

**Decarbonization of Affordable Multifamily Housing:
A Comparative Analysis of Program Approaches**
Charlotte Cohn & Kate Tanabe, American Council for an Energy-Efficient Economy

ABSTRACT

The benefits of efficient electrification in buildings include reduced greenhouse gas emissions, lower costs, and improved indoor air quality and health outcomes. However, these benefits are not equally accessible to all residents and housing types. Low-income renters of multifamily properties have many barriers that block access to these sustainable decarbonization technologies, such as a lack of up-front capital, lack of access to financing, complex building systems that require custom solutions, and property manager disinterest in building decarbonization.

This white paper examines four examples of programs that aim to address these barriers and deliver decarbonization retrofits for low-income multifamily households. This paper explores incentive delivery methods, funding mechanisms, and lessons learned by comparing decarbonization programs in California, New York, and Washington, DC. We also present participation, energy savings, and greenhouse gas emissions reduction data for each program. Based on the results of these programs, we highlight key findings and recommendations to future program managers to expand decarbonization efforts in this sector.

Introduction

To address climate change, our leaders, policymakers, and we as individuals will need to commit to taking the necessary steps to eliminate our dependence on greenhouse gas (GHG)-producing fossil fuels for power generation, transportation, and use in buildings. Through electrification and decarbonization, we can replace these fuels with carbon-free equivalents that perform the same or better service without compromising quality of life. However, this transition will not necessarily come at a low cost or be delivered equitably to all. Decarbonization programs and goals must be specifically designed for hard-to-reach sectors, such as low-income multifamily buildings, or risk stranding these vulnerable populations with higher costs and poorer quality of life compared to those who can afford electrification technologies.

Over the last decade, the rise in building electrification technologies, programs and policy goals has led to numerous pilots and programs that aim to provide decarbonization retrofits for the affordable multifamily building sector. This paper profiles four such programs administered by utilities, state agencies, and non-government organizations, and includes data collected on budget, participation, and impact. We examine four programs: the Low Income Weatherization Program for Multifamily, administered by the Association for Energy Affordability (AEA) in California; the Low Income Decarbonization Pilot run by the DC Sustainable Energy Utility (DCSEU) in Washington, DC; the Go Electric for Multifamily program offered by the Sacramento Municipal Utility District (SMUD); and the RetrofitNY program run by the New York State Energy Research and Development Authority (NYSERDA). Based on these four case studies and related research in this field, we discuss barriers, strategies, and recommendations to scale building decarbonization in the affordable multifamily housing sector.

Potential for Future Decarbonization in Multifamily Buildings

Multifamily buildings represent a large portion of the U.S. housing stock, with one in six households living in apartments and condominiums (Perry, Khanolkar, and Bastian 2021; Samarripas, York, and Ross 2017). Nearly one-third of all households are renters, and most of those households live in multifamily buildings (Clarion Partners 2018). The U.S. currently has over 28 million households living in multifamily units and is projected to add 10 million units over the next decade. Market-rate and affordable multifamily buildings hold significant potential for energy and emissions savings. Apartments in buildings with 5 or more units used a total of 406 trillion Btu of energy in 2015 (EIA 2018). ACEEE estimates that retrofits in multifamily home with high energy bills could reduce energy consumptions by 17% (Samarripas and Tanabe 2020) and retrofits in affordable multifamily buildings could achieve 997 billion Btu in annual energy savings and 207,000 metric tons of CO₂ equivalent in annual avoided GHG emissions (York et al. 2022).

Energy efficiency and decarbonization measures in multifamily buildings can also lower energy and utility bills for tenants, many of whom experience high energy burdens. When energy costs are represented as a percentage of total income, low-income multifamily households spend 2.3 times more on energy-related costs compared to other multifamily households (Drehobl, Ross, and Ayala 2020).

Multifamily building retrofits present unique challenges compared with other types of buildings and target sectors for decarbonization. Because these are very often large, complex multi-unit dwellings with unique systems to distribute heat, hot water, gas, and electricity, there is no singular approach that will work for every building. For this reason, many of the programs featured in this report involve a comprehensive process of working with property owners, managers and tenants in order to identify custom solutions that fit the unique needs of the building and its residents.

Case Studies

Association for Energy Affordability – Low Income Weatherization Program for Multifamily

California’s Low Income Weatherization Program (LIWP), administered by the Association for Energy Affordability, a state-funded nonprofit organization, is one of the largest building electrification efforts in the United States to date (Cohn and ESRAM 2022). This program is designed to deliver comprehensive building retrofits and decarbonization measures to multifamily properties with low-income residents, a historically under-served sector. This program has been operating since 2016 and to date, has delivered more than \$33 million in incentives for more than 8,100 low-income rental households. Building retrofits include measures such as insulation, air and duct sealing; space heating, hot water, and cooking electrification; and distributed energy resources including rooftop and community solar (Hill, Dirr, and Harrison 2020). It is the first low-income program in the state to focus on decarbonization specifically, and this is reflected in the incentives, which are provided based on total avoided GHG emissions instead of a per-measure basis.

This program is designed to address several roadblocks to decarbonization for low-income housing. One crucial barrier is the “split incentive” problem, wherein rental property owners see little to no financial benefit from investing in energy upgrades for units where tenants

pay for their own utility costs. This program addresses the “split incentive” by offering higher incentives to upgrade properties with individually metered units. By working from the ground up with property managers and residents alike to identify high-impact opportunities for upgrades, program administrators can deliver custom measures that lead to lower energy costs and greenhouse gas emissions. Each project starts with a no-cost energy audit to provide recommendations from a whole-building standpoint. The flexible, technology-neutral incentive method allows for program implementers to recommend specific upgrades for a variety of building types and mechanical systems. This approach has demonstrated results: properties enrolled in the program average 37% site energy savings from efficiency measures alone and 43% when solar PV is pursued in tandem. These upgrades translate to savings for residents, with an estimated \$830 in annual utility bill savings per year for residents where the building upgrades combined efficiency, electrification, and solar PV. These upgrades reduce annual GHG emissions by 8,823 metric tons of CO₂ equivalent per year to date.

Funding for the LIWP has in the past come primarily from carbon emissions allowances purchased through California’s Cap and Trade program. As these funds are allocated annually by the California legislature, this creates a somewhat inconsistent annual funding stream which can lead to difficulties with most retrofit projects that require 12-24 months to complete. As of June 2020, this program has completed 81 projects and served approximately 0.6% of the state’s low-income multifamily housing stock, with more than 1,000 multifamily buildings currently on the program’s waiting list. This unique program design, which addresses many of the barriers listed above and delivers lasting decarbonization and electrification, can serve as a model for other states and jurisdictions that are serious about addressing the issue of unequal access to decarbonization through whole-building holistic strategies.

DC Sustainable Energy Utility – Low-Income Decarbonization Pilot

This pilot program, which ACEEE highlighted in its beginning stages in a 2020 space-heating brief (Nadel 2020), concluded its initial run with 10 total residences (6 single-family homes and 4 multifamily units) receiving partial or full conversion to all-electric heating, hot water, and cooking, with distributed solar on the single-family homes and a community solar subscription for the four-unit multifamily complex. These whole-home conversions were provided at no cost to income-qualified participants. Program managers noted high satisfaction rates among participants, with 9 out of 10 reporting entirely positive outcomes in surveys after the pilot concluded. Beyond energy savings, customers responding to these surveys indicated that they experienced improved air quality and greater comfort in their homes because of the electrification and weatherization measures. The program managers cited clear communication from the contractor as key to ensuring that participants were well informed and satisfied with the process.

Program administrators encountered some complexities during program administration. The COVID-19 pandemic created multiple unexpected challenges and required the planned participant group of 20+ households to be reduced by more than half. Other issues included the expense and complexity of wiring and panel upgrades. The cost to upgrade to a 200-amp panel is approximately \$2,750 in D.C., and wiring can increase the price even more if no dedicated circuit exists for a new all-electric appliance. Additionally, the relatively short time frame for the

project placed stress on the contractors, permitting process, and unit delivery. Most projects were completed in less than 45 days, whereas a typical full-home conversion will often take between four and six months (P. Boyd, senior technology strategist, DCSEU, pers. comm., July 9, 2021). Last, administrators learned the importance of clearly communicating program goals and outcomes upfront so that clients know what to expect. At the start, it was unclear to certain participants that this was an energy-oriented program rather than a whole-home renovation. Once program administrators explained, customers were able to proceed smoothly with the process.

With the success of the pilot, the DCSEU is moving forward with additional building decarbonization incentives in 2022. One of these solutions is an HVAC Replacement Program that provides incentives for the installation of high-efficiency electric heat pumps, high-efficiency electric water heaters, and advanced thermostats in single-family homes owned or rented by low- and moderate-income district residents. The other is an Affordable Housing Retrofit Accelerator, a comprehensive energy retrofit program that provides technical and financial assistance to affordable multifamily building owners who are required to comply with the District's Building Energy Performance Standards.

Sacramento Municipal Utility District – Go Electric for Multifamily

SMUD, a municipally owned, not-for-profit utility in Sacramento, California, has one of the most aggressive carbon reduction targets in the country, aiming to reach net-zero emissions by 2040, five years ahead of California's statewide goal (SMUD 2021). Building decarbonization is a critical aspect of meeting this goal, with the utility aiming for 80% of buildings in its service area to be all-electric by 2040 (Wang and Menonna 2020). SMUD aims to achieve this cost effectively and equitably by employing smart technologies and focusing on including under-resourced communities and hard-to-reach sectors. The utility currently offers multiple pathways for building electrification incentives, including a "Go Electric" Multifamily retrofit program.

SMUD's Go Electric incentives for existing multifamily properties with five or more units are designed to promote switching to electric space-heating, water-heating, and cooking appliances. This program also offers incentives for wiring and electrical panel upgrades, EV charging, and energy efficiency measures. Property owners can receive a per-appliance incentive and an additional 25% incentive for apartment complexes where most tenants are income-qualified. Project managers work with property owners to deliver incentives but also engage directly with building tenants to provide education and guidance through the upgrade process.

New York State Energy Research and Development Authority (NYSERDA) – RetrofitNY

NYSERDA's RetrofitNY initiative aims to increase carbon neutral retrofits and electrify affordable multifamily buildings in New York. The initiative takes influence from the successful European program, Energiesprong, and leverages collaboration and collective buying power of building owners, developers, manufacturers, and solutions providers to create market demand (NYSERDA n.d). By mobilizing the building industry to develop innovative solutions, RetrofitNY prompts cost compression for new technologies and reduces the costs for carbon neutral retrofits. NYSERDA launched the program with a focus on affordable housing to

increase the number of residents that have access to the benefits of zero-emissions buildings (NYSERDA n.d).

RetrofitNY provides funding to building owners that collaborate with designers, construction companies, and financing entities to create high-performance energy retrofit solutions for affordable multifamily buildings (Earle, Torcellini, and Chappoz 2020). In 2018, the program’s first pilot funded six teams across the state and demonstrated the feasibility of carbon neutral retrofits in multifamily buildings (NYSERDA n.d). NYSERDA is currently recruiting for the second round of funding, which will award \$5 million for all electric, whole building energy saving projects that improve living conditions and reduce utility costs for residents. Participants receive \$100,000 to offset development and design costs and up to \$40,000 per dwelling unit for retrofit construction (NYSERDA n.d.). Affordable multifamily buildings qualify if owners are planning to refinance in the next two years and conduct significant renovations including updates to mechanical systems, the building envelope, or in-unit kitchens and bathrooms (NYSERDA 2021).

The success of the program relies on the scalability of the retrofit solutions. RetrofitNY hopes the demonstrated feasibility of high-performance projects will serve as templates for national programs, continue to reduce costs for carbon neutral building technologies, and spur wide-spread retrofits for affordable housing properties.

Program Budgets and Participation

Program Name	Year(s)	Budget		Participation	
		Annual	Total	Properties	Households
AEA Low Income Weatherization Program	2016-2022	\$17,900,000	\$63,900,000	81	8268
DCSEU Low-Income Decarbonization Pilot	2020	\$346,000	\$346,000	10	14
SMUD Go Electric Multifamily	2018-2022	\$1,200,000	\$2,600,000	<i>n/d</i>	<i>n/d</i>
RetrofitNY	2019	\$2,599,968	\$4,652,012	6	179

Data Source: Hill, Dirr, and Harrison 2020; Cohn and Esram 2022; RetrofitNY. “n/d” signifies no data is available.

The four programs examined were largely pilot programs with limited budget and scope. The largest program was the AEA Low Income Weatherization Program, with a total budget of \$63.9 Million in its first round of funding beginning in 2016. The smallest program was the DCSEU Low Income Decarbonization Pilot, which was initially scoped for 25 properties but due to the impacts of COVID-19 downscaled its efforts to 10 buildings (including 6 single-family homes and 4 multi-family condominiums in Washington, DC). Three out of the four programs were comprehensive whole-building efforts that provided extensive technical assistance to the

property owners and building managers in order to deliver custom-tailored solutions for each building. SMUD's Go Electric Multifamily program was unique in providing technology-based rebates for upgrades, rather than a whole-building solution, although program administrators also worked with building managers and tenants to provide guidance and communication around the upgrades.

Program Name	Energy Savings (BTU)	GHG Impacts (MTCO ₂ e)	Cost Savings
			Annual per household
AEA Low Income Weatherization Program	637,248	8823	\$830
DCSEU Low-Income Decarbonization Pilot	<i>n/d</i>	<i>n/d</i>	<i>n/d</i>
SMUD Go Electric Multifamily	<i>n/d</i>	<i>n/d</i>	<i>n/d</i>
RetrofitNY	55,133	3,085	<i>n/d</i>

Although energy savings (measured in British Thermal Units) and greenhouse gas (GHG) emissions reduction were the point of many of these programs, these impacts were occasionally difficult to quantify or are still undergoing evaluation as these programs are recent. The programs with reported results did show measurable improvements in terms of energy savings and other factors, as well as qualitative upgrades to tenant quality of life.

Discussion

In the four programs described above, administrators identified some consistent barriers to decarbonization of affordable multifamily buildings, including costs, tenant risk, and disturbance due to construction. These barriers are analyzed in greater detail below.

Cost of upgrades. Each of the programs profiled above provided extensive funding and technical assistance to building owners, managers, and tenants in order to conduct renovation and replacement of fossil-fueled heat, hot water, and other building systems. These retrofits come at a relatively high cost, from the up-front capital costs of the equipment to the labor costs to install and maintain these systems. Additionally, electrification upgrades may carry additional costs, such as wiring and panel upgrades to support new electric appliances, or even electrical distribution infrastructure upgrades to serve higher electrical load. In income-based programs, the high costs of these upgrades are typically borne by the program administrators at no cost to tenants. This results in a high cost per decarbonized unit. Because of the high costs and lack of a clear return on investment (especially in cases where tenants pay their own utility bills), the motivation for multifamily property owners to upgrade is often unclear from a financial standpoint.

Risk to tenants. Because these upgrades come at a high cost, there is a possibility that property owners will seek to recover some of these expenses by shifting costs onto building tenants in the form of increased rent. This is a perverse outcome from an equity perspective. Additionally, in situations where tenants pay their own electric utility bills, changing over some

or all the building systems to electric may end up increasing their cost of living, particularly when moving from central heating systems (e.g., hydronic or steam heating) to distributed in-unit systems (e.g., ductless heat pumps). In its worst case, building owners may even use upgrades as an excuse to evict tenants that are behind on their rent or for other reasons.

To avoid these consequences, several of the programs in these case studies (AEA and RetrofitNY) work exclusively with subsidized affordable housing which includes provisions that limit increases to rent. However, unsubsidized/naturally occurring affordable housing should not be excluded from decarbonization efforts. Program administrators need to work out an agreement with building owners to ensure that costs from these upgrades do not drive out vulnerable tenants.

Disturbance from construction. Finally, because these buildings are inhabited during retrofit, renovations may disturb tenants with noise or personnel entering their housing unit. These disturbances can lead to discomfort and in some cases pushback by tenants against decarbonization upgrades. To mitigate or address tenant concerns in advance, some program administrators engage with tenants to provide educational materials and create open forums for communication. The SMUD Go Electric Multifamily program does this by requiring project participants (property owners, managers, and contractors) to develop a tenant engagement plan. Engagement activities may include digital delivery of educational materials (e.g. community newsletters), on-site educational events with the community, and/or apartment visits with tenants (SMUD 2022).

Recommendations

Across the four programs, there are some lessons learned that can be applied to future decarbonization of affordable multifamily buildings including:

Create a one-stop shop. This type of program model coordinates technical assistance through a single point of contact and assists property owners with project planning and implementation (Tanabe 2021). Many affordable multifamily building owners lack experience or resources to allocate toward retrofit projects. One-stop shop models help address such challenges by assisting building owners or managers navigate a program's application process and manage the project's design, financing, and installation process.

Coordinate and collaborate with relevant stakeholders to implement programs and better support projects. Establishing partnerships with stakeholders, including utilities, developers, financing agencies, contractors, or construction companies can increase participation and reduce costs for affordable multifamily programs (Tanabe 2021). Collaborative programs bring together multiple groups with different areas of expertise, allowing each party to apply specific knowledge to various program elements. Such coordination enables relationships between partners, provides additional marketing opportunities, and yields more comprehensive retrofits (Johnson 2013).

Braid in Funds from Multiple Sources. Because of the high costs of equipment, labor, and prerequisite building upgrades for electrification, program administrators should seek to coordinate all available sources of funds, including state and federal grants, local utility rebates, carbon cap-and-trade market revenues, federal housing assistance funds, green bank financing, personal funds from property owners, and more. By acting as a facilitator, program managers can

leverage numerous sources of funding and financing to reduce the up-front capital and ongoing costs of the project as much as is feasible.

Coincide with Planned Renovations to Leverage Private Capital. To ensure robust participation, multifamily programs should target housing providers during major capital events such as renovations or refinancing (Tanabe 2021). Property owners have greater access to capital to cover the upfront cost of upgrades at these times. However, many affordable housing providers experience difficulties obtaining project financing and funding. Program administrators can pursue several strategies to help building owners plan and finance retrofit projects, including building relationships or partnering with lenders that are active in the local housing market, offering on-bill financing for affordable multifamily projects, or helping applicants find other companies offering to finance energy- or emissions-savings projects. By timing these incentives with already planned maintenance, project managers can reduce the duration of disturbance to residents and increase the likelihood of upgrading multiple building energy systems simultaneously.

Put Efficiency First. Energy efficiency is still the most cost-effective solution in many cases and should be the first step that program implementers take when seeking to reduce a multifamily building's total energy demand and carbon emissions. By improving the thermal envelope through weatherization and air sealing, and by reducing energy waste through installing more efficient appliances and heating systems like heat pumps, decarbonization retrofits can maximize their impact in terms of both carbon reduction and energy cost savings. To the extent that the local utility offers energy efficiency audits, programs and incentives, these should be braided in to multifamily decarbonization plans in order to maximize their effectiveness while reducing overall project costs.

Prioritize Resident Needs. To avoid adverse impacts on building residents, it is vital that program managers engage early and often with tenants in the buildings receiving decarbonization upgrades. The DCSEU program found that using a contractor who was knowledgeable, responsive, and able to clearly convey expectations about project work and timelines was vital to ensuring customers were satisfied throughout the renovation process. SMUD and AEA also feature resident engagement as an important strategy in each of their programs. In developing a building decarbonization plan, program administrators should consider all ways in which it will affect residents, including bill impacts, noise and disturbance, physical changes in interior and exterior building spaces, etc., and communicate those to set clear expectations for all participants in the process.

Conclusion

Multifamily buildings are a vital part of our housing system in the United States and are a critical sector to target in order to deliver equitable decarbonization for all, particularly for low-income households. For future program managers to expand decarbonization efforts in the affordable multifamily sector, the lessons learned from these program approaches can help in designing and scaling new and existing programs. Creating flexible, fuel-neutral solutions, combining existing resources and sources of funding, prioritizing the needs of tenants, and providing technical assistance and a one-stop-shop program model can enable program

implementers to tackle these complex building systems using a cost- and resident-conscious approach.

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