Change You Can Bill-ieve in. Electrification Versus Deep Retrofits in Low-Income Communities.

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ABSTRACT

California has established many forward-looking energy efficiency and carbon reduction goals, including doubling energy efficiency savings by 2030 and transitioning to 100% renewable and zero-carbon electricity by 2045. California is also working to ensure that low-income communities are not excluded from this energy transition. It has created programs prioritizing low-income customers to advance this goal, including a deep retrofit program and an electrification program.

This paper presents a comparison of realized energy, greenhouse gas (GHG) and bill impacts from Southern California Edison's (SCE) Energy Savings Assistance (ESA) Building Electrification (BE) and Whole Home (WH) Pilots for low income single family homes. The BE Pilot supports low-income households in replacing gas appliances with efficient electric technologies, while the WH Pilot provides deep dual fuel energy efficiency retrofits. [1]

This paper assesses how electrification and dual fuel energy efficiency impact energy use, customer bills, and GHG reductions. Specifically, it examines: (1) changes in electricity and gas consumption following installation, (2) whether households experience net bill increases or decreases, and (3) a comparison between bill and GHG impacts from dual fuel energy efficiency and electrification upgrades. The paper includes ESA BE process findings to contextualize program outcomes.

Introduction

California has some of the most ambitious energy and climate goals in the United States. State policy calls for doubling energy efficiency savings by 2030 (California Legislature 2015) while simultaneously transitioning to 100% renewable and zero-carbon electricity by 2045 (California Legislature 2018). Achieving these goals will require not only continued improvements in energy efficiency but also widespread electrification of end uses currently served by fossil fuels. At the same time, policymakers have emphasized that the benefits of the energy transition must be equitably distributed and accessible to low-income households, who historically face barriers to participating in clean energy programs.

Low-income households often live in older and less efficient homes, have limited access to capital for upgrades, and may be particularly sensitive to changes in energy bills. These

[1] Both ESA BE and ESA WH provide weatherization and infiltration reduction measures.

challenges raise important questions about how decarbonization strategies, including electrification and deep energy efficiency retrofits, affect energy consumption, greenhouse gas (GHG) emissions, and household energy costs for this population. Understanding the real-world impacts of these strategies is essential for designing programs that advance both climate and equity goals.

To support these objectives, Southern California Edison (SCE) implemented two Pilot initiatives within its Energy Savings Assistance (ESA) program. The ESA program serves income-qualified households by providing no-cost energy efficiency upgrades designed to reduce energy use, improve comfort, and lower utility bills. Building on this foundation, Southern California Edison (SCE) introduced two Pilots intended to explore deeper energy savings and decarbonization pathways for low-income customers. The Building Electrification (BE) Pilot focuses on replacing natural gas appliances with high-efficiency electric technologies, while the Whole Home (WH) Pilot, a joint Pilot with Southern California Gas Company (SoCalGas), delivers comprehensive energy efficiency retrofits that improve efficiency across both electric and gas end uses.

This paper presents a comparison of realized energy, GHG, and bill impacts from these two Pilots. Specifically, the evaluation assesses (1) changes in electricity and gas usage following installation, (2) whether households experience net increases or decreases in total energy bills, and (3) how and GHG impacts differ between electrification and deep dual-fuel efficiency interventions. It should be noted that this paper presents interim results of these Pilots. Final impact and process results for these Pilots will be provided to the IOUs in early 2027.

Program Background

The ESA BE and ESA WH Pilots have distinct objectives and program designs. Table 1 summarizes the background and key characteristics of each Pilot. At a high level, the ESA BE Pilot is focused on electrification and was established to demonstrate the viability and value of incorporating electrification measures into the core ESA program. In contrast, the ESA WH Pilot is designed to demonstrate the feasibility of delivering targeted, whole-home energy efficiency retrofits that achieve deeper energy savings at individual homes. While both Pilots serve income-qualified customers and aim to improve affordability and comfort, they differ substantially in their measure offerings, participation requirements, and overall program objectives.

Table 1. ESA BE and ESA WH Pilot Background and Characteristics

Characteristic	ESA BE	ESA WH
CPUC Authorization	The California Public Utilities Commission (CPUC) approved the Pilots in Decision (D.) 19-06-022	
Implementing Utilities	SCE Only	SCE and SoCalGas Jointly
Pilot Launch Year	The Pilot launched 2022 with first installations occurring in 2023	2022
Primary Objectives	Assess the value and viability of incorporating electrification measures into the ESA program and provide cleaner, more affordable energy options to income-qualified customers.	Demonstrate whole-home approaches capable of achieving deeper energy savings while improving health, comfort, and safety to income-qualified customers
Program Structure	Single Pilot	Two sub-programs: Pilot-Plus (5–15% whole-home energy savings target) Pilot-Deep (15–50% whole-home energy savings target)

Pilot Offerings	Electrification measures include heat pump (HP) HVAC, heat pump water heaters (HPWH), electric clothes dryers, and induction cooktops. Additional offerings include thermostats, minor home repairs and upgrades, and necessary panel upgrades and electrical work.	Customized packages of electric and gas efficiency measures based on household needs, including weatherization and air infiltration reduction measures.
Participation Requirements	Homes must meet income eligibility requirements, pass a Pilot-sanctioned home assessment, demonstrate that energy bills will likely not increase as a result of participation, and have an existing gas furnace and water heater that can be replaced by heat pump equipment.	Must meet income eligibility requirements. Must complete a home audit to determine Pilot eligibility and determine the appropriate pathway (Plus or Deep). Participant targeting included kWh and therrm consumption targets. Initial targeting included customers who had any bills above 300% of the monthly electricity baseline and 200% above the gas baseline. This was later reduced to 200% above the monthly electricity baseline and 100% gas baseline

Pilot Participation and Characterization

As of August 2026, both the ESA BE and ESA WH Pilots have undergone interim impact and process assessments for participants enrolled as of May 2025. The analysis includes 220 participants in the ESA BE Pilot and 44 participants in the ESA WH Pilot. Figure 1 presents program participation by quarter for both Pilots, showing the number of new and cumulative projects over time. As shown, enrollment in the ESA BE Pilot has steadily increased, while participation in the ESA WH Pilot has remained comparatively lower. Regardless, initial Pilot uptake has been relatively low for both Pilots, with fewer than 300 projects initiated during the first two years of implementation.[2]

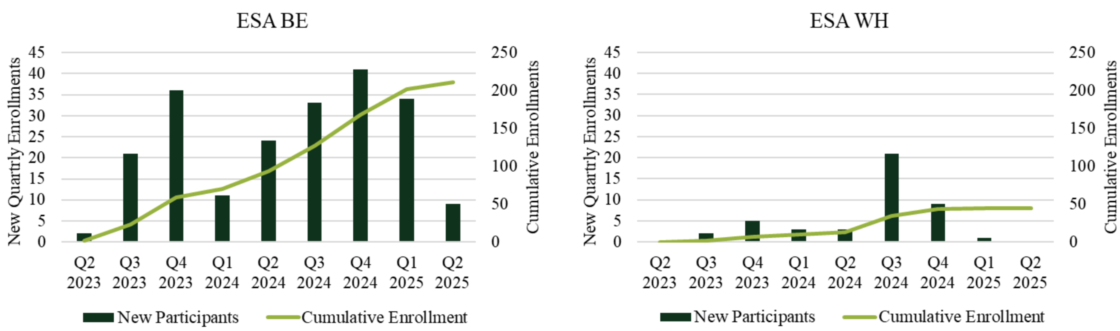

Figure 1.ESA Pilot Participation (First Installation Dates) by Quarter

Figure 2 presents the ESA BE project types and the distribution of measures installed through the ESA WH Pilot. For the ESA BE Pilot, all projects are required to install both a heat pump HVAC and heat pump water heater (HPWH) systems. These installations are collectively referred to as "Base Measures." Projects consisting only of base measures represent approximately 40% (88) of ESA BE projects. The remaining projects include the base measures

[2] Since completion of these interim evaluations, participation in both Pilots has increased substantially. By the end of the first quarter of 2026, each Pilot had enrolled more than 600 participants. This growth was driven in part by changes to customer targeting strategies and revisions to marketing materials aimed at improving recruitment. However, because many of these additional projects were installed after the study period, they were not included in the analyses presented in this paper.

along with additional electrification measures such as electric ranges and/or electric clothes dryers. Additional ESA BE Pilot activities not captured in Figure 2 or discussed below include electrical upgrades, duct repair, weatherization, and minor home repairs.

To characterize installations in the ESA WH Pilot, the analysis focuses on counts of individual measure types rather than project types. ESA WH energy efficiency measures were grouped into eleven measure categories. Infiltration and weatherization measures were the most common category, followed by HVAC measures. The high prevalence of infiltration and weatherization measures may reflect both the need for these types of retrofits in the housing stock and the number of individual measures included within the broader measure category.

The infiltration and weatherization category includes attic, floor, and wall insulation; duct testing and repair; blower door testing; weather stripping; and caulking. HVAC measures include 25 participants who received both a new air conditioner and furnace, five households that received only an air conditioner, three that received only a furnace, eight whole-house fans, four fan controllers, and one evaporative cooler. These HVAC installations illustrate the range and depth of retrofit measures available through the WH Pilot. The deep HVAC retrofits in the WH Pilot are similar to the installation of HP HVAC in the BE Pilot, though the WH retrofits differ in focusing exclusively on energy efficiency while the BE Pilot retrofits focused on electrification with energy efficiency.

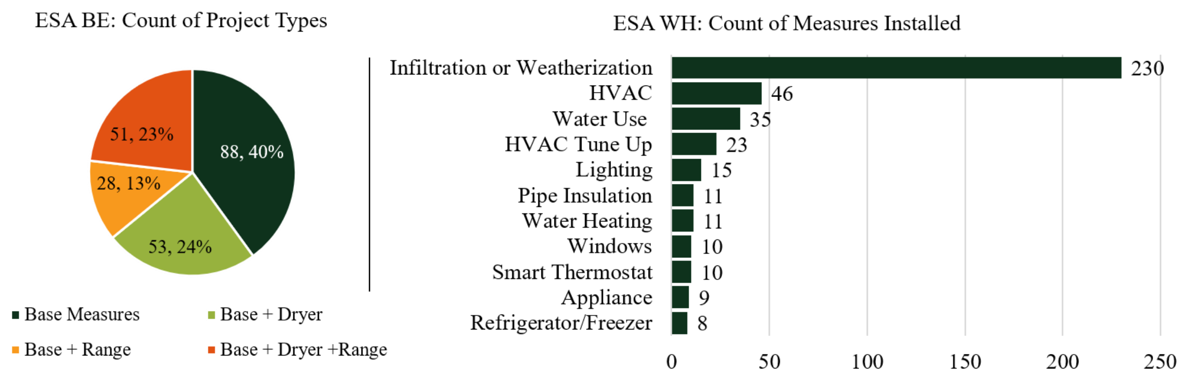

Figure 2.ESA BE Project Types (Left) and ESA WH Measures Installed (Right)

Figure 3 presents participants' SCE electricity utility rates prior to installation (left panel) and rate changes following participation in the ESA BE Pilot (right panel). The ESA BE Pilot encourages participants to transition to SCE's electrification-focused time-of-use rate, TOU-D-PRIME, while the ESA WH Pilot does not specifically recommend rate changes following measure installation.

Across both Pilots, most participants were enrolled in SCE's Domestic tiered rate prior to program participation (53% for ESA BE and 75% for ESA WH). Among ESA BE participants, 47% were already on a time-of-use (TOU) rate before their first installation date, compared with 25% of ESA WH participants.[3] In addition, 8% of ESA BE participants were already enrolled in the TOU-D-PRIME rate prior to participating in the Pilot.

[3] In 2022, SCE began transitioning its customers to TOU rates. To remain on the tiered Domestic rate, customers had to opt out of this transition.

Following participation in the ESA BE Pilot, 44 (20%) customers changed electricity rates. Of these customers, 19 (43%) moved from the tiered Domestic rate to a TOU rate, and 37 (84%) customers transitioned to the TOU-D-PRIME rate.

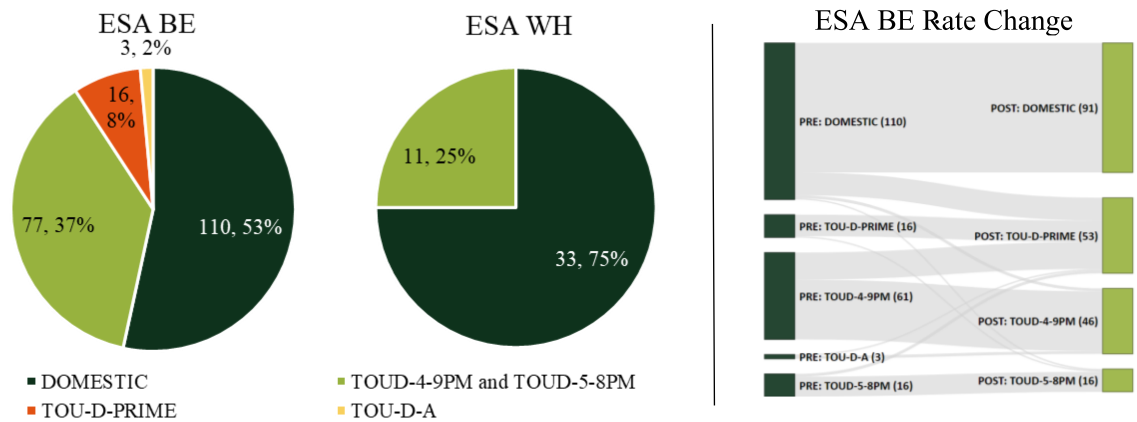

Figure 3. ESA Pre-Pilot Participation SCE Rates (Left) and ESA BE Pilot Participation Rate Change Post Pilot Participation (Right)

Methods

This section describes the analysis methods for the ESA Pilots. These include energy, bill, and greenhouse gas impacts as well as description of surveys with participants used to conduct the process analysis.

Energy and Bill Impacts

The evaluation of the Pilots' impacts used quasi-experimental designs (QED) and difference-in-differences (DiD) modeling approaches that required three separate activities for each Pilot. This subsection describes these tasks and the methods employed in detail.

The energy and bill impact analyses for the ESA BE and ESA WH Pilots follow the same general methodology, with one key exception related to the estimation of natural gas impacts. For the ESA BE Pilot, the gas impact analysis relies solely on participant gas consumption and billing data. In contrast, the gas impact analysis for the ESA WH Pilot includes both participant and non-participant control group gas data.

This difference reflects the program structure and data availability for the two Pilots. The ESA WH Pilot is jointly implemented by SCE and SoCalGas, which allows the evaluation team direct access to SoCalGas customer consumption and billing data. In contrast, the ESA BE Pilot is implemented solely by SCE, and the evaluation team does not have direct access to SoCalGas account identifiers or customer data.

To support the ESA BE analysis, SoCalGas provided participant gas consumption and billing data to SCE. The evaluation team supplied SoCalGas with the addresses of ESA BE participants, which SoCalGas then matched to its customer database to retrieve the corresponding billing and consumption records. Because these data were available only for participants and not for a control group, the ESA BE gas impact analysis differs from the general QED framework used for ESA WH gas and electricity impacts and ESA BE electricity impacts.

The ESA BE gas impact methodology is therefore described separately from the generalized QED approach.

Control Group Development.

A critical first step in the quasi-experimental design (QED) was developing a matched control group to isolate Pilot impacts from external factors that influence energy consumption. Without a control group, observed changes in participant energy use could either overstate or understate program impacts. For example, changes in utility rates may cause both participants and non-participants to reduce consumption independent of the Pilots. A matched control group allows these broader influences to be accounted for and is particularly important when estimating bill impacts, as both groups experienced similar rate changes during the evaluation period.

The control group was drawn from Pilot-eligible customers who were not contacted for participation. One-to-one matches were developed separately for electricity (SCE) and natural gas (SoCalGas) using a Euclidean distance matching approach. Participants and controls were first stratified by the presence of PV export. For ESA WH, participants were further stratified by Pilot pathway (Plus or Deep) and by installation month and year. Because these attributes do not apply to non-participants, control records were duplicated to reflect the various program and installation timing combinations. This step ensured that matched controls aligned with participants' staggered enrollment and that the appropriate pre- and post-installation periods were used.

Multiple matching approaches and dozens of candidate variables were evaluated. The final matches were based on pre-participation average hourly electricity load profiles and monthly natural gas consumption. In many evaluations, this matching exercise defines the final control group.

Weather Normalization.

We weather normalized the energy usage and utility bills for participants and matched non-participants. Weather normalization ensures that differences in pre and post energy and utility bills are not due to changes in weather. For the weather normalization of pre- and post-installation usage and bills, we leveraged the OpenDSM Python library managed by the Linux Foundation. For gas usage and both fuels' bills, the normalization was based on the library's OpenEEmeter Billing Model. For electricity usage, we employed the recently updated OpenEEmeter Hourly Model, which incorporates solar irradiance data and can reliably handle normalization for customers with solar panels. These models were used to estimate separate models for pre- and post-installation for every site using actual (Calmac) weather and then produce the normalized values based on the TMY data for the same weather station. There is comprehensive documentation explaining how the models work and the extensive effort to validate them available at the package's web site (Open DSM).[4]

Difference-in-Differences.

Our impact analysis builds on the Uniform Methods Project (UMP) framework, which estimates program impacts using weather-normalized energy consumption and a regression-based difference-in-differences (DiD) approach. The traditional UMP specification assumes that all participants receive treatment at the same time. However, Pilot installations occurred over more than 12 months, creating a staggered treatment structure. Under these conditions, a

[4] See https://opendsm.energy/documentation/eemeter/ for detailed documentation.

standard two-way fixed effects (TWFE) model can produce biased estimates because treatment effects may vary over time and the assumption of parallel trends may not hold across all participants.

To address these challenges, we employed the two-stage DiD approach developed by Gardner (2022) and implemented through the did2s R package (Butts, 2022). This approach is fully compatible with the UMP framework and is designed specifically for staggered treatment settings. In the first stage, account and time fixed effects are estimated and removed from the energy consumption data, accounting for persistent differences across customers and common temporal factors. In the second stage, a standard DiD model is estimated using the residualized energy usage data and a post-participation indicator to estimate program impacts.

Weather-normalized energy usage and utility bills served as dependent variables, with monthly analyses for natural gas consumption. For the electric analysis, daily consumption was used as the dependent variable. Matched non-participant homes were included to provide a comparison group. By removing customer-specific and time-specific effects before estimating the treatment effect, the two-stage DiD framework reduces the potential for bias associated with staggered adoption, providing a more robust estimate of the average impact of the Pilot on energy consumption and utility bills.

ESA BE Gas Impact Methodology.

For the ESA BE Pilot, gas impacts were estimated as the difference between weather-normalized pre- and post-installation gas consumption. Because non-participant gas data were not available, a matched control group could not be constructed for this analysis. As a result, broader macroeconomic or external factors that could influence gas consumption are not explicitly controlled for in the estimation of gas impacts for the BE Pilot.

The primary measures installed through the ESA BE Pilot—heat pump space heating and heat pump water heating—replace equipment that typically accounts for the majority of residential natural gas consumption. Consequently, most participants experience substantial reductions in gas use following installation.[5] These large reductions are readily observable in the billing data and do not require a more complex quasi-experimental framework, such as a matched control group, which is typically necessary when expected impacts are smaller or more variable. In this case, gas end uses are either eliminated or significantly reduced, resulting in clear and measurable declines in gas consumption.

Greenhouse Gas (GHG) Methodology

The GHG emissions considered in this analysis include carbon dioxide (CO_2) and methane (CH_4), the primary emissions associated with residential electricity and natural gas consumption. These gases are expressed in carbon dioxide equivalent (CO_2e) using 100-year global warming potentials, allowing emissions from different gases to be compared on a common basis.

GHG emissions are estimated differently for electricity and natural gas because the emissions associated with electricity depend on the generation mix at a given point in time and are expected to decline as California's grid becomes less carbon intensive. Consequently, electricity-related emissions are calculated using marginal emissions rates from the 2024 California Avoided Cost Calculator (ACC) (E3, 2024), while natural gas emissions are estimated

[5] ESA BE gas reductions on average were 89%. This is discussed in the results section of this paper.

using standard combustion emissions factors applied to changes in natural gas consumption (also provided in the 2024 ACC).[6]

Electricity-related GHG impacts were estimated by combining the hourly electricity impacts described above with the 2025 marginal emissions rates used in the ACC's hourly GHG cost calculations. However, the ACC emissions rates are based on CTZ22 TMY weather data and a 2018 calendar, whereas the ESA BE electricity impacts are based on CALEE24 TMY weather data and a 2025 calendar. Therefore, a methodology was required to align the two datasets while preserving the relationship between electricity demand and grid conditions. The alignment was guided by two principles:

- ACC emissions rates associated with periods of high grid stress (e.g., hot summer afternoons when grid load is highest) should be matched with ESA BE electricity impacts occurring during periods of high grid stress.
- ACC emissions rates associated with periods of low grid stress (e.g., spring/fall nighttime hours when grid load is relatively low) should be matched with ESA BE electricity impacts occurring during periods of low grid stress.

To satisfy these principles, a day-ranking approach based on ambient temperature was used. For each climate zone and day type, daily average temperatures were calculated and ranked in descending order, with a rank of one corresponding to the hottest day and, generally, the highest level of grid stress. Entire days of ACC emissions rates were then mapped to corresponding days in the ESA BE impact dataset based on climate zone, day type, temperature rank, and hour of day.

Data Attrition

As with any evaluation, data attrition occurred. Of the 220 ESA BE participants initially requested, gas consumption data were obtained for 190 customers. After data cleaning, 167 customers were included in the ESA BE gas impact analysis. For the ESA BE electricity analysis, 103 customers were included. Most of the attrition in the ESA BE electricity analysis resulted from insufficient summer data in the pre- and post-installation periods, which limited the ability to estimate electricity impacts. The ESA WH Pilot included data for 31 of the 44 participants in the electricity impact analysis and 33 in the gas impact analysis.

ESA BE Participant Surveys

The evaluation team conducted ESA BE participant surveys to develop insights around motivations, satisfaction, and experience with various aspects of the Pilot. ESA BE participant surveys include results from multiple rounds of surveys. The most recent occurring in Q2 of 2026. Due to slow Pilot participation uptake in the ESA WH Pilot, participant surveys have been delayed and are not presented in this paper.

[6] The CO_2e of a therm provided in the ACC is 0.0053 tonnes per therm.

Results

The following section describes the ESA Pilots' impacts on energy consumption, bills, and greenhouse gases.

Energy Impacts

Tables 2 and 3 present the estimated energy consumption impacts for the ESA BE and ESA WH Pilots by season and on an annual basis. For the ESA BE Pilot, participation resulted in substantial reductions in natural gas consumption across all seasons, with annual gas use declining by approximately 89%. These reductions are largely driven by the replacement of gas space and water heating systems with electric heat pump technologies. At the same time, electricity consumption increased in the winter and shoulder seasons as electric technologies replaced gas end uses, while electricity reductions were observed during the summer months. Overall, ESA BE participants experienced an annual electricity increase of approximately 12%, reflecting the expected fuel-substitution effects of electrification.

In contrast, the ESA WH Pilot produced more modest reductions in natural gas consumption, reflecting the program's focus on improving efficiency of existing fuel use rather than replacing gas end uses entirely. Electricity consumption impacts varied by season but generally indicate reductions in electricity use, consistent with the installation of energy efficiency measures across multiple end uses. Collectively, these results illustrate the differing mechanisms through which the two Pilots achieve energy impacts, electrification with efficiency in the ESA BE Pilot and deep energy efficiency retrofits in the ESA WH Pilot.

Table 2. ESA BE Energy Consumption Impacts by Season

Season	Months	Seasonal Gas Use Impacts (Therms) n= (167)				Seasonal Electricity Use Impacts (kWh) n= (103)	
		Avg. Pre Monthly Use	Avg. Post Monthly Use	Avg. Monthly Reduction	Precent Reduction	Avg. Monthly Reduction	Precent Reduction
Winter	November through March	47.1	3.4	43.5	92%	-227.10	-43%
Shoulder	April, May and October	24.5	3.4	21.1	86%	-75.30	-13%
Summer	June Through September	16.3	3.1	13.2	81%	64.80	7%
Annual	**All**	**31.2**	**3.4**	**27.8**	**89%**	**-91.20**	**-12%**

Note: All impacts in Table 2 are statistically significant at the 0.05% level. Electricity impacts were modeled at the daily level, as a result monthly impacts represent daily impacts multiplied by 30 days to equate to a monthly representation.

Table 3. ESA WH Energy Consumption Impacts by Season

Season	Months	Seasonal Gas Use Impacts (Therms) n= (33)		Seasonal Electricity Use Impacts (kWh) n= (31)	
		Avg. Monthly Reduction	Precent Reduction	Avg. Monthly Reduction	Precent Reduction
Winter	November through March	3.76	6.3%	87.00*	14.0%
Shoulder	April, May and October	1.83	4.6%	64.47	9.8%
Summer	June Through September	-0.62	-2.4%	110.94	9.0%
Annual	**All**	**1.82**	**4.2%**	**89.34***	**10.7%**

Note: Electricity impacts were modeled at the daily level, as a result monthly impacts represent daily impacts multiplied by 30 days to equate to a monthly representation.

*Indicates statistically significant at the 0.05% level

Table 4 presents the annualized energy impacts for the ESA WH Pilot by the Deep and Plus sub-programs. The estimated electricity savings for both Deep and Plus participants are similar, at 1,054 kWh and 1,099 kWh per year, respectively. Across the two sub-programs, electricity impacts show little variation, with both groups achieving electricity savings of approximately 10% relative to baseline consumption.

Gas impacts show greater variation between the two sub-programs. Participants in the Deep sub-program achieved average annual gas savings of 30.4 therms (6.0% of baseline consumption), while Plus participants achieved smaller reductions of 9.3 therms (1.7%). When combined, the full ESA WH sample achieved average annual gas savings of 21.8 therms, representing a 4.2% reduction from baseline consumption. It should be noted, however, that only ESP WH overall (All) and Deep electricity impacts are statistically significant.

Table 4. ESA WH Energy Consumption Impacts by Sub Program

Fuel	Sub-Program	Participants Modeled	Annualized Impacts (kWh/Therms)	Savings as Percent of Baseline
Electric	All*	31	1,086.8	10.7%
	Deep*	22	1,098.8	10.9%
	Plus	9	1,053.9	10.1%
Gas	All	33	21.8	4.2%
	Deep	20	30.4	6.0%
	Plus	13	9.3	1.7%

*Indicates statistically significant at the 0.05% level

When combining dual fuel impacts, the total dual fuel therm equivalent load reductions for the ESA BE are 296 therms annually while the ESA WH are 58.22 therms annually.

Bill Impacts

Table 5 presents the estimated seasonal and annual bill impacts for ESA BE participants. Consistent with the electrification of space and water heating, participants experienced substantial reductions in natural gas bills across all seasons. On an annual basis, average monthly gas bills declined from $46.41 to $2.29, representing a 95% reduction. Electricity bills increased in the winter and shoulder seasons as electric heat pump technologies replaced gas end uses, with the largest increases occurring during the winter months. However, electricity bills declined during the summer, resulting in a more moderate annual electricity bill increase of approximately 16%. Overall, participants received annual gas bill reduction of $529 and an increase in electricity bills of $222 on average, resulting in net utility bill decreases of $307. It should be noted that there is misalignment between participants in the gas and electricity analysis. When sub-setting the gas dataset to participants included in the electricity analysis. Annual bill reductions decrease to $260 annually, as these customers tended to have smaller pre-participation gas consumption and bills. However, annual bill savings are still substantial on average.

Table 5. ESA BE Energy Bill Impacts by Season

Season	Months	Seasonal Gas Bill Impacts n= (167)				Seasonal Electricity Bill Impacts n= (103)	
		Avg. Pre Monthly Bill	**Avg Post Monthly Bill**	**Avg. Monthly Bill Reduction**	**Percent Reduction**	**Avg. Monthly Bill Reduction**	**Precent Reduction**
Winter	November through March	$74.42	$2.62	$71.80	96%	-$52.91	62%
Shoulder	April, May and October	$28.01	$-4.84	$32.85	117%	-$21.56	27%
Summer	June Through September	$25.19	$7.24	$17.95	71%	$26.10	-15%
Annual	**All**	**$ 46.41**	**$2.29**	**$ 44.11**	**95%**	**-$18.27**	**16%**

Note: All impacts in Table 5 are statistically significant at the 0.05% level. Electricity impacts were modeled at the daily level, as a result monthly impacts represent daily impacts multiplied by 30 days to equate to a monthly representation. Winter and shoulder months include Climate Credit payments in March and April, as a result bills can be negative (representing bill credits)

While these average bill savings are promising, not all customers reported a decrease in their bills. Figure 4 presents participants' self-reported changes in utility bills from the survey results. Although most respondents indicated that their natural gas bills decreased, 53% reported an increase in electricity bills and 42% reported an increase in their overall energy bills.

Interpreting customers' bill experiences is complex. During the study period, SCE electricity rates increased substantially (by nearly 50% for some rate plans between January 1, 2023, and October 1, 2025). At the same time, electrification measures shift energy consumption from natural gas to electricity, increasing electric bills while reducing gas bills. Furthermore, both electric and gas bills vary seasonally. As a result, participants' perceptions of bill changes do not always align with the average impacts estimated by the evaluation.

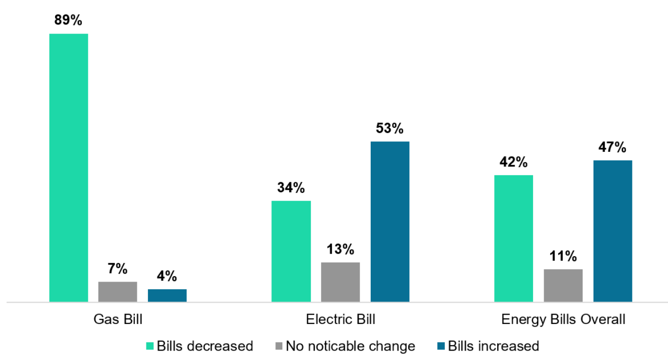

Figure 4.Customer Self-Reported Bill Impacts (n=127)

Table 6 presents the estimated seasonal and annual bill impacts for ESA WH participants. On an annual basis, average monthly gas bills declined by $2.29 per month (total annual gas bill savings of more than $27), representing a 3% reduction with the largest reductions occurring in the winter months. Consistent with energy efficiency, electricity bills decrease by $1.64 per day, an annual electricity bill decrease of $598, or approximately 24%. Overall, participants had combined utility bill decreases of $625. Note that the participants used to assess these bill impacts did not overlap perfectly with the participants used to assess energy impacts, but a large majority were in both analyses.

Table 6. ESA WH Energy Bill Impacts by Season

Season	Months	Seasonal Gas Bill Impacts n= (33)		Seasonal Electricity Bill Impacts n= (31)		
		Avg Monthly Reduction	Percent Reduction	Avg Daily Reduction	Avg. 30 Day Reduction	Percent Reduction
Winter	November through March	$10.44*	9%	$1.14	$34.22	24%
Shoulder	April, May and October	-$0.86	-2%	$1.86	$55.88	44%
Summer	June Through September	-$5.14	-14%	$2.08	$62.34	18%
Annual	**All**	**$2.29**	**3%**	**$1.64***	**$49.20**	**24%**

Note: Electricity impacts were modeled at the daily level, as a result monthly impacts represent daily impacts multiplied by 30 days to equate to a monthly representation. *Indicates results that are statistically significant at the 0.05% level

Greenhouse Gas Impacts

The GHG analysis estimates the change in emissions associated with the observed energy consumption impacts from the ESA BE and ESA WH Pilots. Emissions impacts are calculated by applying fuel-specific emissions factors to the estimated changes in electricity and natural gas consumption. Electricity emissions factors reflect the marginal emissions associated with electricity generation in California, while natural gas emissions factors reflect the direct combustion emissions associated with residential gas use.

The resulting GHG impacts reflect the differing mechanisms through which the two Pilots reduce emissions. Electrification measures installed through the ESA BE Pilot are expected to reduce or eliminate on-site natural gas combustion while increasing electricity consumption as end uses shift to electric technologies. In contrast, the ESA WH Pilot primarily reduces emissions through improvements in energy efficiency across both gas and electric end uses. The following section presents the estimated seasonal and annual GHG impacts for each Pilot and compares the relative emissions reductions achieved through electrification and deep energy efficiency retrofits.

Table 7 presents the average GHG reductions for the ESA BE and ESA WH Pilots. The ESA BE Pilot produced substantial reductions in emissions associated with natural gas consumption, averaging 0.148 tonnes of CO_2e per month. These reductions were partially offset by increases in electricity-related emissions resulting from higher electricity consumption following electrification. On an annual basis, electricity-related emissions increased by 0.045 tonnes of CO_2e per month (17%), yielding a net reduction of 0.102 tonnes of CO_2e per month (1.22 tonnes of CO_2e annually), or 24% relative to baseline emissions. Seasonal results indicate that the largest emissions reductions occurred during the winter months, when displaced space and water heating loads generated average reductions of 0.135 tonnes of CO_2e per month (31%).

The ESA WH Pilot exhibited a different pattern. Because the WH Pilot delivers energy efficiency improvements, emissions reductions were achieved through decreases in both electricity and natural gas consumption. Annual natural gas emissions declined by 0.010 tonnes of CO_2e per month (4%), while electricity-related emissions decreased by 0.038 tonnes of CO_2e per month. Combined across both fuels, the Pilot reduced emissions by an average of 0.048 tonnes of CO_2e per month. Electricity savings were responsible for the majority of these reductions, with the largest impacts occurring during the summer months, when lower cooling loads resulted in average emissions reductions of 0.079 tonnes of CO_2e per month. Although the magnitude of emissions reductions from the ESA WH Pilot (0.052 average per month or 11% of baseline) was smaller than those observed for the ESA BE Pilot, the results demonstrate that both electrification and whole-home efficiency approaches can contribute to California's decarbonization goals through distinct pathways.

Table 7. ESA Pilot GHG (CO_2e) First Year Impacts

ESA Pilot	Season	Gas GHG Impacts		Electricity GHG Impacts		Combined Fuel GHG Impacts	
		(Tonnes of CO_2e)					
		Avg Monthly Reduction	Percent Reduction	Avg Monthly Reduction	Percent Reduction	Avg Monthly Reduction	Percent Reduction
ESA BE	Winter	0.231	92%	-0.096	-50%	0.135	31%
	Shoulder	0.112	86%	-0.036	-20%	0.076	24%
	Summer	0.070	81%	0.010	3%	0.080	18%
	Annual	**0.148**	**89%**	**-0.045**	**-17%**	**0.102**	**24%**
ESA WH	Winter	0.020	6%	0.026	10%	0.046	8%
	Shoulder	0.010	5%	0.022	9%	0.031	7%
	Summer	-0.003	-2%	0.079	28%	0.076	18%
	Annual	**0.010**	**4%**	**0.043**	**16%**	**0.052**	**11%**

ESA BE Self-Reported Changes in Equipment Use

The age and functional status of existing equipment can significantly influence the realized impacts of retrofit programs, while also providing insight into the comfort and reliability benefits associated with equipment upgrades. Figure 6 presents the self-reported age (left) and functional status (right) of participants' existing equipment prior to participation in the ESA BE Pilot. As shown, the majority of equipment was eight years or older (73%). Additionally, slightly less than half of the surveyed equipment was reported to be functioning well prior to replacement. Most replaced equipment was reported to be functioning below expectations (49%) or was non-operational (4%).

These findings align with participants' reported motivations for participating in the ESA BE Pilot. Fifty-eight percent of respondents indicated that their primary motivation for participating was to replace older or poorly functioning appliances, making it the second most frequently cited reason for program participation.[7]

[7] The top three motivations for ESA BE participation were (1) to participate to save money on energy bills and/or save energy (88%, n=46), (2) to replace old or functioning below expected appliances (58%, n=30), and (3) to improve home safety (48%, n=25).

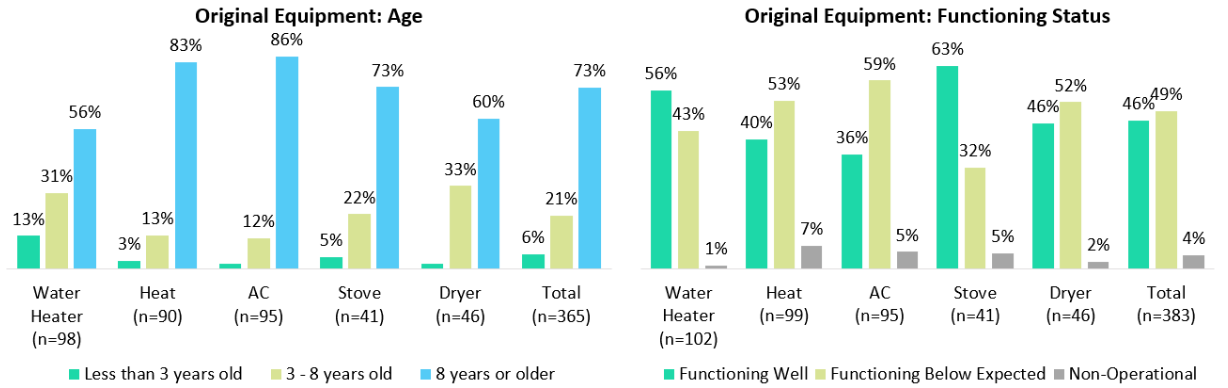

Figure 5.ESA BE Self-Reported Pre-Existing Equipment Conditions – Equipment Age (Left) and Functioning Status (Right)

Following participation in the ESA BE Pilot, respondents reported high levels of satisfaction with their newly installed equipment, with satisfaction rates ranging from 69% to 81% depending on the equipment type. Approximately one-third of respondents reported using their new equipment more frequently after installation (ranging from 21% to 42% depending on the equipment type). Notably, 42% of participants reported increased air conditioning use after participation. Despite this increase in cooling usage, participants still realized overall bill savings, suggesting that the efficiency improvements associated with the installed equipment offset increased use of Equipment. Figure 6 below presents details on equipment satisfaction (left) and changes to equipment use (right).

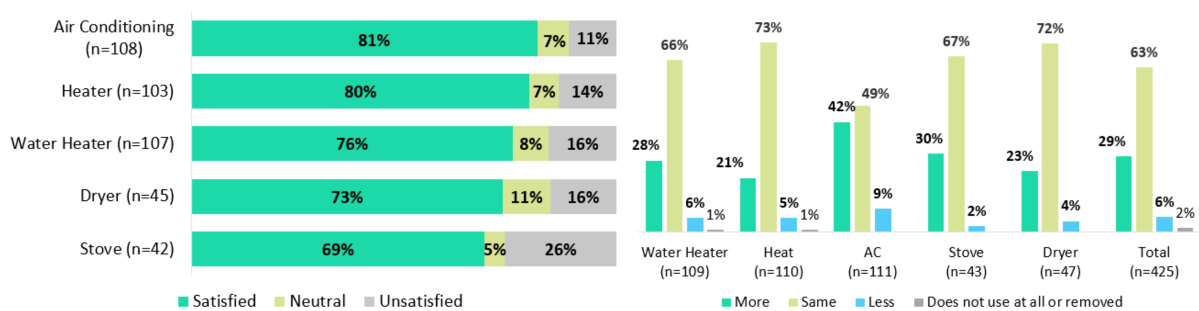

Figure 6.ESA BE Self-Reported Program Equipment Use (Left) and Satisfaction (Right)

Summary and Conclusions

The ESA BE and ESA WH Pilots demonstrate two complementary approaches for delivering deeper energy savings, bill reductions, and decarbonization benefits to income-qualified households. The ESA BE Pilot achieves these outcomes primarily through electrification, replacing natural gas end uses with efficient electric technologies, while the ESA WH Pilot reduces consumption across both fuels through comprehensive efficiency retrofits. Both Pilots encountered early recruitment challenges, largely related to customer trust and targeting strategies. However, refinements to customer outreach and enrollment approaches increased participation substantially, with both Pilots exceeding 600 projects by the first quarter of 2026. These experiences highlight that successful program scaling requires not only effective technologies, but also customer-centered marketing, trusted messaging, and informed outreach.

The interim results indicate that the two Pilots achieve their objectives through different pathways. ESA BE reduced annual natural gas consumption by approximately 89%, accompanied by a 12% increase in electricity consumption and a 24% reduction in combined GHG emissions. In contrast, ESA WH reduced electricity consumption by approximately 10.7% and natural gas consumption by 4.2%, producing an estimated 11% reduction in GHG emissions. Despite these differing energy and GHG impacts, both Pilots delivered net utility bill savings. ESA BE participants experienced average annual bill savings of approximately $307, as large reductions in gas costs more than offset higher electricity bills, while ESA WH participants realized average annual bill savings of approximately $625 through reductions in both electric and gas consumption. ESA BE participant survey results, however, suggest that customer perceptions do not always align with measured outcomes, as many participants perceived their bills had increased despite average bill savings.

These findings also illustrate that energy, bill, and GHG impacts are not necessarily aligned. Larger reductions in energy consumption do not always produce larger emissions reductions, nor do larger energy reductions necessarily translate into comparatively greater bill savings. What matters is not only the magnitude of the change in consumption, but also when and where those changes occur. For example, reductions in summer electricity use provide greater economic and environmental benefits because electricity prices and grid emissions are generally higher during periods of peak summer demand. Consequently, electrification can increase electricity consumption while simultaneously lowering household utility costs and producing substantial GHG reductions through the elimination of natural gas use and summer load reductions. Likewise, whole-home efficiency retrofits can provide meaningful bill savings and reduce emissions even if the magnitude of GHG reductions is smaller. As California pursues both affordability and decarbonization goals, these results suggest that electrification and whole-home efficiency retrofits should be viewed as complementary strategies rather than competing approaches, allowing programs to meet customers where they are and provide multiple pathways toward a cleaner and more affordable energy future.

Broader Program and Policy Considerations

The substantial GHG reductions observed in both Pilots underscore the important role that low-income programs can play in achieving California's decarbonization goals. While not covered in this paper electrification, in particular, offers benefits beyond emissions reductions. As natural gas demand declines over time, the fixed costs associated with maintaining the gas distribution system may be spread across a smaller customer base, potentially increasing natural gas prices for customers who remain connected. Helping low-income households transition away from fossil fuels can reduce their exposure to these future cost shifts while ensuring that vulnerable populations are not left behind in the energy transition. Electrification also provides important health benefits by eliminating indoor combustion sources that contribute to pollutants such as nitrogen dioxide, carbon monoxide, and particulate matter, which have been linked to respiratory illnesses and other adverse health outcomes. These benefits may be particularly important for low-income households, which often include children, older adults, and individuals with preexisting health conditions.

As California continues to expand building decarbonization efforts, program design should consider affordability, GHG reductions, and health outcomes together rather than treating them as separate objectives. Future program designs should ensure that low-income households have access to technologies that not only lower energy costs and emissions but also improve indoor air quality and reduce exposure to harmful pollutants. Viewed through this broader lens, investments in electrification and whole-home efficiency are not solely mechanisms for reducing energy consumption or GHG emissions; they are also long-term affordability, equity, and public health strategies that help ensure disadvantaged communities share in the benefits of California's clean energy transition.

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