Avoiding Locking in Emission through Electrification Readiness

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ABSTRACT

Almost half of California's low-income households live in multifamily buildings; therefore, equitable electrification will require strategies to serve these multifamily rental populations. Yet several barriers hinder electrification of multifamily space and water heating. One of the major barriers for electrification is the ease of replacing equipment at unit turnover and/or burnout when not undergoing a large capital improvement scope of work. Approximately 90% of water heater installations are emergency replacements. The barriers with in-unit water heating and HVAC changeout may be associated with (1) different form factors (2) fuel infrastructure and upgrades and (3) different maintenance requirements. California's climate goals require strategies that scale retrofits and avoid locking in emission for the next 15 years.

An HVAC or water heater appliance replacement schedule, mapped to unit turnover or other trigger and coupled with an initial investment in infrastructure, can spread capital investment costs and construction logistics over a longer period. A pilot was developed and executed to test these strategies, requirements, and approaches to adapt the upgrade over time approach typically used for refrigerators to address in-unit water heating and HVAC equipment. In addition, this pilot has helped understand what electrification readiness looks like for different projects to support the phasing of electrification. Lessons from this program strategy will include electrification readiness lessons and executing upgrades over time. This paper will discuss the results and ongoing activities of electrification readiness strategies, deployed to aid in scaling retrofits of heat pump water heaters and HVAC in multifamily buildings.

Introduction

Almost half of California's low-income households live in multifamily buildings, and approximately 91% of the state's three million multifamily housing units are rented (Bachman et al. 2022). Meeting California's ambitious heat pump goals (California 2022) equitably requires strategies to serve these multifamily rental populations. Based on the Association for Energy Affordability's (AEA's) experience with multifamily electrification retrofits in California, approximately 50% of multifamily properties have individual water heating systems; individual space conditioning is more common than central space conditioning systems.

Under TECH Clean California, AEA is implementing a multifamily pilot that works with affordable housing properties to adopt a phased approach to electrifying in-unit space and water heating equipment. This approach supports planning and preparing for full electrification to occur over time. It considers common retrofit approaches such as incremental replacement on failure or upgrading multiple systems at capital events but lays out a multi-step process with the end goal of full electrification. Participating owners first work with AEA to identify an eligible property, then receive technical assistance to plan for equipment upgrades and electrification readiness components. The approach considers synergies with upgrade protocols, Physical Needs

Assessment (PNA) schedules, and property financing cycles. The pilot offers TECH incentives toward initial equipment upgrades and electrification readiness measures.

Replacing equipment at time of failure is a common approach, with approximately 90% of water heaters replaced on an emergency basis (Khanolkar, Egolf, and Gabriel 2023). While less robust research is available to quantify the share of HVAC replacements made on an emergency basis, it also is understood to be most cases (DOE 2018). Without a plan in place to electrify, like-for-like replacements are the default option.

Over-time replacements help address upfront cost barriers. Particularly if coupled with an initial investment in infrastructure, spreading capital investment and installation costs over time can prove more manageable for properties with limited resources. Experience to date with electrification retrofits has shown that full electrification is frequently cost prohibitive with estimates averaging $15,000 unit, even before taking into account electrical infrastructure needs, for which costs can vary widely (E3 2023). Partial electrification can create a scenario where full electrification becomes feasible in time. Moving from business as usual and avoiding new investments in fossil fuel equipment that lock in emissions requires support for conversion scenarios that align with multifamily replacement practices. Pilot findings indicate that this is a necessary pathway for electrification and further conditions and scenarios should be explored.

Current Landscape

Common approaches to equipment and appliance retrofits in multifamily housing include models of larger-scale projects that replace equipment at once and models of incremental, over-time replacements. Larger-scale projects may be driven by capital events or by incentive programs. Over-time retrofit models include replacement at failure and replacement at unit turnover. This patchwork of models has born success in multifamily retrofits despite entrenched barriers such as the split incentive (Castellazzi, Bertoldi, and Economidou 2017), which limits owners' inherent financial incentive to invest in efficiency upgrades. However, these models face greater challenges when applied to electrification. Replacing fossil fuel water or space heating equipment with efficient electric heat pumps often requires electrical infrastructure measures such as additional circuit(s) and electrical capacity. This can be accomplished when completing a whole building renovation but is more challenging on a retrofit basis and practically impossible in a unit turnover or equipment failure circumstance.

Larger-Scale Retrofits

Larger-scale retrofits that replace particular equipment or even address multiple upgrades as part of a single project are driven primarily by funding availability. This can come as part of a broader property rehabilitation funded through a capital event or when a retrofit program offers sufficient incentives to warrant a stand-alone retrofit.

Capital events are an opportune time to undertake energy upgrades. However, they are relatively infrequent, occurring in approximately 15 to 20-year cycles. They can take the form of proceeds from refinancing a mortgage or an influx of equity from the Low Income Housing Tax Credit (LIHTC) program. When a property owner is undertaking extensive, property-wide improvements, energy upgrades can be integrated into the scope of work. Although energy upgrades may compete with other capital needs and priorities when determining the scope of work for a rehabilitation project, policy levers tied to the funding, such as requirements to meet a green building certification or to take advantage of utility programs, can promote increased emphasis on energy upgrades at this time (Bartolomei 2021).

When more extensive work is taking place, it is a particularly valuable time to undertake electrification retrofits, which may require electrification enabling measures. A key factor in having energy upgrades included in rehab scopes of work is having an energy consultant involved in the design process early who can provide experience in energy efficiency and in changing out equipment types. Policy drivers that support energy efficiency are increasingly being used to support all-electric rehabilitation projects.

Stand-alone retrofits (those that take place outside of a capital event) are also driven by funding availability. Programs that cover a significant share of the retrofit cost, especially when paired with technical assistance to scope and carry out the retrofit, can act as enough of a “carrot” to induce owners to replace older, inefficient equipment before it has reached the point of failure. The programs that cover a large share of costs are particularly important for affordable housing considering the limited funds available to undertake stand-alone retrofits. Contributions to reserves for replacement, a core resource for building improvements outside of a capital event, are driven by Capital Needs Assessments, and withdrawals from these funds are not solely at the owners’ discretion. Agencies overseeing subsidies, investors, and lenders have a say in the review and approval of withdrawals from reserves (HCD 2016). Similarly, operating income to support large-scale retrofits is limited by design in affordable housing, where regulations prioritize maintaining affordable rents and where the capital stacks used to finance construction and renovation frequently include soft debt with claims on operating income.

State and federal policies are increasingly focused on electrification retrofits. However, electrification can be more complicated than typical efficiency projects, leading to potentially greater need for planning and design support and higher upfront cost. Programs that support electrification frequently do not offer enough funding to cover the full cost of electrification, leaving replacement over time as the main way to electrify outside of a capital event.

Over-Time Retrofits

Replacements at time of failure or unit turnover can either be like-for-like replacements or upgrades to a higher energy performance standard depending on internal procurement practices. When a piece of equipment or an appliance fails or repeatedly requires significant maintenance, a natural impulse is to replace it quickly. This approach can be applied to equipment, appliances, and fixtures, including PTACs, hot water heaters, dishwashers, refrigerators, showerheads, or faucet aerators. At replacement is an opportune time to upgrade because when products are already being replaced, the energy premium is just the difference between the like-for-like option and the more efficient option.

A variety of internal procurement practices can promote an incremental upgrade approach, and they all entail some amount of advanced planning. For smaller items such as faucet aerators and showerheads, properties can help ensure that these are replaced with more conserving options through stocking practices. They are small enough and inexpensive enough to keep a supply in stock on site. They are inexpensive enough that they may be pro-actively replaced at unit turnover (when a unit is being refreshed between when one household moves out and another moves in) or even during annual inspections. Properties are less likely to house a stock of larger items such as appliances, but purchasing policies that specify either specific models a standard such as ENERGY STAR or a CEE rating can encourage incremental upgrades of these products, including upgrading older equipment at unit turnover. Purchasing policies are most effective when they are accessible. Companies that use online purchase platforms can integrate their standards directly into the platform, while others may take steps like creating posters that reflect their purchasing standards for certain common products.

Replacements over time are easier to implement where the upgrade closely resembles the like-for-like replacement. For example, people upgrading refrigerators can likely find an ENERGY STAR refrigerator that meets a kitchen's space constraints. Complex systems such as HVAC or DHW equipment at time of failure is less common, especially in an electrification scenario. Advanced planning and investments in electrification readiness are critical to making electrification a more "plug and play" prospect that can be implemented over time.

Challenges to electrifying include the higher upfront cost and the tension between the longer lead-times needed for additional measures that enable electrification and the urgency of restoring energy services such as heating or hot water. Increased costs originate from higher equipment costs, required electrical upgrades or infrastructure and physical modifications to accommodate new form factor of equipment, with costs for electrification alone averaging $15,000 per unit (E3 2023). However, installing a new fossil fuel system means losing the opportunity to decrease emissions and increase resident health and comfort. The urgency of climate change drives us to avoid locking in emissions until a future electrification opportunity presents itself, possibly decades down the road. Figuring out the types of advanced planning and electrification readiness measures needed to electrify space and water heating systems over time is part of a multifamily pilot taking place through the TECH Clean California initiative.

Pilot Approach

Given the low levels of heat pump adoption in a retrofit context within the multifamily sector, a goal of TECH Clean California is to increase market familiarity with technologies and build capacity within design teams from owners to architects to MEPs. By accelerating the learning curve, this pilot is intended to reduce the time and cost for developers to transition to all-electric buildings. Phasing an electrification scope has the benefit of reducing the capital burden on the property owner by spreading project-related expenses across longer timelines and reducing the likelihood of needing to relocate residents if major upgrades are occurring in the dwelling units all at once. To move from business as usual, either large rehab or like-for-like, and prevent locking in emissions from like-for-like change outs requires support for conversions over time that align with multifamily replacement practices. Multifamily property owners are the main target of these pilots as they are the key decision-makers.

This pilot engaged four property owners. Three out of four owners specialize in affordable housing and one has a significant share of market rate housing. All four pilot projects are affordable housing properties, and their characteristics are summarized in Table 1 below.

Table 1. Summary of Project Characteristics

Property Number	Climate	# units	# buildings	Unit Types	HVAC System Type	Water Heating System Type
1	Dry hot summer, mild winter	144	Multiple	Studio, 1 and 2 bedroom	Individual	Individual
2	Temperate	100	24	1 and 2 bedroom	Individual	Individual
3	Moderate	45	1	Studio, 1-bedroom	Individual	Central
4	Cool winter, hot summer	46	12	2, 3, and 4 bedroom	Individual	Individual

The Team engaged with each owner to discuss the over-time upgrade strategy, which was not their typical approach. Identifying a project and an approach that was a good fit for the pilot, made financial sense, and aligned with owner processes and physical sense for the property was a long process. It took discussion, technical assistance, and education to owner, contractor, and engineer as well as site assessments, electrical infrastructure assessments, and analysis and demonstration of phasing scenarios. The phasing scenarios helped to engage owners to evaluate what it would mean for them and their project. These examples included:

- **Phasing by scope measure** – i.e., completing one or multiple measures at a single time for the whole property and then moving on to the next single/group of measures.
- **Phasing by residential building** – i.e., completing all scope measures in one/group of building(s) and moving on to the next one/group.
- **Phasing by scope measure & upon equipment failure** – i.e., completing the electrification readiness work and several full measures, like windows and water heating or attic insulation, and then coming up with a replace upon failure plan for remaining measures like HVAC to utilize put-in-place readiness infrastructure.

Each option has pros and cons that were reviewed with the owners. Interestingly, none of the owners chose the by-building scenario, preferring iterations of the other two scenarios. Also, the initial phasing examples did not include electrification readiness only. The specific phasing scenario selected for each of the projects was informed by owner preferences, access to funding, existing conditions of the property, benefits to residents, and future funding projections. Each of the four projects navigating phasing were driven by different factors and conditions.

Pilot Results

The pilot approach initially targeted the strategy to assess unit turnover when introducing the concept to potential participants. Through the engagement and subsequent planning processes, several other scenarios to undertake electrification readiness emerged. Findings from the pilot revealed lessons about electrification readiness definition and approaches to phasing.

Definitions of Electrification Readiness

Electrification readiness has typically been defined as electrical infrastructure to enable electrification prior to the actual electric appliance being installed, but this pilot identified the need for the definition to include other measures to truly enable future installation of electric appliances. For new construction under the 2022 code (CEC 2022), electrification readiness for heat pump water heaters was expanded to include addressing physical space constraints.

Electrical Infrastructure. Electrical infrastructure is defined as infrastructure installed to meet future loads, such as: installing conduit, electrical box(es) near future location(s), conductors, replacing panels to ensure adequate space and capacity. As discussed below in the Approaches to Phasing section, electrical infrastructure proved to be both a component of electrification readiness and a driver of approaches to phasing, with the scope able to be completed prior to utility-driven electrical infrastructure upgrades defining an initial retrofit phase.

Space modifications. To be electric-ready the space needs to accommodate future equipment. Particularly in emergency replacements, physical modifications would lead to too much of a delay to restoring service, and electrification might not occur due to lack of time or available resources. Therefore, the evaluation for electrification readiness must include form factors. For example, multifamily individual water heaters are typically small and skinny while heat pump water heaters are typically wider and taller. As a result, readiness measures may include modifications to the opening of the water heater closet or widening the closet itself to create more generous space. Similarly, considerations for HVAC heat pumps include location of outdoor unit or space for air handler. Installing pads for outdoor units also could be considered an electrification readiness measure, documented in a plan, and completed in the initial phase.

Ventilation. There are physical conditions that can affect performance and should be taken into consideration. One example is ventilation air for a heat pump water heater in a closet. For one project, the proposed readiness work involved widening the closet door and replacing the door with a louvered door to achieve desired ventilation and not rely on replacement in the future.

Energy Efficiency. Like ventilation, there are energy efficiency and distribution conditions that should be addressed prior to electrification to improve performance, reduce loads, and reduce operational costs. This can include insulation to reduce loads and therefore the size of equipment which would affect the form factor. Another example is correcting distribution issues in central domestic hot water systems to support optimized central heat pump water heater retrofit.

Taken together, the pilot experience made clear that electrification readiness should be defined as the scope required to allow for future replacement of a gas appliances most easily with an electric appliance and should include aspects from electrical infrastructure, to form factor, installation requirements that may be time intensive, and best practices that impact performance.

Approaches to Phasing

The pilot supported four projects with different motivations and electrification readiness strategies. The approaches are characterized as: Navigating Utility Upgrades, Preparing for Low Income Tax Credit Scope, Layering Financing and Incentives, and Planning Upgrades Over Time. Only one project adopted replacement upon failure, the pilot's initial scenario. Through owner engagement, it became apparent that owners had not considered this type of strategy previously and there were more expansive applications for this strategy than initially proposed.

Navigating utility upgrades. This example is a scattered-site property with four senior housing buildings. They have similar existing conditions and shared management and funding. The buildings have individual water and space heating without air conditioning in a climate with dry hot summers and increasing cooling degree days. The owner initiated evaluations of the property based on available incentives, aging equipment, and resident comfort needs.

An initial electrical assessment of existing conditions and future loads indicated electrical infrastructure would require an upgrade for full electrification at both the apartment and building levels. The utility timeline for providing engineering services was at least nine months. To think creatively about a retrofit scope, a technical review of the electrical load calculation was conducted, an alternative NEC methodology was applied to different scenarios in a loading order of owner priority for the. The first phase included a scope of work that could be met within current electrical infrastructure. The results showed that all units could receive at least one packaged terminal heat pump (PTHP) and a feeder upgrade. The initial scope is to:

- Install at least one PTHP in each unit in the main living space.
- Upgrade feeder from main panel to subpanel to meet load for full electrification.
- Run conduit to all future locations for electric appliances and potentially run conductors.
- Remove heat lamps in bathroom to free up breaker space and reduce energy loads.

This scope provides improved space conditioning with cooling to senior residents and improved indoor air quality resulting from decommissioning of wall furnaces in this first phase. The owner can leverage existing incentives and pilot funding. The application and engagement with the utility would be initiated in Phase 1 to inform readiness scope and understand utility requirements. The second phase of work would include additional PTHPs and replacement of the water heater for the 2- and 3-bedroom units and could be executed on a longer timeline, driven by the utility. Because the preparation for the phase two work will already be completed, the change out of the appliances will be simpler and the only electrical work that will be required will include service drop upgrade and main panel change out which is all on exterior of the building.

This strategy did not align with how the owner approached retrofits, assuming that they would complete all HVAC retrofits at one time and then upgrade other appliances when possible. The team laid out three scenarios to show different combinations of measures that could be undertaken in each phase and discussed the pros and cons of each with the owner. Realizing that a partial HVAC upgrade combined with other load reduction and electrification readiness measures would allow them to improve comfort and indoor air quality for a vulnerable population now without the utility process driving their timeline was appealing.

This project is in scope development, so we are not able to include a cost comparison for work completed as proposed compared to electrification work completed piecemeal.

Preparing for Low Income Tax Credit Scope. A 100-unit garden-style, financially distressed property is applying for tax credits in a year to address capital improvements, durability, and appliances but cannot accommodate all desired retrofits. Because California has limited efficiency and/or green building requirements for tax credit projects due to regulation changes, the LIHTC projects are not driven to prioritize efficiency much less electrification.

For this property, the water heating, space conditioning, cooking and dryers are all gas appliances proposed to be replaced by ducted mini splits, 120v Heat Pump Water Heaters (HPWHs), induction stoves, and electric dryers. The service drop to each building appears to be adequate but the feeder to the apartments and lack of circuits for new appliances is the limiting factor. Therefore, full electrification would not be supported under a LIHTC re-syndication.

The electrification plan is to upgrade the feeder from the main panel to the load center and run new circuits and install receptacles for future appliances. This will position the property to be able to utilize the LIHTC funding to purchase new equipment that can be installed with relative ease. The LIHTC program is a critical funding mechanism for affordable housing but may only cover 55% to 80% of project costs. Therefore, the scope of work undertaken is very selective, particularly for a financially distressed property with no reserves. Electrifying end uses would be value-engineered out due to cost and other priorities. The LITHC application will be submitted in the spring of 2024, and the electrification readiness work will be completed in the summer of 2024, allowing the owners to plan for a full electrification scope of work without additional costs except price differential between like-for-like and electric alternative. The project is currently being bid out so we do not have any costs at this time.

Layering Refinancing and Incentives. A 45-unit property with a central domestic hot water plant and individual space conditioning was undergoing capital refinancing. The proposed scope of work for the project was comprehensive and included cabinet upgrades, carpet replacement, interior spruce up, window replacement, central heat pump water heater retrofit, new PTHP, low-flow fixtures, in-unit lighting, electric stoves, efficient dishwashers, and pool pumps. Based on equipment selection and optional method of the NEC load calculation, the 600-amp service to each building and 60-amp service to each apartment was adequate to serve the load. However, the panels, a brand that was recalled, need to be replaced, feeders upgraded, and new circuits needed to be run for the central domestic hot water and stoves.

Refinance projects are undertaken by the facilities team who have limited bandwidth for project management. Therefore a construction management firm was hired, which cut into the retrofit budget reducing the scope of work. Participating in and receiving incentives from the pilot allowed the owner to support readiness measures within the refinance scope, which covered the windows, panel upgrades, interior apartment work, circuits, and cabinets. Stove and HVAC electrification will follow, and the final phase will be the central heat pump water heater and pool pump retrofit. All phases will be completed by the same general contractor. Including the electrification readiness measures in the first phase reduced the number of times that walls would need to be opened and residents temporarily displaced from their homes.

The retrofit scope was driven by the asset management and sustainability department in the organization. To accomplish this required a change in internal processes. The facilities department undertakes work based on wear and tear and not retrofits or upgrades, which asset management undertakes. Yet without that critical change in approach, the stoves would not have been electrified because it would not have been possible or affordable to run a circuit later. Additionally, prewiring removes a barrier to the future central heat pump water heater replacement while allowing time for the contractor to get on board and educated on these systems. The incentives for readiness and technical assistance on load calculations and central heat pump water design and sizing were critical for the success of the project and building capacity within the team. Electrifying this project moved the organization closer to their goal of 50% reduction of greenhouse gas emission in ten years.

Planning upgrades over time. The final project is a property in great need of upgrades that did not receive LIHTC funding. From a financial perspective it is “cash poor”, meaning the property has limited access to expendable income and limited reserves making scopes of work like electrification impossible. They had to navigate these financial limitations when investigating improvement and electrification opportunities. Electrification could be particularly beneficial to residents because the property has existing solar, partially metered to residents.

Because of the financial limitations, the team presented a range of scopes with electrification readiness and funding options to inform decision-making. The most limited option included in-unit lighting, water fixture upgrades, and electrification readiness measures. The most comprehensive scope included insulation, windows, more extensive lighting, replacement of in-unit HVAC and water heating and upgraded electrical for apartments and common laundry.

When different options were being explored, it became apparent that a new HPWH would not fit in the current water heater closet and the venting would not be adequate to meet manufacture recommendations. As a result, if the water heaters could not be installed in this first phase, the electrification readiness scope of work was to include widening of the closet doorway and a new louvered door. This would enable easy installation of a HPWH in the future even in an emergency. The owner indicated if physical modifications were needed later, it would be highly probable the staff would conduct a like-for-like replacement. This discussion prompted the investigation as to what was required to adequately prepare a project for future electrification.

Based on recently available incentives the current proposed scope of work for the project includes efficiency measures of attic insulation, lighting, water fixtures, replacement of most of the water heating, in-unit HVAC and electrification readiness measures including in-unit and building panel upgrades and circuits for electric stoves, common area HVAC and common laundry. At one point the scope was all efficiency measures and electrification readiness with no system replacement due to lack of availability of incentives. The common area HVAC, dryers and remaining water heaters and the stoves will be replaced over time at failure or when substantial incentives may be available in the future. This work will position the property to be all electric in the future, resulting in greater benefits to residents' utility bills and giving the owner flexibility to respond to future incentives. The owners will evaluate the need to expand solar in the future to cover more of the residents’ electrical load. The owner is considering how to leverage this strategy at other properties provided there is funding for readiness scope of work.

Recommendations for Multifamily Stakeholders

The nuances and conditions for each of the projects indicate there is value in advanced planning to phase retrofits and electrification readiness measures. This small pilot provided many lessons learned and recommendations to support all-electric retrofits of multifamily properties because it is not always possible to complete a full retrofit in a single phase or timeframe. The recommendations and implications are relevant to different stakeholders involved in the multifamily retrofit process, including housing agencies, program administrators/ implementers, property owners, and contractors/engineers, and regulatory agencies. This section lays out core recommendations and notes the key aspects for critical stakeholders.

Requires Education Broadly

Because retrofits over time are a shift from a business, all stakeholders in the process need education, from those creating the constructs to those executing on projects. These stakeholders can be supported with educational resources, case studies, and strategies that should be broadly disseminated to advance the market. The specific resources should be tailored to different audiences and deployed through appropriate distributions strategies such as webinars, conferences, workshops, and proceedings. Educational needs for owners, contractors and engineers identified in the pilots ranged from technical knowledge on technologies and electrical infrastructure to strategy for phasing to identifying and accessing incentives.

Requires Planning and Processes

The success of an over-time strategy relies on upfront planning that provides assurance toward the ultimate emissions-reduction goal and documents a path forward that address existing upgrade processes and/or maintenance requests. As noted above, procurement policies also play a role in codifying practices to facilitate upgrades over time. Updating these policies to reflect electrification over-time plans also eases implementation of this approach and can help increase compliance with the plan in the event of staff turnover. Housing agencies also play a critical role in facilitating these efforts through requirements for PNAs. Building off the precedent of a GreenPNA, there can be a PNA requirement to evaluate electrification or a carbon PNA that would identify potential upgrades opportunities and constraints. This also requires expansion or shift in scopes of work that may be undertaken by different departments such as facilities undertaking readiness within their maintenance scopes.

Requires Technical Assistance

Identifying electrification constraints and problem solving for system designs and electrification readiness measures requires technical assistance beyond what is required for like-for-like replacements or larger efficiency-focused scopes of work and are more nuanced than required for a large electrification retrofit. This technical assistance is additional to standard program technical assistance which should include pre-retrofit scoping and post-retrofit verification and should be provided p front to support owners' decision making.

Contractors and engineers require technical assistance to evaluate electrical infrastructure, calculate loads, and strategize on scope. The example above on navigating utility upgrades showcases how electrical infrastructure requirements are not just an element that needs to be determined for the overall scope but are an element that can determine retrofit phasing. For each of the pilots, an electrical engineer was engaged who already understood the strategy, could provide the evaluation, and educate the project team. In addition, projects required assistance in scope development and guidance on project management for this type of phased project. Resources that can support this work include documenting processes for load calculations or applications of monitoring for load calculations. Organizations that design and administer programs also need to consider a wider range of technical assistance and build into program designs and resources support for critical thinking and planning for readiness measures.

Requires Measure Options and Flexibility

That the pilot uncovered a need for a broader definition of electrification readiness point to the need for incentives that cover a broader range of electrification readiness measures. While there is increasing support for panel upgrades, other measures that enable electrification or take place ahead of equipment being installed are rarely incentivized. Part of the difficulty with this approach is that these measures do not lead to direct, immediate savings for which program administrators can claim credit. A framework that supports electrification will need to be (a) comprehensive in defining electrification readiness, (b) flexible on the timing of savings or the metrics used to gauge success, and (c) long term to facilitate planning for longer-term retrofits. A last consideration for a long-term electrification framework is that program rules should provide clear pathways for participation over time. I.e., if a property owner accesses incentives for a subset of units, they should be able to apply for incentives for additional units at a later date.

Conclusions

Direct engagement with owners of four affordable housing properties and contractors through this TECH Clean California multifamily pilot revealed a range of approaches to undertaking electrification retrofits over time. Planning for electrification over time and implementing electrification readiness measures at additional properties with different ownership structures, existing conditions, climate considerations, and/or funding opportunities would no doubt lead to additional implementation models. Even so, the lessons from this set of affordable housing properties offers lessons to the broader market on the types of electrification readiness needs they may encounter, the potential to create and execute on a plan in a range of scenarios, and the value of deep technical assistance that charts a path to a deeply decarbonized future that navigates constraints owners may face today and creates a glide path toward full electrification and the attendant benefits of low emissions, healthier homes, and greater resident comfort.

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