Equitable Electrification: Program Models that Work for Existing Low Income Multifamily Buildings

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ABSTRACT

Designing programs that prepare low-income communities for participation in our clean energy future is a critical component of equitable long-term decarbonization strategies. California's Low Income Weatherization Program for Multifamily (LIWP-MF) is the first building retrofit program in the state to deliver both energy efficiency and onsite renewables under a single program delivery model. More importantly, it is the first low-income program to promote and directly incentivize building electrification and decarbonization. As the implementer of the LIWP-MF program statewide, the Association for Energy Affordability (AEA) has learned firsthand the technical, policy and programmatic challenges associated with electrifying the low-income multifamily market and effective approaches to address those challenges. LIWP-MF's model has proven to be an extremely successful program for practical implementation of decarbonization strategies in disadvantaged communities, with more properties on its waitlist than it has available funding to serve. In this study, the authors will discuss the origins and evolution of the LIWP-MF program model and program impact statistics from the last four years. This study will explore program results, including actualized cost and energy savings data, and lessons learned from LIWP-MF for other program administrators and implementers looking to achieve similar results.

Introduction

California has been pushing towards an increasingly proactive low-carbon future, committing to 100% clean electricity by 2045, zero net carbon by 2050, and reducing the state's greenhouse gas emissions by 40% and doubling its energy efficiency by 2030. Building electrification, moving from fossil-fueled to electricity-powered appliances that can use renewable, low carbon electric energy sources, provides a pathway to significantly decarbonize our housing stock while reducing energy consumption and improving the health and safety of inhabitants. While momentum builds to meet the statewide climate goals, California's existing low-income multifamily housing stock presents a significant opportunity and challenge for decarbonization and energy savings statewide.

Thirty-three percent of California households are low-income[1], and forty-seven percent of low-income Californians live in multifamily housing (CEC 2016). In California, the age of the existing multifamily housing stock is one of many determinants that can characterize its energy performance; more than fifty-seven percent of California's multifamily buildings were built prior to 1979 (Census 2017), making them prime candidates for deep energy efficiency retrofits not

[1] Low-income is defined in this context as 200% Federal Poverty Level

only because they were likely built before the first American energy code was in place but also because they house a substantial proportion of the state's low-income communities.

Across the United States, low-income communities are typically faced with a higher energy burden, paying an average of 7.2% of their monthly income on energy bills in comparison to 3.5% for the average American (Drehobl and Ross 2016, 3-4). This burden is particularly disempowering for low-income renters who may lack not only the capital but also the right to upgrade their residences to significantly reduce their energy consumption costs. An inherent conflict arises in multifamily rental properties when the landlord owns the equipment but residents pay for its operation, creating a split incentive. Affordable housing property owners in deed-restricted affordable housing have complicated debt stacks and limited bandwidth and funding to pursue energy upgrades in general, but when the return on investment is distributed to residents, it makes pursuing substantial resident-benefitting energy upgrades economically unviable. This building type historically has been a challenging market to penetrate, and as a result, multifamily renters have been largely underserved by energy efficiency programs to date (Johnson and Mackres 2013). This lack of investment contributes to a higher energy burden and reduced indoor air quality for low-income renters throughout the country.

Furthermore, the energy burden of low-income communities is poised to increase in the coming years as California pursues its climate goals. As we continue to quantify the system-wide greenhouse gas and emissions impact of natural gas, the electric grid is getting greener as renewables increase. Meanwhile, the price of natural gas is trending upward. As the state's natural gas infrastructure ages, the cost to maintain statewide distribution is increasing, and the costs will be passed on to rate payers. Both Southern California Gas Company (SoCalGas) and Pacific Gas and Electric (PG&E) have petitioned California Public Utilities Commission to increase their revenue requirement by 25% and 15% by 2022, respectively, to cover the cost of upgrading the distribution infrastructure (Aas, D et.al 2019).

Meanwhile, as municipalities follow Berkeley's lead to adopt ordinances banning gas infrastructure from new construction, the customer base for natural gas is diminishing. With fewer customers to spread the cost of the aging infrastructure, the cost for what used to be considered affordable fuel is projected to increase dramatically in coming years, leaving residents of gas-intensive buildings, now stranded assets, to foot the bill (Aas, D et.al 2019). While gas bans for new construction help the state and country meet climate goals, expanding these policies to include the sizable contribution from existing buildings would broaden the impact significantly. Electrifying existing buildings, however, is significantly more complicated and costly than electrifying new construction. Without effective programs to assist communities through this transition with technical and financial support, there is a real and significant threat that low-income communities will continue to be disproportionately burdened by the rising cost and health impacts of natural gas.

This tension between the collective push for a clean energy future and the disempowerment of low-income renters to directly engage in this future presents an urgent challenge and opportunity. In order to create equitable access to California's clean energy future, the state's clean energy initiatives must incorporate bold new paradigms that overcome barriers to access for this hard-to-reach market to incentivize deep energy upgrades with electrification and renewable energy benefits for low-income residents. The Low Income Weatherization Program for Multifamily Properties (LIWP-MF) incorporates a dynamic program model that has

proven success bringing deep energy retrofits, including electrification, to low-income disadvantaged communities across the state. This paper will unpack the program design elements that LIWP-MF incorporates to overcome barriers and bring deep energy savings, decarbonization, and renewable energy to low-income renters and share results and lessons learned for program administrators and implementers nationwide.

Program Overview

The Low Income Weatherization Program for Multifamily Properties (LIWP-MF) was launched in January of 2016 and funded with an initial budget of $24M as part of the California Climate Investments, a statewide initiative that puts billions of Cap and Trade dollars to work reducing greenhouse gas emissions with particular focus on disadvantaged and low-income communities. California's Cap and Trade program launched in 2013 as a key part of the state's strategy to limit carbon pollution and greenhouse gas emissions. Implemented by the California Air Resources Board (CARB), the program is a market-based solution designed to limit or "cap" emissions from the most polluting business sectors. Companies can buy or sell allowances at auction, and the proceeds are deposited in the Greenhouse Gas Reduction Fund (GGRF). Annually, the California Legislature allocates funding from the GGRF to state agencies to administer programs designed to reduce greenhouse gas emissions. To date, LIWP-MF has been allocated a total of $63.9M to continue to serve low-income properties in disadvantaged communities through 2022.

Administered by the California Department of Community Services and Development (CSD) and implemented by the Association for Energy Affordability (AEA), the program model was intentionally designed with an understanding of barriers to enrollment and impact for both affordable property owners and low-income residents, including:

- Basic Program Design
- Inclusive Eligibility Criteria
- Serving Naturally Occurring Affordable Properties
- Incentives that Overcome Split Incentives
- Incentives that Encourage Electrification
- Single Point of Contact Comprehensive Technical Assistance
- Co-leveraging
- Benchmarking

Moving into its fourth year of implementation, the program has documented wide scale success incentivizing deep energy retrofits, electrification, and solar photovoltaic (PV) installations for this hard-to-reach market segment. Tailored to meet the needs of the communities it serves while remaining flexible and attractive to affordable property owners, the program effectively brings energy and non-energy benefits to disadvantaged communities to help frontline communities prepare for the challenges of climate change and participate in the health and economic benefits of California's clean energy future. Table 1, below, characterizes the program impact to date.

Table 1. LIWP-MF Program Statistics

Low-Income Households Served	8,268
Projects Completed	81
Annual GHG Emission Reduction	8823 MTCO2e
Annual MWh Savings	17,266
Annual Therm Savings	637,248
Solar PV Capacity Installed	5.8 MW-DC
Program Incentives Provided	$33,252,173

As of June 26, 2020

Although the program has served more than 8,100 low-income rental households to date, estimated to constitute 0.6% of the state's low-income multifamily housing stock, more than 1,000 multifamily buildings housing approximately 18,000 low income residents remain on the program's waitlist due to the lack of stable, long-term funding. Because the California Legislature allocates Cap and Trade proceeds annually, the amount of proceeds available and programs funded by the GGRF vary year to year. This creates a lack of stable, multi-year funding which can be a challenge for programs like LIWP-MF that typically require 12-24 months to design and implement deep energy retrofits.

The following sections will outline program design elements of LIWP-MF that, in combination, address barriers. While each of these elements provide value on their own, the proven success of this program model is the way in which these elements work together to provide a viable and attractive pathway to encourage high impact retrofits in California's frontline communities.

Basic Program Design

At its foundation, the Low Income Weatherization Program for Multifamily was designed as a comprehensive whole building program. LIWP-MF provides a free energy audit as part of its program offerings to assess energy saving opportunities throughout the property at the beginning of the scope development process. This is a fundamental component for success in multifamily buildings, as a whole building approach allows an assessment that aligns with building science, providing recommendations for interventions that will address whole-building energy loss. Programs that silo multifamily buildings into resident or common area spaces end up compartmentalizing recommendations that holistically affect one or the other. In reality, multifamily buildings include diverse boundary and ownership conditions that blur this line. Programs that serve a single space type often wholly ignore or are unable to serve these boundaries, such as shared envelope conditions and mechanical systems that serve both common area and tenant spaces. The program's ability to address all existing energy flows within the building equally to reduce overall building consumption is critical to successful and impactful interventions in the multifamily market.

The program provides a simple, flexible incentive methodology that allows properties to receive financial incentives for any measures that save energy. LIWP-MF is also the first program in California to combine whole building comprehensive energy efficiency retrofits with renewable energy under a single program model. Providing access to both energy efficiency and renewable energy incentives allows property owners to consider the holistic impact of energy

efficiency combined with solar PV when evaluating the scope and long-term return on investment of the retrofit. This evaluation is particularly important as property owners assess the feasibility of electrification. When the program, by design, evaluates the interaction between energy efficiency upgrades, electrification, and solar PV, it provides property owners with more information to consider an integrated approach for deep energy savings. Arming property owners with information about both solar and energy efficiency opportunities during the design phase encourages well-informed deeper scopes of work, and the flexible measure incentive model makes deeper scopes of work more financially viable, ensuring every incremental energy saving measure is incentivized.

Flexible, comprehensive program design has demonstrated results. Properties enrolled in LIWP-MF are averaging 37% site energy savings from energy efficiency measures alone and 43% site energy savings when energy efficiency and solar PV are pursued in tandem; furthermore, as highlighted in Figure 1 below, more than one-third of the projects completed to date are projected to save more than 45% overall, including three that are projected to reach near net zero (>85% savings). As illustrated in Figure 2, below, 44% of projects enrolled in LIWP-MF choose to pursue both energy efficiency and solar PV incentives, taking full advantage of the comprehensive measure offerings.

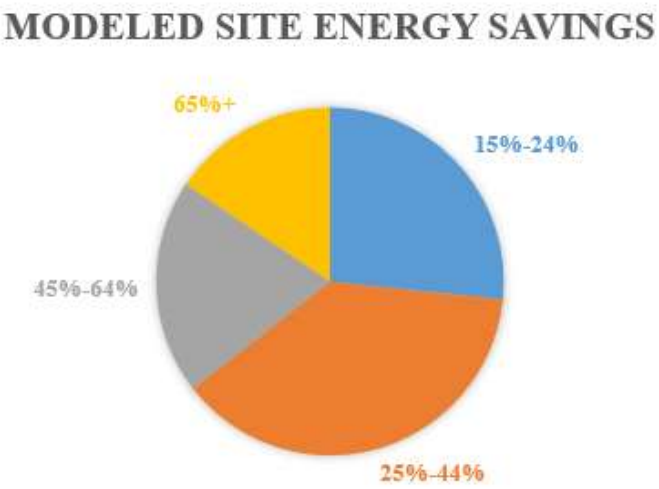

Figure 1: Modeled Projected Site Energy Savings for Completed LIWP-MF Projects

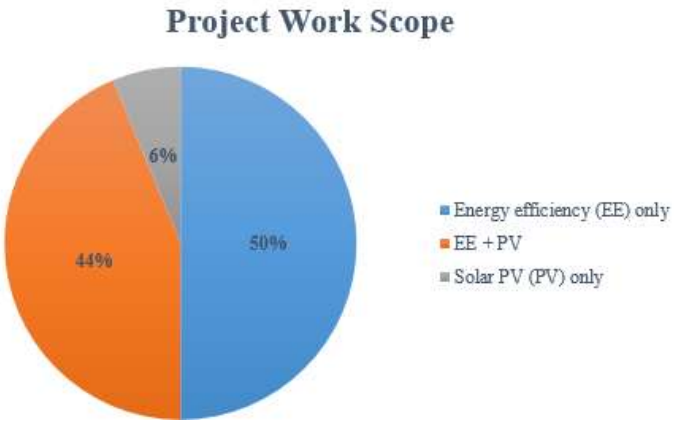

Figure 2: Percent of completed LIWP-MF projects that pursue energy efficiency, solar PV, and/or both scopes of work.

Inclusive Eligibility Criteria

Designing intentional eligibility criteria encourages enrollment from the diverse instances of multifamily housing across the state while targeting the most vulnerable and underserved populations. Eligibility criteria should be an embodiment of the program intent. Definitions for what constitutes low-income residents, multifamily buildings, and affordable properties can either work to encourage or exclude interested participants; therefore, in order to design a program for equitable access and according to need, inclusive yet targeted eligibility criteria should be a key consideration. Furthermore, leveraging tools and criteria used by aligned state and federal programs can help streamline enrollment while targeting front-line communities.

Properties that enroll in LIWP-MF must demonstrate that at least sixty-six percent of the apartments qualify at or below 80% Area Median Income (AMI), aligning with the definition for "lower income" households per state limits published by the Department of Housing and Community Development (HCD) based on federal limits set by U.S. Department of Housing and Urban Development (HUD). Aligning program eligibility criteria with the criteria established for common funding mechanisms, like the Low Income Housing Tax Credit (LIHTC), allows a streamlined approach, reducing administrative burdens to enrollment. Where possible, accepting co-enrollment in appropriate subsidized housing programs as a proxy for eligibility allows LIWP-MF to reduce administrative burden, streamline enrollment, and rely on the inherent regulation and diligence of those programs to ensure compliance. Furthermore, as demonstrated in Figures 3 and 4, while program criteria allows inclusion for up to 80% AMI, 48% of the households served by LIWP-MF to date qualify at or below the "very low income" threshold below 50% AMI.

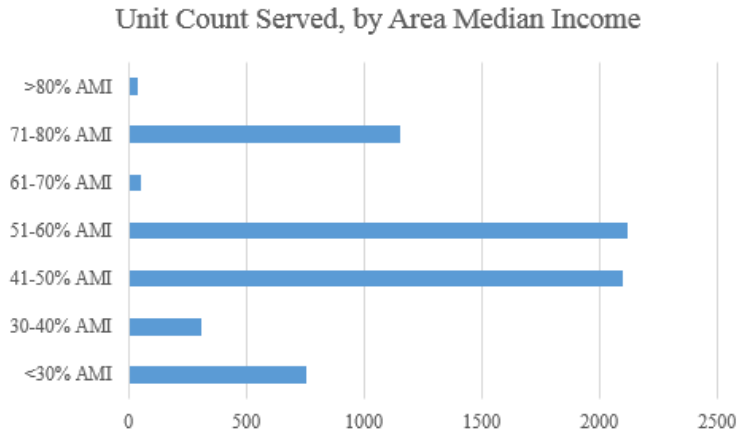

Figure 3: Total units served by area median income (AMI). LIWP-MF projects completed before March 16, 2020.

Figure 4: Percent of completed LIWP-MF projects by HUD Income Classification

Multifamily buildings come in all shapes and sizes. One lesson learned by the program early on was that overly restrictive definitions for multifamily residences inadvertently excluded otherwise appropriate properties from enrolling. The program originally defined multifamily buildings as having more than 20 units per building. This definition categorically excluded garden style apartments, for example, a building type most appropriate to be served by a multifamily-specific program. Updating this definition to include all property types with 5 or more units allowed the program to include all relevant building types. Restrictive definitions can create situations where a particular property type is excluded from both single-family and multifamily program offerings.

Finally, the program uses the California Communities Environmental Health Screening Tool (CalEnviroScreen), developed by the California Environmental Protections Agency (CalEPA) and the California Office of Environmental Health Hazard Assessment (OEHHA), to map multiple stressors and pollutants in California communities. The tool uses indicators such as health vulnerability, socioeconomic disparity, exposure to pollutants, and environmental effects to identify the most disadvantaged communities in the state in order to direct funding and programs to serve those most vulnerable to the cumulative impacts of pollution (OEHHA 2017).

All properties served by LIWP-MF to date[2] are located in disadvantaged communities, as defined by this tool, allowing the program to target the highest impacted communities first to bring clean energy resources to historically underserved and highly polluted neighborhoods.

Serving Naturally Occurring Affordable Properties

While subsidized affordable housing ensures both permanence and regulation for low-income communities, only one quarter of the 3.3 million low-income households in California live in subsidized affordable housing or receive vouchers (LAO 2016, 4). Including naturally occurring affordable properties in program eligibility criteria was crucial in order to serve the remaining three quarters of low-income households in the state. LIWP-MF designed affordability criteria and an affordability covenant for naturally occurring multifamily properties who participate in the program to ensure that their residents meet low-income requirements and that their rents will remain affordable for at least 10 years after participation. This inclusion provides two benefits: it allows the program to serve the largest population of low-income residents while also preserving existing affordable properties by procuring a commitment to maintaining affordable rents and improving their building performance and conditions for the long term.

This aspect of the program represents one area for continued research and policy design for low-income programs nationwide. While LIWP-MF has intentionally integrated policies to engage and serve this housing type, less than 10% of completed projects to date are naturally occurring affordable properties. The program is continuing to evaluate barriers that could help explain this relatively low participation. Some of the challenges identified to date include outreach challenges with "mom and pop" property owners to educate them about program offerings, limited access to capital to cover out-of-pocket construction costs, and property owner bandwidth.

Furthermore, additional research into best-practices for compliance enforcement in non-regulated properties is warranted. California Assembly Bill 1232, approved in October of 2019, authorizes funding to coordinate, in part, an assessment of post-construction rental rates "with the goal of better enforcing or adjusting affordability contracts" (AB 1232, 2019). This assessment, in conjunction with ongoing barrier research, will provide a broader understanding of the effectiveness of the affordable rent protection mechanisms in place and a platform to consider means to better engage this underserved property type.

Incentives that Overcome Split Incentives

Split incentives are arguably one of the most important and challenging obstacles to overcome when designing multifamily efficiency and renewable energy programs. LIWP-MF developed an innovative tiered incentive model, for both energy efficiency and solar PV installations, aimed at overcoming the split incentive hurdle to maximize resident-benefitting investments.

The whole-building framework is supported by a simple, flexible incentive methodology: any measures that save or generate energy are eligible for incentives. When program offerings

[2] Future LIWP-MF funding years have small allocations available that allow properties within ½ mile of a disadvantaged community and those outside of these criteria to enroll.

are constrained, it limits the true effectiveness of a whole-building approach. To maximize impact and efficacy in the existing multifamily market, a whole building approach should provide comprehensive and customized recommendations for energy savings based on the unique characteristics of each property; however, when the program restricts eligible measures to a prescriptive list, the resulting energy assessment often will not include recommendations that might be impactful but are not eligible for incentives through the program. By keeping the eligible measures flexible, it allows the program to optimize its team of energy auditors to provide customized recommendations for holistic energy savings that are specific to and able to most-efficiently address a property's energy profile to ensure that the property maximizes efficiency and health outcomes.

As a part of the California Climate Investments Program, LIWP-MF's main purpose is to reduce greenhouse gas emissions. LIWP-MF's energy efficiency incentive rate is determined by the metric tons of CO2e reduced by energy efficiency measures at a property, calculated by the program quantification methodology and emissions factors. The tiered incentive model, as outlined in Table 2 below, allows the program to contribute a higher incentive rate for installed measures that impact the utility bills of the low-income residents.

Table 2. Program Iterations of Energy Efficiency Incentive Structure

Benefitting Meter	Owner Paid Meter	Tenant Paid Meter
Program Cycle 1	$4,000/MTCO2e	$5,000/MTCO2e
Program Cycle 2	$3,500/MTCO2e	$4,500/MTCO2e
Program Cycle 3	$3,000/MTCO2e	$4,500/MTCO2e

Incentives in dollars per metric ton of CO2e.

By significantly increasing the funding for resident-benefitting upgrades, the program offsets the out of pocket investment for property owners to make substantial upgrades within the units and to the building envelope. In addition to lowering resident energy burden, these investments allow property owners to tackle deferred maintenance and replace inefficient systems that are nearing the end of their useful life with high efficiency upgrades. As a result, the program is able to encourage deeper investments that bring direct benefits to residents. In master-metered properties, where the owner is receiving all program benefits but at a lower incentive rate, this incentive structure has also proven effective, encouraging comprehensive work scopes and deep investment in whole-building energy upgrades.

The efficacy of this model is demonstrated in the program results. As shown in Figure 5, the program has contributed approximately half of its incentives, energy savings, and greenhouse reduction to benefit residents directly.

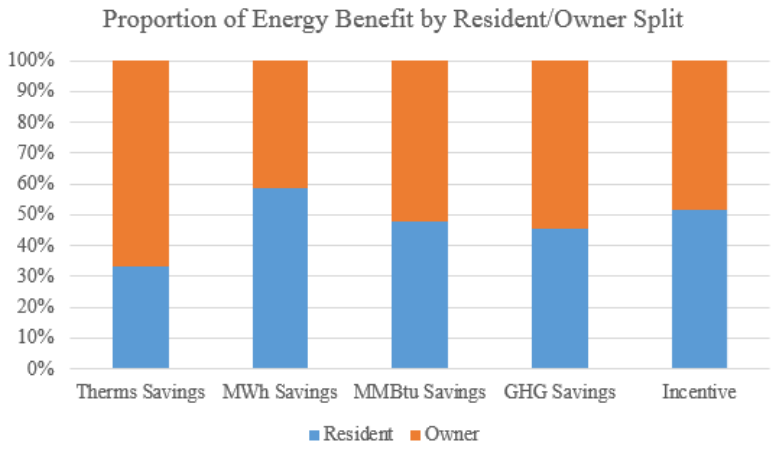

Figure 5: Proportional Benefits by Owner/Resident Split

A similar methodology was used to develop the incentive structure for solar PV. In an effort to scale investment in renewable energy for the affordable multifamily housing stock while also providing equitable access to renewable energy benefits for low-income residents, the LIWP-MF program developed a tiered incentive structure designed to encourage property owners to maximize their available roof space for solar PV installation. Acknowledging the financial disincentive for affordable property owners to install resident-benefitting PV systems, the LIWP-MF PV incentives are designed to fully subsidize the cost of the portion of the system allocated to residents. The success of this incentive structure relies predominantly on the availability of Virtual Net Energy Metering (VNEM) as a mechanism to deliver a predetermined proportion of a system's generation as bill credits to both residents and owners. As shown in Tables 3 and 4, the incentive structure also adjusts to allow for co-leveraging of typical state and national funding sources such as the California Multifamily Affordable Solar Housing (MASH) Program, the Low Income Housing Tax Credit (LIHTC), and the Investment Tax Credit (ITC).

Table 3. LIWP Solar PV Incentives: Program Cycle 1

Leverage Types			Incentive $/W-DC		
MASH	ITC	LIHTC (4% only)	Owner Meter PV Systems <100kW	Tenant Meter PV Systems <100kW	
				VNEM	Direct Meter
No	Yes	Yes	0.5	1.5	2.5
No	Yes	No	1	2.4	3.4
Yes	Yes	No	0	1	2
No	No	No	1.5	3.5	4.5
Yes	No	No	0.8	1.7	2.7
No	No	Yes	1	2.4	3.4
Yes	No	Yes	0	0.9	1.9

Yes	Yes	Yes	0	0	0

LIWP Solar PV Incentives calculated in dollars per Watt – DC.

Table 4. LIWP Solar PV Incentives: Program Cycle 2

Leverage Types			Incentive $/W-DC		
MASH	ITC	LIHTC (4% only)	Owner Meter PV Systems <100kW	Tenant Meter PV Systems <100kW	
				VNEM	Direct Meter
No	Yes	Yes	0.5	1.5	1.8
No	Yes	No	1	2.1	2.4
Yes	Yes	No	0	0.5	0.8
No	No	No	1.3	3	3.3
Yes	No	No	0.6	1.4	1.7
No	No	Yes	1	2.4	2.7
Yes	No	Yes	0	0.9	1.2
Yes	Yes	Yes	0	0	0

LIWP Solar PV Incentives calculated in dollars per Watt – DC.

Incentives that Encourage Electrification

Historically, California's investor owned utility programs have been restricted from incentivizing fuel-switching measures across all programs regardless of demographics. This limitation has widespread impact on not only the state's GHG reduction goals but also on workforce development for building decarbonization.

Conversely, LIWP-MF's incentive structure is optimally designed for appropriate incentive rates to encourage or at least level the playing field for affordable property owners to consider electrification. First, as the impact metric is reduction of GHG emissions, this methodology better captures the real societal impact of decarbonization; therefore, the program can typically provide larger incentives to electrify end-uses that can make electrification cost-competitive with less-efficient gas alternatives. Furthermore, the program expects this trend will only intensify as the electric grid gets greener. As the emissions factors for greenhouse gas emissions by the electricity sector diminish and remain neutral for natural gas, the incentives for electrifying end uses through this methodology will become increasingly attractive.

Program results indicate that the integration of fuel-switching into LIWP-MF projects is consistently increasing. This trend can be attributed to several factors. While properties find value in eliminating combustion safety concerns on site and often are interested in supporting decarbonization, the program's higher incentive rates for fuel-switching measures and expert technical assistance are both considerable contributing factors as well. Because the program incentives are designed to promote measures that reduce greenhouse gases, they offer higher incentives for fuel-switching. This incentive boost helps offset added costs associated with electrification. Furthermore, with no-cost, expert technical support from LIWP, property owners

are presented with options to consider electrification early in the design process, often in combination with solar. When the program incentives can make the option to electrify cost competitive with same-fuel upgrades, reduce barriers through added technical assistance, and include solar feasibility assessment and incentives to offset additional electric load with renewable energy under the same program, it makes electrification attainable.

Program results confirm the effectiveness of this formula. To date, 41% of completed LIWP-MF projects have integrated some form of fuel-switching into their work scope, and half of these projects incorporated solar PV as well. The availability of solar incentives under the same program umbrella allows property owners and residents, alike, to offset additional electric load with on-site renewable energy, providing a means of further reducing operating costs.

Single Point of Contact: Comprehensive Technical Assistance

Managing the process of a deep energy retrofit and navigating the complexities of various incentive programs is a challenge, and affordable property owners' time and knowledge base can be a significant barrier to enrollment. To mitigate this barrier, LIWP-MF offers no cost technical assistance throughout the lifecycle of the project. No cost technical assistance is a critical program offering that improves energy savings, reduces owner out-of-pocket costs, and produces higher quality results. Three aspects of technical assistance that LIWP-MF has developed ensure that property owners receive the necessary support to facilitate successful rehabs: organizational partnerships, experienced and objective Technical Analysts, and quality assurance protocols.

From its inception, LIWP-MF has consisted of a team of organizations that bring a wealth of experience in various aspects of affordable housing, which in addition to AEA playing the lead role, includes support from California Housing Partnership (CHPC), GRID Alternatives, and TRC Companies (TRC). This team provides wrap-around support to owners and lends years of affordable housing experience to the ongoing design and operation of the LIWP-MF program. California Housing Partnership leverages its knowledgeable staff and existing work with non-profit low-income multifamily buildings to provide targeted outreach, helping LIWP-MF maintain a pipeline of informed participants, and technical assistance for properties who need guidance to navigate financing models to find the upfront capital required to fund a deep energy retrofit. GRID Alternatives brings program design and technical assistance support to participants to assess solar feasibility and inform program updates. TRC provides outreach and intake support as well as overflow capacity for technical assistance. Building an implementation team with diverse areas of expertise allows the program to provide targeted technical assistance to help overcome the barriers to participation for this hard-to-reach market sector.

Another critical aspect of technical assistance is providing participants with an experienced, objective single-point of contact. LIWP-MF Technical Analysts (TAs) have years of experience with multifamily building audits and construction and receive ongoing support from senior staff to ensure the highest level of reliability and expertise. Having access to their services allows participants to rely on an experienced and objective consultants at no-cost. Technical analysts are critically important to the success of this program, providing guidance throughout the process, including:

- Energy modeling

- Assessing existing site conditions and energy saving opportunities in an on-site energy audit
- Evaluating constructability and feasibility of various strategies
- Communicating program rules and incentive levels
- Providing performance specifications and guidance to assist with contractor selection and bid procurement
- Recommending complementary programs to co-leverage to maximize impact
- Performing quality assurance site visits and benchmarking to ensure final product is installed and is performing as expected

The experience level of the technical analysts is particularly important for projects considering electrification. From analyzing bill impacts to evaluating existing electrical capacity, having experienced, objective Technical Analysts on the team from the start helps property owners, particularly those that are risk-averse, make well-informed decisions about significant energy investments. This level of support is critical as property owners become pioneers in the existing building decarbonization movement. While heat pump water heaters are not a new technology, the design and installation workforce is still approaching the learning curve. With more than 2,468 low-income households having received the benefits of fuel-switch projects to date, LIWP TAs bring real-world expertise and lessons learned to set projects up for success.

Co-leveraging

A program's ability to work in tandem with complementary programs has been a crucial pathway for success for many LIWP-MF projects. Technical Analysts develop familiarity with regional, utility, and statewide energy-efficiency, battery storage, and renewable energy programs to assist owners in layering additional resources into projects to encourage maximum impact and reduce property owner administrative burden. This structure is intentional; the LIWP-MF program was designed to encourage layering multiple programs to facilitate the most comprehensive energy savings possible with as little out of pocket costs for the property owners. Leveraging LIWP-MF's whole building comprehensive approach and technical support with supplemental regional and utility programs and tax incentives facilitates deeper energy savings in a single rehabilitation (Robbins and Bartolomei, 2018). When coupled with LIWP-MF, other program models that may be less effective or impactful on their own can stack with LIWP to provide incremental benefit, which in turn encourages additional property upgrades.

Furthermore, the program has had significant success aligning enrollment with LIHTC resyndication or other expected rehabilitation cycles, using the existing momentum, staffing, and supplemental funding to spearhead a project while leveraging the LIWP-MF technical assistance and incentives to facilitate a deeper work scope with greater long-term impact. Identifying projects years in advance through targeted outreach allows properties to work with LIWP early on in the design process to integrate and optimally leverage both sources of funding to maximum impact.

Benchmarking

In early program cycles, accessing resident utility bills to confirm program efficacy provided a significant challenge, requiring door-to-door release forms or similar effort to collect data. This process improved significantly in 2017 when Assembly Bill 802 went into effect, requiring utilities to provide whole-building aggregated consumption data for multifamily properties with 5 or more units upon request (AB802, 2015). Assembly Bill 802 signaled a significant increase in benchmarking efforts throughout the state of California, and allowed LIWP-MF to dedicate a team member to collecting and analyzing utility data from all available LIWP properties.

LIWP-MF's programmatic commitment to benchmarking provides transparency, accountability, and opportunities for post-construction system and bill optimization. Although there are still large hurdles related to data access and accuracy that create challenges, when available, energy use data is particularly relevant to ensuring long term benefits for low-income residents, as it allows technical analysts to review actual post-construction utility data to determine whether systems are performing and solar credits are allocated as expected. In some cases, this also allows the program to provide ongoing technical support to help troubleshoot in order to realize expected energy savings. Furthermore, benchmarking is relevant on a programmatic level to evaluate program efficacy based on actual post-construction results instead of relying solely on deemed or modeled savings estimates. While energy models and deemed savings estimates are important guideposts for design, integrating actual performance data allows LIWP-MF to confirm that modeling methodologies are accurate, savings persist over time, and low-income residents continue to benefit from reduced utility bills.

Confirming results lends the program credibility and an ability to demonstrate proven economic benefits for low-income communities. This ongoing level of analysis has been fundamentally important to the success of projects that incorporate electrification as well. Benchmarking has allowed LIWP-MF to show the actual energy bill reductions through electrification and energy efficiency alone.

As an example, benchmarking data for a 36 unit property in Wasco, CA highlights the results of replacing non-condensing gas domestic hot water and space heating systems with inverter-driven heat pumps. The project also included a 110 kilowatt solar PV system, 93% of which directly offsets resident energy use.

This property, which houses predominantly low-income families, demonstrates the importance of reviewing pre- and post-construction utility bill data to show the benefits of electrification with and without solar. The property installed the following measures as part of the energy retrofit:

- Heat pump water heaters
- High efficiency ducted heat pumps
- Seal ductwork with Aeroseal
- Air seal and insulate attic
- New ENERGY STAR washing machines and refrigerators
- Dual pane windows
- Comprehensive LED lighting upgrade
- Low-flow aerators and showerheads
- Solar PV (110 kW system)

As illustrated in Figure 6, residential in-unit energy use was reduced 44% (combined BTU savings) by energy efficiency upgrades alone.

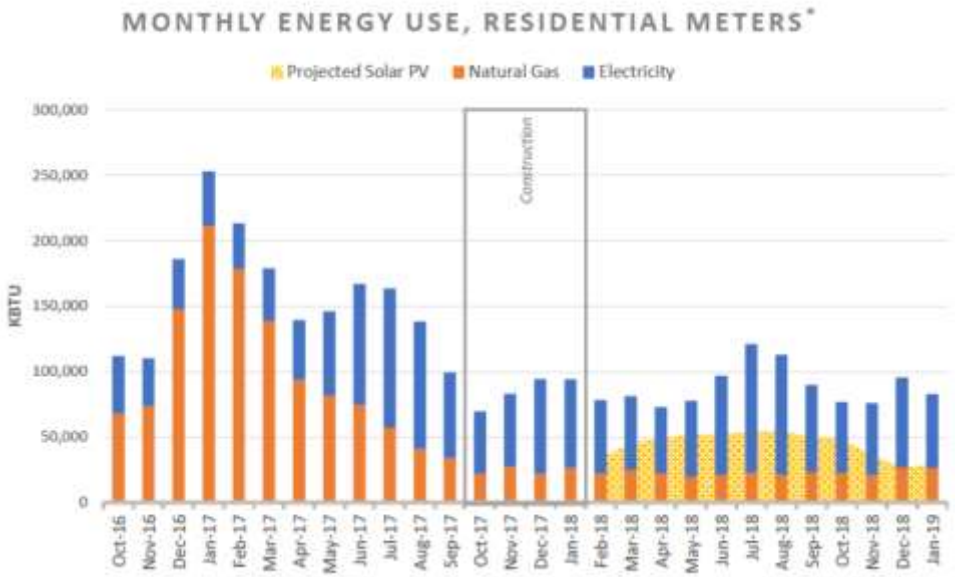

Figure 6: Aggregated resident utility bill data and projected solar PV production for a 32 unit property in Wasco, CA.

Resident utility costs decreased by 18% after installing energy efficient heat pump water and space cooling equipment and other energy efficiency measures in apartments. When combined with the resident-benefitting solar arrays, the residents are projected to save $30,000 annually on their combined energy bills, saving an estimated $830 per household per year.

These compelling results are not limited to a single electrification project. As shown in Figure 7, a review of actual utility data for 23 completed LIWP-MF projects revealed that the energy savings for electrification projects was consistently higher than projects that did not include an electrification measure.

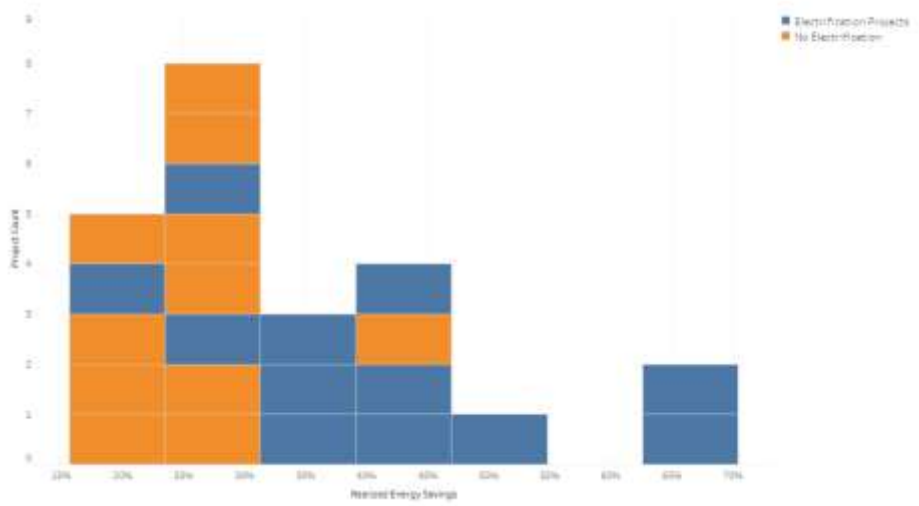

Figure 7: Realized Energy Savings for 23 LIWP-MF Projects, Project Comparison

Conclusion

As the climate continues to change, the need to address disparities in energy burden, comfort, health, and resilience in disadvantaged communities becomes increasingly urgent. Low-income communities will face a disproportionate burden in the burgeoning clean energy future if California does not continue to invest resources to level the playing field.

Low-income households, renters, African American households and LatinX households "paid more for utilities per square foot than the average household," which shows the comparable inefficiency of their housing stock (Drehobl and Ross 2016, 4). However, increasing the energy efficiency of the housing stock to equal that of the median household would eliminate 97% of the excess energy burden for renters (Drehobl and Ross 2016, 4).

This issue expands far beyond economic benefits. Energy efficiency and electrification can also provide health and resilience benefits to underserved communities, improving the outdoor and indoor air quality and thermal comfort. The number of cooling degree days has increased and is projected to continue to increase into midcentury, particularly in the inland areas of California (CEC 2009); energy upgrades like air-sealing, windows, insulation, cool roofs and heat pumps are critical to preparing communities to weather the heat.

In order to penetrate the low-income multifamily sector, program models that break traditional silos of ownership and fuel type need to be explored. California's Low Income Weatherization Program for Multifamily Properties has proven to be an effective model for targeted deep energy retrofits, bringing the benefits of electrification to historically disadvantaged communities. The demand for the program has grown to exceed funding, with more than 180 properties on the waitlist.

And while California has been the proving ground for the effectiveness of this model, the program elements can be applied to any jurisdiction. Best practices from LIWP-MF can be replicated in programs across the country.

Currently, more than 50 cities have already passed or are considering passing all electric building ordinances (Greenlining 2019). Now is the time to scale energy efficiency and electrification opportunities for the most vulnerable populations. Continued funding for impactful program models with demonstrated results is critical to prepare frontline communities nationwide. The actions taken today can either help to mitigate or significantly increase the wealth and health disparity of the next decade of climate change.

References

Aas, D., A. Mahone, Z. Subin, M. Mac Kinnon, B. Lane, S. Price. Draft Results from Natural Gas Distribution in California's LowCarbon Future Technology Options, Customer Costs, and Public Health Benefits. San Francisco, CA: Energy and Environmental Economics. Prepared for California Energy Commission. ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-D.pdf

AB 802 (Assembly Bill 802). Chapter 590. (California 2015). leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB802

AB 1232 (Assembly Bill 1232). Chapter 754. (California 2019) https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB1232

CEC (California Energy Commission). 2009. Potential Impacts of Climate Change on California's Energy Infrastructure and Identification of Adaptation Measures (CEC-150-2009-001). ww2.energy.ca.gov/2009publications/CEC-150-2009-001/CEC-150-2009-001.PDF

CEC (California Energy Commission). 2016. SB 350 Low-Income Barriers Study, Part A - Commission Final Report. assets.ctfassets.net/ntcn17ss1ow9/3SqKkJoNIvts2nYVPAOmGH/7bc56e2692769abda31a2aace7b00147/TN214830_20161215T184655_SB_350_LowIncome_Barriers_Study_Part_A__Commission_Final_Report.pdf

Drehobl, A., and L. Ross. 2016. Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low-Income and Underserved Communities. Washington, DC: ACEEE. aceee.org/research-report/u1602.

Johnson, K., and E. Mackres. 2013. Scaling Up Multifamily Energy Efficiency Programs: A Metropolitan Area Assessment. Washington, DC: ACEEE. aceee.org/research-report/e135.

LAO (Legislative Analyst's Office). 2016. Perspectives on Helping Low Income Californians Afford Housing. lao.ca.gov/Reports/2016/3345/Low-Income-Housing-020816.pdf

Miller, C., S. Chen, L. Hu, and I. Sevier. 2019. Equitable Building Electrification: A Framework for Powering Resilient Communities. Greenlining Institute and Energy Efficiency for All. www.energyefficiencyforall.org/resources/equitable-building-electrification-a-framework-for-powering-resilient.

OEHHA (Office of Environmental Health Hazard Assessment). 2017. Update to the California Communities Environmental Health Screening Tool. oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf

OEHHA (Office of Environmental Health Hazard Assessment). 2018. CalEnviroScreen Tool version 3.0. oehha.maps.arcgis.com/apps/View/index.html?appid=c3e4e4e1d115468390cf61d9db83efc4

Robbins, L. and D. Bartolomei. 2018. Seizing the Moment: Incorporating Efficiency, Health, and Renewables Upgrades into Affordable Housing Financing Events. ACEEE Summer Study. assets.ctfassets.net/ntcn17ss1ow9/5OCa9cYLh2eAuXtk2BqfWk/7e9e569d3db842ab97c28826446a8597/ACEEE-summer-study-2018-financing.pdf

U.S. Census Bureau. 2017. "2013-2017 American Community Survey 5-Year Estimates." factfinder.census.gov.