maintenance periods. This mode will result in maximum power consumption. (5) Vacation: This mode will allow during setting between 2 and 28 days or set indefinitely with the "Hold" setting. Tank temperature will be maintained at about 82°F. Only compressor operation will be allowed as needed.

Figure 8. On-site HPWH Digital Screen

Laundry Equipment. The builders installed washer and dryer hookups in each unit. The tenants must provide their own washer and dryer equipment. Our site contact told us that most tenants have their own laundry equipment. The electrical outlet for in-unit laundry equipment is a NEMA 14-50 or a 14-30 socket, as shown in Figure 9 and Figure 10.

Figure 9. 240V Outlet for One Bedroom Laundry

Figure 10. 240V Outlet for Two Bedroom Laundry

Cooking Equipment. We could not verify the electrical receptacle for in-unit ranges because we lacked the proper tools to maneuver the appliance; however, they are most likely a NEMA 14-30 or 14-50 socket to match the in-unit laundry receptacle.

Other. The site has community gardens. There is no shared pool or jacuzzi on-site.

SIGNIFICANT SITE-SPECIFIC FINDINGS

- The manufacturer, number, size, and efficiency of all HVHP and HPWH equipment were confirmed.
- Although no EV charging equipment currently exists, the site was pre-wired to facilitate the addition of such equipment in the future.
- The HPWHs found on site were all in High Demand mode, the second least energy-efficient mode after Electric mode. This could lead to excess electricity being used, making the site less energy efficient overall.
- The HPWHs found on site do not have TMVs installed and are not JA13 compliant. As such they are not eligible for a kicker incentive.

4.1.4 EX-POST ANALYSIS & RESULTS

We found no discrepancies between the given project files and the on-site equipment for any of the buildings at this site. We made no changes to the as-built EnergyPro energy models or the CPT files. As a result, we did not perform any revised runs of EnergyPro energy modeling software or the macro-enabled CPTs. Table 6 shows the reported and verified metric tons of GHGs avoided per year. The GHG realization rate for this project is 100%.

Table 6. Site-001 Total GHG Avoided: Reported vs Verified

Building	Reported Total GHG Avoided (metric tons/year)	Verified Total GHG Avoided (metric tons/year)	Realization Rate
F1	6.78	6.78	100%
F2	6.78	6.78	100%
G1	8.65	8.65	100%
G2	8.34	8.34	100%

Building	Reported Total GHG Avoided (metric tons/year)	Verified Total GHG Avoided (metric tons/year)	Realization Rate
G3	6.72	6.72	100%
G4	6.79	6.79	100%
G5	8.38	8.38	100%
G6	3.39	3.39	100%
G7	4.79	4.79	100%
HA1	6.76	6.76	100%
HA2	3.28	3.28	100%
HA3	6.87	6.87	100%
Total	**77.53**	**77.53**	**100%**

4.2 SITE-002

Project Site-002 is a low-rise (three or fewer floors) multifamily complex completed in 2023. The complex comprises one community building and seven residential buildings totaling 72 units, 44 of which are reserved for families experiencing homelessness. The seven residential buildings are two to three stories tall with solar PV systems on the rooftops. The individual apartments (tenant units) range from studios to three-bedroom units. Each building has a dedicated meter room containing the PV distribution equipment. Additionally, the site offers a community laundry room available for tenant use.

4.2.1 PROJECT SUMMARY & ON-SITE VERIFICATION APPROACH

We sampled units through a two-stage sample design: first, we sampled buildings, and then we sampled units from within the sampled buildings described in Section 3.3.

BUILDING GROUP SAMPLING APPROACH

To guide site sampling, we grouped buildings into categories based on floor area, number of stories, and number of units. Buildings in category A are all two stories and contain eight units, while buildings in category B are all three stories and contain 12 units. The single building in category C is the community building. Our building sample includes buildings from each category, A and B.

Table 7 summarizes the building sampling design for site-002.

Table 7. Site-002 Building Sample Design Summary

Building Name	Building Categories	Building Floor Area	# of Stories	# of Units	# of Bedrooms
1A	A	5,863	2	8	14
2A	A	5,863	2	8	14
3A	A	5,863	2	8	14
4B	B	8,555	3	12	18
5B	B	8,555	3	12	18
6B	B	8,555	3	12	18
7B	B	8,555	3	12	18
8C	C	N/A	1	N/A	N/A

UNIT SAMPLING APPROACH

We determined the unit sampling approach for this site from the combinations of unique HVHP system sizes, HPWH configuration, and apartment configurations. As shown in Table 8, this complex has two unique HVHP configurations and two HPWH configurations. Studio and one-bedroom units have one HVHP size, while two- and three-bedroom units use different-sized HVHP units. Studio, one-, and two-bedroom units have 50-gallon HPWHs, while the three-bedroom units have an 80-gallon HPWH. Therefore, we sampled a one-, two-, and three-bedroom unit. Table 8 shows this sample selection. The final column of the table shows the location of the HPWH as indicated in the energy models provided; however, aside from the energy models, no mention of on-site garages is made in any of the project documents.

Table 8. Site-002 Unit Sample Design Summary

# of Bedrooms	HVHP Unit Name	HVHP Size (kBtu/hr)	HPWH Unit Name	HPWH Size (gallons)	HPWH Location
Studio, 1	HVHP-1	12	HPWH-1	50	Garage
Studio, 1	HVHP-1	12	HPWH-1	50	Inside
2	HVHP-2	18	HPWH-1	50	Garage
2	HVHP-2	18	HPWH-1	50	Inside
3	HVHP-2	18	HPWH-2	80	Garage

4.2.2 PROJECT DOCUMENTATION REVIEW RESULTS SUMMARY

Below, we summarize the primary documents and key information received for Site-002. For reference, a description of each document type is provided in Appendix A.

- **CEC CPT QC and Changes.** The CEC review of the EnergyPro models and the CPT result files revealed two potential discrepancies.
  - The file contains a few unfulfilled requests for crucial data. The CEC included requests for CF2R, PTO, and VNEM documents as well as missing water heater invoices.
  - The file states that the applicant's energy model simulations assumed the units contained laundry hookups. This is incorrect, and the CEC staff reran the CPT using correct files with no in-unit laundry. The CPT results are largely the same and only contain small rounding differences in incentives.
- **Kickers.** The only kickers this site claims are the JA13 compliant water heaters.
- **Macro-Enabled CPT (Custom Path Tool).** One full, macro-enabled CPT file corresponds to buildings 3A, 4B, and 7B. For the remaining buildings, one macro-enabled CPT file corresponds to each building pair: 1A/2A and 5B/6B. The CPT files indicate the site has a central laundry, which requires FILE3 and FILE4 for correct modeling. We received FILE3 and FILE4 for this site. The number of JA13 compliant water heaters aligns with the number of units in each particular building.
- **CPT Reports.** The CPT reports correspond to buildings like the macro-enabled CPT: individual files for 3A, 4B, and 7B, and shared files for each building pair, 1A/2A and 5B/6B. The CPT reports state that the site has a central laundry. In addition, the number of JA13 compliant water heaters in each file aligns with the number of units in each building.

- **CBECC Energy Compliance Models**. The energy models were structured like the macro-enabled CPT: individual files for 3A, 4B, and 7B, and shared files for each building pair, 1A/2A and 5B/6B. We found that all information in all energy models, as viewed in EnergyPro Version 8, aligns with the rest of the project documentation.
- **HERS files**. We received five HERS documents (CF2Rs). The make and model of all equipment in these files align with those in the energy model files.
- **Invoices**. The invoices show the make, model, and quantity of water heaters purchased and delivered to the site align with the rest of the project documentation.
- **PTO forms**. We received one PTO form for each of the seven residential buildings. The PTO files inform questions for the on-site visit surrounding the solar energy allocation to the tenants of each building, the solar energy generated (kW), NEM, and the tenants' TOU rate schedule.
- **VNEM forms**. The VNEM files inform on-site visit questions about the TOU rate schedules used for the tenant and common areas.

4.2.3 ON-SITE RESULTS SUMMARY

Below, we summarize the on-site verification results and present them in the same order as the survey instrument: site-level results first, followed by in-unit results. We performed the on-site visit in November 2024.

SITE-LEVEL VERIFICATION

Energy Services and Tenant Billing. Utilities meter and bill tenant units individually. Tenants must create an account with the utility companies upon moving into their units and are responsible for paying utility bills. We obtained copies of bills from different pay periods from one tenant. The bills list the utility provider as Pacific Gas and Electric (PG&E) and show winter and summer TOU periods in effect. In addition, the bills show an NEM true-up.

Solar/PV Equipment. The site has solar panels installed on every building. Through the VNEM agreement the financial value of the electricity generated by the solar installation is evenly split between all the units of that building.

Site/Building Electrical Service (Panels, Meter Banks, Infrastructure). Unit meters in meter rooms align with the number of units in each building inspected. The meter rooms also contain the PV support equipment.

Equipment Kickers. The reported kickers align with what we found on-site. The project documentation only claims JA13 compliant HPWHs as a kicker. During the site visit, we found no other measures eligible for kicker incentives.

EV Charging Equipment. The site is planning to install six EV chargers in the future, and the builders wired the site for future EV chargers.

Battery Equipment. No battery equipment is installed on-site.

Other On-site Fuels & Equipment. Natural gas is not present on-site. The communal BBQ area is electric-powered, not gas-powered.

Common Area Space equipment. The common space equipment includes an HVAC heat pump and HPWH for the laundry room and community space in the same building. The common area also contained an electric, non-induction range.

The electrical receptacle for the laundry room was a NEMA 14-30 240V outlet, as shown in Figure 11. The site installed Speed Queen combined washer/dryer machines (Model Number: STENXASP176W01) in the laundry room.

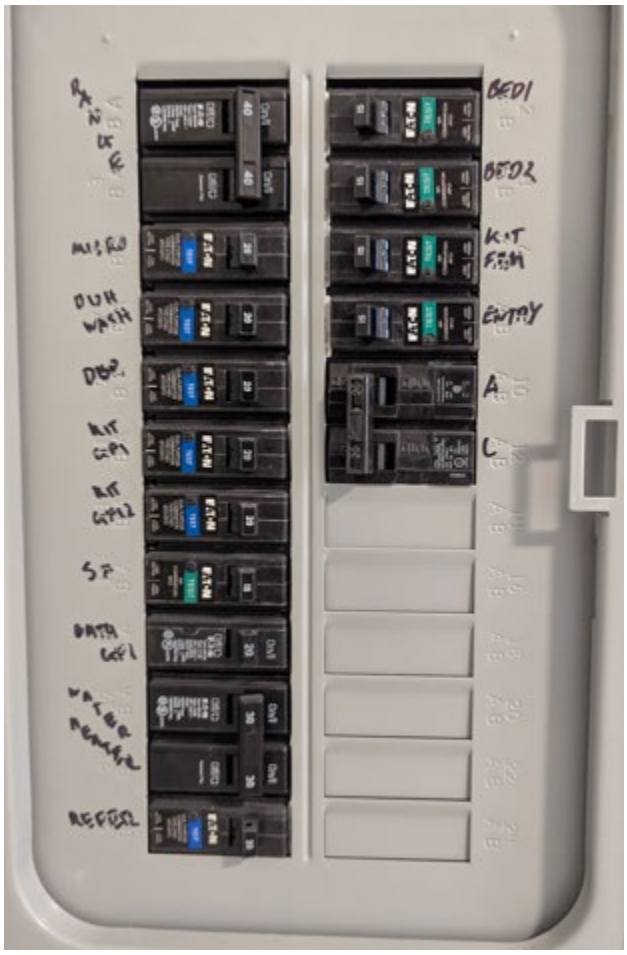
Figure 11. 240V Outlet for Community Laundry Room

Building Shading. There are no current issues with shading affecting the solar panels, which are on the second and third-story roofs. Future shading will also not affect the solar panels.

IN-UNIT VERIFICATION

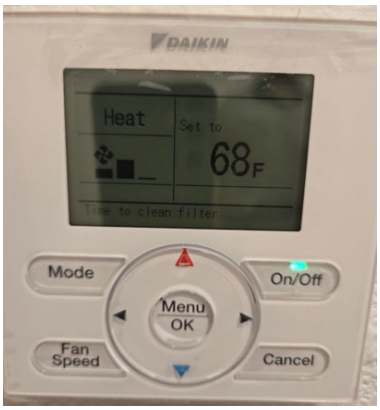
Electrical Panels. The central hallways of each unit contain the in-unit electrical panels accessible to the tenant. The in-unit panels do not contain a master breaker; those are located in the building utility rooms. Clear labeling is present for all circuits. The panels inspected had five to six empty slots, and solar breakers were not present. These in-unit panels are not "smart" and do not have any load-sharing devices present. Figure 12 shows an example of an in-unit electrical panel.

Figure 12. In-Unit Electrical Panel



HVAC Equipment and Thermostat. All units inspected have centrally ducted HVHPs. The Daiken thermostats in each unit are all in central hallways and are programmable (not smart), see Figure 13.

Figure 13. In-Unit HVAC Thermostat Control



The builders installed the outdoor condensing units on ground-floor concrete pads on the side of the unit or on rails on the roof of the unit. The fan discharge is also on the side of all units. Figure 14 shows an example of the rooftop units.

Figure 14. HVAC System Outdoor Condensing Unit

Capacities of HVAC units are in line with project files. A visual check and a verbal confirmation with the site superintendent confirmed that there is no backup heat source for the heat pump units. HVAC equipment manufacturer and model are in line with the project files, as shown in Table 9.

Table 9. HVAC Unit Detail Comparison – Project File vs On-site

Unit Name	Capacity (kBtu/hr)	Project Files Manufacturer	Project Files Model	On-Site Manufacturer	On-Site Model
HVHP-1	12	Daikin	RX12RMVJU	Daikin	RX12RMVJU
HVHP-2	18	Daikin	RXL18UMVJU	Daikin	RXL18UMVJU

Water Heating Equipment. The majority of the HPWHs on-site operate from dedicated, exterior closets. Tenants have no access to the water heater closets. As suspected, no garages are present on site. We confirmed that a garage is used in the energy model to represent an unconditioned space, which aligns with our on-site findings. Some HPWHs operate from rooms inside tenant units, which are conditioned spaces. The energy models for those units show the HPWH location as inside. Figure 15 shows an example of a water heater utility room.

Figure 15. HPWH Utility Room

Table 10 compares the HPWH details from the project files with those from the on-site visit. The capacities of HPWHs are in line with the project files, and the HPWH manufacturer and model align with the project files as well.

We found all HPWH on-site to not have thermostatic mixing valves (TMVs) installed, as such they are not JA13 compliant and not eligible for a kicker incentive.

Table 10. HPWH Unit Detail Comparison – Project File vs. On-Site

Bedroom	Unit Name	Capacity (gallon)	Project Files Manufacturer	Project Files Model	On-site Manufacturer	On-site Model	TMVs Present?
1	HPWH-1	50	Rheem	PROU H50 T2 RU375-30	Rheem	PROU H50 T2 RU375-30	No
2	HPWH-2	80	Rheem	PROU H80 T2 RU375-30	Rheem	PROU H80 T2 RU375-30	No

We found all HPWHs were in High Demand mode with a setpoint of 120°F.[15] Figure 16 shows the digital screen of an HPWH on-site.

[15] Describe the proprietary heating modes for these units: https://zwellhome.com/faq/what-operating-options-do-rheem-proterra-have/: 1) Energy Saver: The default mode, aiming to optimize energy usage by utilizing the heat pump primarily. 2) Heat Pump: Operates solely using the heat pump to heat water, generally the most energy-efficient option. 3) Electric: Uses only the electric heating element to heat water, typically used in situations where the heat pump may not be sufficient. 4) High Demand: Designed for situations with high hot water usage, prioritizing fast recovery time over maximum energy savings 5) Vacation: Lowers the water temperature to conserve energy while you're away from home.

Figure 16. On-Site HPWH Digital Screen

Laundry Equipment. Units do not have washer and dryer hookups. The central laundry room is the only on-site option available to tenants.

Cooking Equipment. We could not verify the electrical receptacle for in-unit ranges, but they are most likely NEMA 14-30 sockets, to match the central laundry room receptacles.

Other. There is no shared pool or jacuzzi on site.

SIGNIFICANT SITE-SPECIFIC FINDINGS

- The number, size, and efficiency of all HVHP and HPWH equipment were confirmed.
- Although no EV charging equipment currently exists, the site was pre-wired to facilitate the addition of such equipment in the future.
- The HPWHs found on site were all in High Demand mode, the second least energy-efficient mode after Electric mode. This could lead to excess electricity being used, making the site less energy efficient overall.
- The HPWHs found on site do not have TMVs installed and are not JA13 compliant. As such they are not eligible for a kicker incentive.

4.2.4 EX-POST ANALYSIS & RESULTS

We found no discrepancies between the given project files and the on-site equipment for any of the buildings at this site. We made no changes to the as-built EnergyPro energy models or the CPT files. As a result, we did not perform any revised runs of the EnergyPro energy modeling software or the macro-enabled CPTs. Table 11 shows the reported and verified metric tons of GHGs avoided per year. The GHG realization rate for this project is 100%.

Table 11. Site-002 Total GHG Avoided: Reported vs Verified

Building	Reported Total GHG Avoided (metric tons/year)	Verified Total GHG Avoided (metric tons/year)	Realization Rate
1A	5.74	5.74	100%
2A	5.74	5.74	100%
3A	5.71	5.71	100%
4B	7.84	7.84	100%
5B	7.90	7.90	100%
6B	7.90	7.90	100%
7B	7.83	7.83	100%
Total	**48.66**	**48.66**	**100%**

4.3 SITE-003

Project Site-003 is a single-family community comprised of 36 single-family detached homes completed in 2022. The 36 homes are all one-story tall with attics and solar PV systems on the rooftops. There is also a solar carport on the premises at the leasing office. The homes range from two to four bedrooms. Each home is individually metered.

4.3.1 PROJECT SUMMARY & ON-SITE VERIFICATION APPROACH

We sampled units through a two-stage sample design: first, we sampled buildings, and then we sampled units from within the sampled buildings described in Section 3.3.

BUILDING GROUP SAMPLING APPROACH

To guide site sampling, we grouped buildings into categories based on the number of bedrooms. There are three Building Categories, A, B, and C, corresponding to buildings with two, three, and four bedrooms, respectively. Our proposed building sample includes one building from each category (A, B, C), depending on home availability and tenant participation.

Table 12 summarizes the building sampling design for Site-003.

Table 12. Home Details by Building

Building Name	Building Categories	Building Floor Area	# of Homes	# of Bedrooms
N/A	A	1,042	4	2
N/A	B	1,042	4	3
N/A	C	1,339	28	4

Note: There are no building names (Column 1) because each building has its own address.

The configuration of HVHP and HPWH is an additional factor in the selection of on-site home visits. As shown in Table 13, the homes have one HVHP configuration and three HPWH configurations. Two-, three-, and four-bedroom homes have unique HVHP sizes. Each building configuration by number of bedrooms uses a different-sized HPWH, which we hoped to capture in our building sample described above.

Table 13. HVAC and HPWH Sampling

# of Bedrooms	HVHP Unit Name	HVHP Size (kBtu/hr)	HPWH Unit Name	HPWH Size (gallons)
2	HVHP-1	24	HPWH-1	50
3	HVHP-1	24	HPWH-2	65
4	HVHP-1	24	HPWH-3	80

4.3.2 PROJECT DOCUMENTATION REVIEW RESULTS SUMMARY

Below, we summarize the primary documents and key information received for Site-003. For reference, a description of each document type is provided in Appendix A.

- **CEC CPT QC and Changes.** The CEC review of the EnergyPro models and the CPT result files revealed no potential discrepancies.
- **Kickers.** The only kickers this site claims are the JA13 compliant water heaters.
- **Macro-Enabled CPT (Custom Path Tool).** One full, macro-enabled CPT file corresponds to each of the three building configurations. The CPT files all indicate that the site does not have a central laundry. The information in these files aligns with the rest of the project documentation.
- **CPT Reports**. One CPT report file corresponds to each of the three building configurations. The CPT reports all state that the site does not have a central laundry. In addition, the number of JA13 compliant water heaters in each field aligns with the number of units in each building.
- **CBECC Energy Compliance Models**. The energy models correspond to the three building configurations. We found that all information in all energy models, as viewed in EnergyPro Version 8, aligns with the rest of the project documentation.
- **HERS files**. We received three HERS documents (CF2Rs). The make and model of all equipment in these files align with those in the energy model files.
- **Invoices**. The invoices show the make, model, and quantity of water heaters purchased and delivered to the site align with the rest of the project documentation.
- **PTO forms**. We received one PTO form for each of the three building configurations. The PTO files inform questions for the on-site visit surrounding the solar energy generated (kW) , NEM, and the TOU rate schedule.
- **VNEM forms**. The VNEM files inform on-site visit questions about the TOU rate schedules used for the tenant and common areas.

4.3.3 ON-SITE RESULTS SUMMARY

Below, we summarize the on-site verification results and present them in the same order as the survey instrument, with site-level results first, followed by in-unit results. We performed the on-site visit in November 2024.

SITE-LEVEL VERIFICATION

Energy Services and Tenant Billing. Utilities meter and bill tenant homes individually. Tenants must create an account with the utility companies upon moving into their homes and are responsible for paying their utility bills. We obtained

copies of tenant bills for two properties. These bills list the utility provider as PG&E, show VNEM tracking, and customer enrollment in the NEM 2.0 program.[16]

Solar/PV Equipment. The site has solar panels installed on every building. Unused solar electricity generated that month shows up as a credit on each tenant's account.

Site/Building Electrical Service (Panels, Meter Banks, Infrastructure). Each home has its own electric meter and a second, adjacent panel for the PV system.

Equipment Kickers. The reported kickers align with what we found on-site. The project documentation only claims JA13 compliant HPWHs as a kicker. During the site visit, we found no other measures eligible for kicker incentives.

EV Charging Equipment. The homes inspected did not have EV chargers, but the builders pre-wired each garage for a future charger.

Battery Equipment. We found no battery equipment in the homes inspected.

Other On-site Fuels & Equipment. Natural gas is not present on site, and the communal BBQ area is charcoal-powered, not gas-powered.

Common Area Space equipment. The common space equipment includes an HVHP and an HPWH.

Building Shading. There are no current issues with shading affecting the solar panels, which are all on the roofs. Future shading will also not affect the solar panels.

HOME VERIFICATION

Electrical Panels. Tenants can open all home electrical panels mounted on an exterior wall in the side or back yard. All panels inspected were rated at 200 amps. Clear labeling is present for all circuits, including 240V loads. The panels inspected have between three and four empty slots. These home panels are not "smart" and do not have any load-sharing devices present. Figure 17 shows an example of a home's electrical panel.

[16] NEM 2.0 refers to the revised NEM tariff adopted by the CPUC in D.16-01-044.

Figure 17. Home Electrical Panel

HVAC Equipment and Thermostat. All homes inspected have a centrally ducted HVHP. The thermostats in each home are all Pro-1 brand, located in central hallways, and programmable (not smart), as shown in Figure 18.

Figure 18. Home HVAC Thermostat Control

The builders installed outdoor condensing units on ground-floor concrete pads on the side of the home. The fan discharge is also on the top of all units. Figure 19 shows an example of these units.

Figure 19. HVAC System Outdoor Condensing Unit

The indoor air handler units are in the attic of each home, and we were not permitted to access the attic to perform any visual verification. HVAC equipment capacities, manufacturer, and model are in line with the project files, as shown in Table 14.

Table 14. HVAC Unit Detail Comparison – Project File vs. On-Site

Unit Name	Capacity (kBtu/hr)	Project Files Manufacturer	Project Files Model	On-Site Manufacturer	On-Site Model
HVHP-1	24	Maytag	PSH4BG024K	Maytag	PSH4BG024K

Water Heating Equipment. The HPWHs inspected in the homes serve between one and four people, according to the number of tenants in the homes. The home garages contain all the HPWHs we inspected.

Table 15 compares the HPWH details from the project files against the on-site visit. The HPWH capacities, manufacturer, and model align with the project files. We found all HPWH verified on-site to be JA13 compliant. The water heaters at this site have TMVs installed.

Table 15. HPWH Unit Detail Comparison – Project File vs. On-Site

Bedroom	Unit Name	Capacity (gallon)	Project Files Manufacturer	Project Files Model	On-Site Manufacturer	On-Site Model	TMVs Present?
2	HPWH-1	50	Rheem	RE2H50	Rheem	PROU H50 T2 RUH375	Yes
3	HPWH-2	65	Rheem	RE2H50	Rheem	PROU H65 T2 RU375	Yes
4	HPWH-3	80	Rheem	RE2H80	Rheem	PROU H80 T2 RU375	Yes

We found all HPWHs were in Heat Pump mode with a setpoint of 120°F [17] Figure 20 shows the digital screen of an HPWH on-site.

Figure 20. On-Site HPWH Digital Screen

Laundry Equipment. The builders installed washer and dryer hookups in each home. The tenants must provide their own washer and dryer equipment. The electrical outlet for home laundry equipment is a NEMA 14-30 socket. We could not secure a picture of the socket.

Cooking Equipment. We could not verify the electrical receptacle for home ranges because we lacked the proper tools to maneuver the appliance, but they are most likely a NEMA 14- 30 socket to match the laundry receptacles.

Other. The site has community gardens. There is no shared pool or jacuzzi on site.

[17] Describe the proprietary heating modes for these units: https://zwellhome.com/faq/what-operating-options-do-rheem-proterra-have/: 1) Energy Saver: The default mode, aiming to optimize energy usage by utilizing the heat pump primarily. 2) Heat Pump: Operates solely using the heat pump to heat water, generally the most energy-efficient option. 3) Electric: Uses only the electric heating element to heat water, typically used in situations where the heat pump may not be sufficient. 4) High Demand: Designed for situations with high hot water usage, prioritizing fast recovery time over maximum energy savings 5) Vacation: Lowers the water temperature to conserve energy while you're away from home.

SIGNIFICANT SITE-SPECIFIC FINDINGS

- The number, size, and efficiency of all HVHP and HPWH equipment were confirmed.
- Although no EV charging equipment currently exists, the site was pre-wired and has panel capacity to facilitate the addition of such equipment in the future.
- The HPWHs reviewed on-site were all in Heat Pump mode, the second most energy-efficient mode designed for regular resident usage (after Energy Saver mode).

4.3.4 EX-POST ANALYSIS & RESULTS

We found no discrepancies between the given project files and the on-site equipment for any of the buildings at this site. We made no changes to the as-built EnergyPro energy models or the CPT files. As a result, we did not perform any revised runs of the EnergyPro energy modeling software or the macro-enabled CPTs. Table 16 shows the reported and verified metric tons of GHGs avoided per year. The GHG realization rate for this project is 100%. While four two-bedroom homes were constructed, only three were incentivized because one is the site manager's residence.

Table 16. Site-003 Total GHG Avoided: Reported vs Verified

Building Categories	# of Bedrooms	# of Homes	Total GHG Avoided (metric tons/year)	Realization Rate
A	2	3	2.7	100%
B	3	4	3.8	100%
C	4	28	31.36	100%
Total		**35**	**37.86**	**100%**

5. OVERARCHING PROJECT VERIFICATION RESULTS

5.1 PROTOCOLS, PROCESSES, AND TOOLS

The CEC informed us that the BUILD application process has been challenging in many cases. Many applicants have not been able to complete the applications on their own and have requested additional support from the CEC. In turn, the CEC began offering application support to applicants through its existing TAP. Specific assistance has been needed to navigate the CPTs and ensure accurate inputs and outputs. These extra challenges inadvertently added a barrier to participation for applicants.

5.2 BILL IMPACTS

As part of the BUILD Program impact evaluation, we evaluated the program's utility bill impact estimation practices and methods. Based on a review of documents, energy models, CPTs, and conversations with CEC staff, we made the following determinations:

- Changes in the common area energy consumption are not distorting the tenant unit bill calculations for the following two reasons:
  - The common area heat pump and HPWH energy consumption is removed from the energy models if the equipment requirements for BUILD are not met. In these cases, the common area usage is not in the tenant 8760 files.[18] Otherwise, the CPT removes the energy consumption of the central equipment from the bill calculation.
  - The remainder of the common area energy consumption is likely negligible compared to the total tenant energy consumption. Moreover, equipment incentivized by the BUILD Program is not expected to affect the common area energy consumption other than through a central heat pump and HPWH.
- Solar allocation shares to tenants through the VNEM files are not directly accounted for in the energy model or CPTs. Instead, the allocation shares and verified solar in each site can be used to scale up the 1 kW-8760 files.[19]
- We verified that the application of a CARE discount factor is appropriate for the following reasons:
  - For a low-income building, all units are assumed to receive the CARE discount.
  - For a building with both low-income and market-rate units, they use an allocation factor equal to the ratio of units in the building that are low-income.
  - Some tenants may be ineligible for discounts or may not apply for one. As such, the calculation takes a conservative approach.

Finally, we verified and updated kW values per building from PTO files and/or PV site plans, allocated PV generation to tenants as per VNEM documents, updated energy model output files, reran CPT files, and compared the new CPT values against the original ones.

Table 17 shows the Verified Monthly Modeled Resident Utility Cost Savings at the site level based on verified kW values. To generate these values, we:

[18] 8760 files are outputs from the energy modeling software that estimates hourly energy consumption of different end uses and total GHG emission based on different building assumptions. Since there are 8,760 hours in a typical year, these files are known as 8760 files.
[19] 1 kW-8760 files are 8760 files assumes 1 KWdc of solar installation.

- Estimated baseline utility bill per building of each site using the received CPTs.
- We then multiplied the baseline utility bill per building by the Verified Modeled Utility Cost Savings (%) value that the CPTs output.
  - This generates Verified Monthly Modeled Resident Utility Cost Difference (building-level)
- The Verified Monthly Modeled Resident Utility Cost Difference (building-level) values for each building are summed.
- These sums are then divided by the sum of the estimated baseline utility bill values to calculate Verified Monthly Modeled Resident Utility Cost Savings (%) (site-level).

To meet the BUILD target, these sums must be at least 5% at the site level. If the site is below 5%, then it is not generating or allocating enough solar energy at the site level to meet the BUILD requirement of at least 5% bill reduction. When updating the analysis to verified inputs, all three sites are above the 5% requirement at the site-level. We will explore each site in detail below.[20]

Table 17. BUILD Tenant Bill Impacts

Site	Verified Monthly Modeled Resident Utility Cost Savings (%) (site-level)
Site-001	72
Site-002	7
Site-003	121

We show the bill impact analysis for Site-001 in Table 18. The CPT Report PV - Minimum BUILD Requirements kW value (Column B) provides the minimum PV needed to achieve a 5% tenant bill reduction per building. Columns C and D provide the inputs to calculate verified PV capacity based on the PV site plan details and VNEM, which is then provided in Column E. Column F provides the resulting bill impact when the CPT is updated based on the kWdc values provided in Column E.

All buildings at this site meet the 5% threshold and the site-level expected utility cost savings is 72%. Building G2 does not have a verified result nor PTO form values because this building's generated solar electricity is routed through building G1's main service panel and utility meter point of interconnection. This was confirmed via the PV system plan drawings that we received from the site.

Table 18. Site-001 Bill Impact Results

Site Building	CPT Report PV - Minimum BUILD Requirements (kWdc)	PV Site Plan (kWdc)	Tenant Share per VNEM (%)	PV Allocated to Tenants per VNEM (kWdc)	Verified Monthly Modeled Resident Utility Cost Savings (%)
(a)	(b)	(c)	(d)	(e) = (c)*(d)	(f)
F1	20.67	34.20	100	34.20	88
F2	20.66	34.20	100	34.20	88
G1 (and G2)	27.61	62.32	100	62.32	118
G2	27.17	N/A	N/A	N/A	N/A
G3	20.67	28.50	100	28.50	75
G4	20.67	30.78	100	30.78	80

[20] Please note that the total percentage savings values in the site level tables do not equal to the average of row-wise percentages since i) the number of tenant units in each building is different and ii) VNEM based allocation to tenant can also vary between buildings within the same site.

G5	27.21	27.74	100	27.74	9
G6	10.10	34.96	100	34.96	178
G7	14.14	19.38	100	19.38	75
HA1	20.36	28.12	100	28.12	74
HA2	9.72	21.28	100	21.28	108
HA3	21.00	28.50	100	28.50	74
Totals	**239.98**	**378.1**	**N/A**	**349.98**	**72**

We show the bill impact analysis for Site-002 in Table 19. Four of the seven Verified Monthly Modeled Resident Utility Cost Savings (%) values meet the 5% threshold, and the site-level cost savings is 7%. Three of the four category B buildings barely missed the modeled residential utility cost savings requirement of 5%. At this site, the category B buildings all have three stories and contain 12 units. One of these buildings (7B) had 55 PV panels installed and met the required modeled utility cost savings threshold. The other three only had 51 panels installed, and just barely fell short of the requirement. However, the site still met the requirement overall because the verified solar generation allocated to tenants in other buildings exceeds the BUILD required minimum enough to move than offset the shortfall in these three buildings.

The values in Column C were generated by multiplying the number of PV panels stated in each building's PTO form by the kWdc output capacity of the PV panels, as stated in the panel's spec sheets.

Table 19. Site-002 Bill Impact Results

Site Building	CPT Report PV - Minimum BUILD Requirements (kW)	PTO PV (kWdc)	Tenant Share per VNEM (%)	PTO PV Allocated to Tenants per VNEM (kWdc)	Verified Monthly Modeled Resident Utility Cost Savings (%)
(a)	(b)	(c)	(d)	(e) = (c)*(d)	(f)
1A	15.67	16.38	96%	15.72	6
2A	15.67	16.38	96%	15.72	6
3A	15.86	43.23	40%	17.29	21
4B	22.87	23.21	96%	22.28	0
5B	22.61	23.21	96%	22.28	2
6B	22.61	23.21	96%	22.28	2
7B	22.88	25.03	96%	24.02	14
Totals	**138.17**	**170.63**	**N/A**	**139.59**	**7**

The bill impact for Site-003 is shown in Table 20. All Verified Monthly Modeled Resident Utility Cost Savings (%) values exceed the 5% threshold, and the site-level cost savings is 121%. These verified results are greater than the reported results due to a higher level of verified solar generation allocated to tenants relative to the CPT Report PV minimum (kW) values.

The values in Column C were generated by multiplying the number of PV panels stated in each building's PV site plan by the kWdc output capacity of the PV panels, as stated in the panel's spec sheets.

Table 20. Site-003 Bill Impact Results

Site Building	CPT Report PV - Minimum BUILD Requirements (kWdc)	PV Site Plan (kWdc)	Tenant Share per VNEM (%)	PTO PV Allocated to Tenants per VNEM (kWdc)	Verified Monthly Modeled Resident Utility Cost Savings (%)
(a)	(b)	(c)	(d)	(e) = (c)*(d)	(f)
2BD	2.97	7.21	100	8.60	137
3BD	3.39	7.21	100	8.60	129
4BD	3.90	7.21	100	8.60	118
Totals	**10.26**	**21.63**	**N/A**	**25.80**	**121**

5.3 AVOIDED GHG EMISSIONS

SB 1477, the enabling legislation that created both the BUILD Program and the TECH Initiative, requires each program to be evaluated based on, in part, the cost per metric ton of GHG reduction. This metric directly assesses the program's ability to reduce GHG emissions efficiently. It facilitates a ready comparison to other decarbonization programs or initiatives California legislators and regulators may be considering to address climate change, both inside and outside of the consumer-facing energy program space. Further, the metric can be compared to marginal damage estimates of GHG emissions, such as the EPA's social cost of carbon. In this section, we provide two separate estimates of the cost per avoided metric tons of CO_2e.

The first estimate (CE1) includes all program administration costs, incentives, and program spending on technical assistance.[21] Although not a cost-effectiveness test, the included costs in this scenario are most conceptually aligned with those of the CPUC's Program Administrator Cost test.[22] In this estimate, the average cost to the BUILD Program per participating site ranges from approximately $330,000 to $750,000, including all program administration and BUILD incentive costs. Based on the estimated avoided GHG emissions associated with BUILD participation, this results in an average cost of $302 per lifetime avoided metric ton CO_2-e.[23]

The second estimate (CE2) provides the cost per metric ton of CO_2-e when accounting for the additional equipment and construction costs to the participant and all costs included in CE1. Although not a cost-effectiveness test, the costs included in this scenario are most aligned with those of the CPUC's Total Resource Cost test. In this scenario, the average cost per site increases to between $4.5 million and $15 million, translating to an average of $5,694 per avoided metric ton CO_2-e.[24] We provide CE2 for informational purposes only; however, we believe it is appropriate for the cost-efficiency metric to account for only program implementation costs (including incentives) and to exclude customer contributions to equipment and construction costs. This approach increases the comparability of the metric to non-customer-facing programs and avoids the asymmetry of including all participant costs while excluding some participant benefits.

Both scenarios are shown in Table 21. For comparison, the EPA estimates the social cost of CO2 emissions at $190 per MT using a discount rate of 2.0% and $340 per MT using a discount rate of 1.5% (damages in 2020 dollars).

[21] Given that the program is ongoing and new construction programs can have very long lead times, the program has developed a strong pipeline of projects since its inception. Therefore, to calculate the cost per ton of avoided CO_2-e, program administration costs are estimated from separate datasets, normalized to a per-incentive basis, and extrapolated to the study population of sites.

[22] California Public Utilities Commission (CPUC) Standard Practice Manual. October 2001.

[23] Lifetime GHG impacts assume a 30-year measure life.

[24] Calculating the incremental cost of building a high-efficiency all-electric new construction multifamily building relative to code-compliant buildings is a complicated and highly site-specific process. Here, we assumed a very modest 20% cost premium.

Table 21. Cost Per Avoided MT CO_2-e

Site	Lifetime GHG (MT CO2e)	CE1		CE2	
		Program Costs Only	*Cost per GHG (MT CO2e)*	*Program Costs + Non-Program Costs*	*Cost per GHG (MT CO2e)* [A]
Site-001	2,325.90	$752,554	$324	$14,968,136	$6,435
Site-002	1,459.80	$401,167	$275	$8,496,890	$5,821
Site-003	1,135.80	$334,051	$294	$4,559,126	$4,014
Total	**4,921.50**	**$1,555,064**	**$302** [A]	**$28,091,445**	**$5,694** [A]

[A] This is a weighted average and not a sum.

6. KEY FINDINGS AND RECOMMENDATIONS

Based on our research, we offer several key findings and recommendations to ensure the BUILD Program can effectively improve on past, current, and future projects.

- **Finding: Cost-efficient reductions in emissions relative to a deemed baseline.** Relative to a deemed code-compliant mixed fuel baseline, the three reviewed projects are estimated to have collectively reduced lifetime GHG emissions over the course of an assumed 30-year measure life by approximately five million metric tons of carbon dioxide equivalent (MT CO2e). Based on a review of project costs, this reduction was achieved at a cost per MT similar to that of the United States Environmental Protection Agency (EPA)'s social cost of carbon.
- **Finding: Equipment alignment between the project files and on-site.** All HVAC and water heating equipment counts, types, sizes, and efficiencies were consistent between project files, invoices, energy models, and the on-site verification visits.
- **Finding: Non-Intuitive Custom Path Tool (CPT) Process.** Applicants were not able to complete the process themselves, and a third party was needed specifically to aid applicants through the application process. We had initial trouble interpreting results from the CPT, as well.
  - **Recommendation:** Improve the application by adding definitions for each section of the CPT. Consider including an example completed application.
- **Finding: Not all heat pump water heaters (HPWHs) operated in Heat Pump mode.** Two of the three sites we visited had HPWHs operating in the High Demand mode, the least energy-efficient mode.
  - **Recommendation:** Discuss with sites why they are operating in this mode and assess if there's a way to transition to Heat Pump mode. Investigate the energy implications of operating in High Demand mode instead of Heat Pump mode and adjust energy and GHG calculations accordingly. Alternatively, BUILD (or other future new construction decarbonization programs) could require participants who receive program incentives for the installation of HPWH to operate them in heat pump mode.
- **Finding: Non-JA13 compliant HPWHs at two of the three sites.** We found that all three sites installed HPWHs which are only JA-13 compliant when installed with TMVs as they do not conform to UL 60730-1, ASSE 1082, or ASSE 1084.[25] Two of the three sites have HPWHs installed without TMVs, representing 177 of 212 HPWHs, and as such are not JA13 compliant and should not have received a kicker incentive.
  - **Recommendation:** Ensure installation of HPWH equipment intended to qualify for equipment kickers meets all necessary JA13 requirements.
- **Finding: Insufficient photovoltaic (PV) kW capacity installed at one of the three projects resulted in buildings that did not meet the program's required estimated 5% bill savings.** We used the PV system plans and PTO forms to source verified PV kW generation values because these forms, in conjunction with the VNEM forms, represent the most up-to-date PV generation capacity (kWdc) that is available to tenants. Updating the CPT to rely on these values resulted in one of the three projects we evaluated having some buildings fail to meet the program's required minimum of 5% expected bill savings.
  - **Recommendation:** Ensure sufficient PV system capacities are installed and allocated to tenants through a VNEM agreement at the building-level to ensure program requirements are met.
- **Finding: Building management was unable to verify solar generation at every site.** During some of the on-site visits, we learned that staff were not able to live-monitor the electric generation of the installed solar equipment.

[25] Appendix JA13 – Qualification Requirements for Heat Pump water Heater Demand Management Systems: https://www.energy.ca.gov/sites/default/files/2022-12/JA13_2022_Qualification_Requirement_HPWH_DM_ADA.pdf

- **Recommendation:** Implement solar monitoring software to enable sites to track solar electricity generation. With this capability, sites could correlate generated electricity to earned solar credits, observe the effects of changes in electric-usage behaviors, and gain general transparency into the solar electricity generated.

APPENDIX A. PROJECT DOCUMENTS AND DIRECTORIES

The evaluation team reviewed building simulation/energy models, CPT input files, CPT output files, HERS files, invoices, PTOs, and VNEMs for each sampled project. Each file type is described below.

Energy Models. This directory contains the energy model files made using EnergyPro version 8. EnergyPro is a CEC-approved energy modeling software that incorporates the CBECC.

- We use the energy models to compare unit and site configuration by building against the other project files received.
- The output of the EnergyPro files are 8760 hourly result CSV files that detail the energy consumption of the modeled building for each hour in a calendar year.

CPT Version 1.3.#. This directory contains the macro-enabled CPT calculator and associated 8760 hourly results input files (FILE1 and FILE2). It also contains a copy of the CEC's CPT QC review notes. We describe the files in more detail below:

- **Macro-enabled CPT calculator (Excel workbook).** We received one CPT file for each building or building type at the project site, depending on the site.
  - The user inputs in these files include building name, project address, California climate zone, gas and electric utility provider, building stories, number of units in the building, and total number of bedrooms. The user inputs include selecting whether the site has central laundry and water heating. All of these inputs were used to compare against other project files and verify the layout and configuration at each site.
  - Using the above inputs along with the 8760 hourly results files generated by the energy model, the CPT then outputs the building's estimated avoided GHG in metric tons. It will also output the projected BUILD program incentive per building and bedroom. The outputs from these CPT files should align with the shared BUILD tracking data.
- **CEC CPT QC and Changes.** We received one PDF file per site containing the results of the CEC's various reviews of the site's CPT files and application. Each site might have received up to three reviews by the CEC, with changes and discussions shared at each review cycle. Topics discussed in these reviews range from specifics about the energy models to energy-efficient equipment make and model, site details, and file management.

CPT Reports. This directory contains the CPT report files that are standalone versions of macro-enabled files. There is one corresponding CPT report file for every macro-enabled CPT file. The original CPT user created these files using the macro-enabled CPT file by clicking the button in the file that says, "SAVE AS XSLX, REQUIRED FOR APPLICATION." The information in these CPT reports should match the macro-enabled CPT files.

Home Energy Rating System (HERS) files. This directory contains the certificates of compliance (CF1R), the certificates of installation (CF2R), and the certificates of verification (CF3R), sets of each for each building on each site. Some of these certificates were completed by a certified HERS provider. We use these certificates to verify HVAC and water heater equipment against the other project files we received. We also pull building configuration details from these files.

Invoices. This directory contains the heat pump HVAC and HPWH equipment invoices. We use these to verify site and building details, such as addresses and dates, and to compare equipment makes, manufacturers, and quantities against other project files.

PTO forms. This directory contains the solar PTO forms from the electric utilities. We use these forms to verify building addresses and details of the site's solar system.

VNEM forms. This directory contains the VNEM forms, which provide some site and building information we can compare against the other project files we received. In addition, these files contain information on the electric utility, the utility rates, and details of the site's solar system. The VNEM forms help us better understand each building's solar generation capacities by sharing the estimated monthly solar energy production of each building in kWh. This proves useful when verifying the outputs from the CPT files.

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