Scaling Small Residential Decarbonization: A Data-Driven Analysis of Two Massachusetts Pilots

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ABSTRACT

Massachusetts has long been a national leader in home energy efficiency, with decades of investment building the robust infrastructure to deliver weatherization and efficiency improvements at scale. As the state's climate goals have accelerated, that foundation has increasingly been leveraged to support a transition from energy efficiency to whole home decarbonization.

While delivering individual energy efficiency measures is well established, supporting a household through a multi-year, multi-system decarbonization process presents a fundamentally different challenge. To examine the programmatic and technical support requirements for multi-year, whole home decarbonization processes, the Massachusetts Clean Energy Center (MassCEC) launched two pilots: Decarbonization Pathways Pilot and the Triple Decker Decarbonization Pilot, designed to test models of residential decarbonization planning and implementation across diverse contexts.

This paper presents cross-pilot findings from five deployment contexts with three themes consistently observed:

1. Comprehensive decarbonization planning improves outcomes but requires dedicated program infrastructure to sustain;

2. The existing contractor marketplace is not well aligned with whole home decarbonization; and

3. Program effectiveness depends on how well it integrates with the broader energy program ecosystem.

These findings are grounded in empirical observations from deployed projects operating in an evolving policy and program environment. While the pilots are specific to Massachusetts, the structural challenges and opportunities identified are broadly applicable to other regions pursuing residential decarbonization.

1. Introduction

Massachusetts is home to one of the most established residential energy efficiency programs in the country. Mass Save, administered by the state's electric and gas utilities, is a statewide initiative that offers residents no-cost home energy assessments, rebates on efficient appliances and heating systems, and subsidized insulation and weatherization, designed to reduce household energy consumption and associated costs. The program had spent decades building the infrastructure that makes efficiency programs work at scale and benefited from strong household participation.

However, the energy efficiency foundation of Mass Save, while effective for delivering energy savings, was not originally designed to support coordinated, multi-year decarbonization pathways across multiple building systems. Full electrification of a home involves decisions that may span multiple years and affect multiple systems. These include appliances, heating equipment, and electrical systems and require coordination that extends beyond the scope of any single program as currently structured. When the Decarbonization Pathways Pilot launched, Massachusetts had set climate targets that would require deeper building decarbonization than existing efficiency programs were designed to deliver. These pilots were designed to start building the evidence base for the requirements for achieving this transition. This paper analyzes five deployment contexts: three cohorts within the Decarbonization Pathways Pilot and two pathways within the Triple Decker Decarbonization Pilot.

The Massachusetts Clean Energy Center (MassCEC) worked with Abode Energy Management (Abode) to develop two programs to test the practical requirements for decarbonizing of 1–4-unit residential buildings. The Decarbonization Pathways Pilot tested a “zero-over-time" approach, a process that develops a long-term plan for eliminating fossil fuel use, implemented through sequenced upgrades over multiple years. The pilot focused on single-family households across three cohorts, starting with personalized, high-touch advising and evolving toward integration with Mass Save's standard delivery infrastructure. The Triple Decker Decarbonization Pilot applied a whole-building lens to Greater Boston's most common multifamily housing type across both market-rate and affordable ownership structures.

MassCEC structured both programs to address the broader program ecosystem throughout. Mass Save program administrators participated in the program’s review committee, providing feedback that informed the pilot as it evolved. Pilot learnings in turn informed concrete changes to Mass Save. Abode trained Mass Save advisors statewide on the pilot’s decarbonization approaches, Mass Save’s Home Energy Assessment was expanded to incorporate pilot-developed data collection, and the Mass Save report was updated to more explicitly surface decarbonization opportunities and planning. At present, the program landscape looks meaningfully different than it had at the start.

Together, these two programs generated five distinct deployment contexts, varying in housing stock, income mix, program structure, and incentive design, each designed to test a distinct implementation hypothesis about how to move households towards decarbonization. A central design consideration across the pilots was the tradeoff between depth of support and scalability. The iterations which provide time-intensive, high-touch support, sustained engagement, and multi-program coordination guide households through comprehensive decarbonization have limitations to scale. Lower-support program models can scale more easily but typically achieve less decarbonization delivery per household. This trade-off reflects the structural constraints of time and cost associated with individualized planning and coordination. Each of the five contexts navigated this trade-off consciously and tested different approaches.

2. Pilot Program Summaries

2.1 Decarbonization Pathways Pilot

Starting Point and Program Goals

The Decarbonization Pathways Pilot launched in 2021 and was designed with three explicit goals: develop and test a scalable holistic approach to decarbonization that could realistically be adopted by scaled programs, such as Mass Save; build evidence-based protocols, best practices, and support requirements; and generate practical guidance for future programs, homeowners, and contractors. This pilot was designed as an evidence-generation effort rather than solely a delivery program.

Scope and Approach

The zero-over-time framework organized the scope of work. Each home received a whole-home assessment, a prioritized decarbonization plan spanning 8–12 measures, and structured support through the early phases of implementation. Measures were organized into phases by priority, budget, and timing, recognizing that households would not complete all measures concurrently, and that the sequencing of what happened when mattered.

The incentive structure was income-tiered, ranging from $10,000 to $30,000 per household, stacked with Mass Save and other available incentives.

Participant Journey

For Cohorts 1 and 2, the participant journey moved from in-home assessment to tailored decarbonization plan to decision-time services (DTS) at key decision points during project implementation. DTS included general education and support, quote and design review, and multi-program coordination. A final quality assurance and education visit after the first year completed the program model.

Cohort 3 tested a fundamentally different approach. Mass Save advisors took on the full in-home role, completing a structured data collection form at the end of their standard assessment and encouraging participants to schedule a follow-up consultation with Abode. Participants who opted in received a light initial report and could access variable levels of DTS based on participant needs. No pilot-specific incentives were offered as the model was intentionally framed as a testing ground for how decarbonization support could be embedded in Mass Save's standard delivery infrastructure rather than run as a standalone pilot.

	Scale	Population Served	Support Model	Incentive Structure	Primary Question
Cohort 1	29 enrolled 26 completions	Single-family homeowners, competitive application	Deep in-home assessment + unlimited DTS	$10k–$30k income-tiered + Mass Save	What does high-touch holistic decarbonization support require?
Cohort 2	41 enrolled 22 completions (ongoing)	Single-family homeowners, lighter screening	Focused assessment + DTS + post-assessment planning	$10k–$30k income-tiered, refined milestones + Mass Save	How can the program refine approach, incentives, and scalability?
Cohort 3	653 assessed Mass Save pipeline	Mass Save pipeline homeowners, no screening	Mass Save assessment + optional Abode follow-up	No pilot incentives, standard Mass Save + tax credits	Which elements remained effective when embedded in Mass Save's standard delivery?

Results

Cohort 1 is complete.

Key Metrics, Cohort 1:

Top 3 Measures Installed	Upfront Cost	Average Incentives
Heat Pumps: 25 Heat Pump Water Heater: 15 Mass Save Weatherization: 14	Minimum: $26,974 Maximum: $178,796.14 Average: $62,669.16	Mass Save: $16,913.81 MassCEC: $17,156.37 State: $1,083.33

Participant Averages, Cohort 1:

Average # Of Recommendations Per Participant	Average # of Measures Installed Per Participant	Average Net Cost Post Incentives
14	7	$22,148.64

Cohort 2 is ongoing, with 24 of 41 enrolled households completed at time of writing. Project scope and cost data are available for completed households; outcome and operating cost data will be reported as the cohort finalizes.

The following data reflects 35 projects that are either complete or nearly complete, save for the final site visit.

Key Metrics, Cohort 2:

Top 3 Measures Installed	Upfront Cost	Average Incentives
Heat Pumps: 28 Water Heater: 19 Mass Save Weatherization: 17	Minimum: $1,232 Maximum: $129,513 Average: $51,317	Mass Save: $16,364 MassCEC: $16,582 Tax Credits: $4,117

Participant Averages, Cohort 2:

Average # Of Recommendations Per Participant	Average # of Measures Installed Per Participant	Average Net Cost Post Incentives
13	5	$13,768

Cohort 3 participant engagement data is available, including interest, opportunity, referral, and follow-up dates for decarbonization planning support. Project outcome and cost data are not available for this cohort, as participants navigated measures independently through existing programs. Reporting on what participants did after receiving their plans will require follow-up data collection beyond the pilot period.

2.2 Triple Decker Decarbonization Pilot

Starting Point and Scope

Triple-deckers are one of the most common residential building types in Greater Boston. The three-unit, wood-frame buildings are found across the region in a wide range of neighborhoods, income levels, and ownership structures. Their prevalence and age make them a high-priority target for developing replicable decarbonization approaches that could scale across the region, but their ownership configurations don't map cleanly onto either single-family or large multifamily program models.

The pilot enrolled buildings across a range of ownership configurations, including owner-occupied with renters, absentee landlords, individual condo owners, and multi-owner buildings, as well as affordable buildings owned by housing authorities. The market-rate and affordable pathways operated as meaningfully different engagement models and are treated separately below.

Market-Rate Pathway

Nine buildings were enrolled with a range of ownership configurations. Abode provided full technical support from the initial assessment through post-installation follow-up, with MassCEC providing incentives up to $70,000 per building braided with Mass Save and other available programs. The program required whole-building electrification and a complete

envelope strategy, addressing all pathways for heat loss and air leakage at whatever depth was practical for each building rather than a predetermined level of retrofit.

Seven buildings reached full completion at time of writing, averaging 16.6 measures per building, with contracted costs averaging $130,935 and net cost to owners averaging $30,752.27 after incentives.

	Scale	*Population Served*	*Support Model*	*Incentive Structure*	*Primary Question*
Triple Decker Market-Rate	*9 buildings 5 full completions*	*3-unit triple-decker owners, market-rate*	*Full technical advising through post-install*	*Up to $70k per building + Mass Save*	*What does deep retrofit look like for a common but complex housing type?*
Triple Decker Affordable	*~9 buildings Completions ongoing*	*3-unit triple-decker, housing authority / affordable*	*Technical advising to housing authority staff + contractors*	*MassCEC gap-fill + Mass Save LI + Climate Ready Housing + owner capital*	*How does the model change with institutional ownership and braided funding?*

Results for 7 Completed Market Rate Triple Decker Projects

Key Metrics:

Top 3 Measure Categories Installed	Upfront Cost	Average Incentives
Heat Pumps: 21 Water Heater: 21 Mass Save Weatherization: 9	Minimum: $116,040.35 Maximum: $157,348.24 Average: $130,935.14	Mass Save: $29,418.92 MassCEC: $65,238.00 Tax Credits: $5,417.38

Building Averages:

Average # Of Recommendations Per Building	Average # of Measures Installed Per Participant	Average Net Cost Post Incentives
28	17	$30,752.27

Buildings with multiple owners introduced a governance challenge that single-family programs have a more limited framework for. Getting owners with different budgets, timelines, and risk tolerances to act collectively on a shared building requires a different kind of support than technical advising alone. In several cases one owner's resistance blocked building-wide

progress entirely. Programs targeting multi-owner properties need a strategy for collective decision-making, not just technical support.

Post-installation operating cost data is not yet available for most buildings; reporting on energy performance outcomes will follow in subsequent work.

Affordable Pathway

The affordable pathway enrolled approximately nine buildings owned by housing authorities. This was a fundamentally different engagement model than the market-rate pathway, as Abode worked not with individual occupants but with housing authority staff and the Mass Save low-income program's implementing contractors. The Mass Save low-income program provides no-cost energy efficiency upgrades to income-qualified households, including insulation, heating system replacements, and weatherization, with fully covered costs rather than rebated. Abode provided ongoing technical advising throughout the project rather than direct participant support.

The affordable pathway had the most complexity with braiding multiple incentives and funding sources to complete projects. Most projects worked with the Mass Save low-income program and housing authority capital budgets, with additional sources such as the Climate Ready Housing Program accessed in some cases. MassCEC incentives were used to fill the remaining funding gaps from those programs.

The implementing contractor, appointed by the Mass Save low-income program, effectively functioned as the general contractor across most buildings, managing subcontractors and coordinating scopes across programs. Identifying contractors willing and able to take on that integrating role is a key program design consideration. For LMI tenants moving from delivered fuels to heat pumps, increasing energy burden is a real risk. The solution was to start with a package of measures more likely to result in savings, then use energy modeling to confirm net operating cost savings before proceeding. This approach is replicable in any program serving low- and moderate-income renters.

Post-installation operating cost data is not yet available for most buildings; reporting on energy performance outcomes will follow in subsequent work.

3. Cross-Pilot Findings

Across all pilot projects, three themes were consistently observed, though they varied in form and intensity. These themes are highlighted as overarching findings since they reflect core aspects of decarbonizing small residential buildings at present, rather being specific to any single program. These findings are the observations of the pilots' administrators.

3.1 Comprehensive Decarbonization Planning Delivers Better Outcomes and Requires Deliberate Infrastructure to Sustain

The case for holistic decarbonization planning is supported by several interrelated observations. Together they explain why comprehensive decarbonization planning requires a fundamentally different program architecture than the traditional weatherization programs. The following observations explain why comprehensive decarbonization planning requires a distinct program structure.

Observation 1 - Decarbonization is interdependent, and prior actions can constrain a holistic decarbonization plan.

The interdependence is evident in typical decarbonization sequences. In some cases, early decisions constrain subsequent decisions. The level of air sealing and insulation affects what size heat pump the building needs. How the heat pump is sized, combined with other electrification goals, determines whether the electrical panel and service need upgrading. The total load from all electrified systems affects the size of the solar array that can offset it.

In other cases, early decisions may constrain future options that are more costly to correct than to continue. Many pilot participants had already taken some decarbonization action before enrolling. It was frequently observed that prior decisions were a challenging fit with the recommended path forward, and correction was rarely cost-effective. Households that had installed a partial heat pump system often could not simply add to the current design. Contractors designing for partial-home situations tend to oversize equipment to serve as much of the home as possible, resulting in equipment that is not optimally sized for the conditioned space. Solar PV is also a common lock-in example. Homeowners who had installed solar prior to the pilot frequently had either insufficient capacity relative to what a more comprehensive decarbonization plan would recommend, or they had lease and PPA terms that made the economics of an electrified home with solar considerably less favorable.

Observation 2 - Comprehensive decarbonization requires a level of home-specific analytical judgment that weatherization programs do not.

Weatherization programs are built around measures that apply broadly across housing stock. There are real building science considerations involved, and designs are adjusted to fit specific conditions, but the core task is fitting the same prescriptive measures to different homes. Comprehensive decarbonization requires a different level of depth. The right approach to space heating, water heating, and electrification depends on a home's layout, existing equipment, insulation levels, electrical capacity, and household goals. That level of depth and interaction among factors results in a much more diverse set of recommendations and outcomes.

Observation 3 - Advisor judgment alone does not ensure consistent outcomes across a program.

These pilots indicate that holistic thinking at this level of complexity cannot rely solely on advisor expertise. Individual advisors vary, and judgment is not consistent across staff or over time. The right plan for a given household depends on how many factors combine in a specific situation, and advisors may not consistently weigh those factors the same way. Programs that produce better outcomes build the decision points and dependencies into the process itself, through tools, templates, and structured assessments, so that judgment is more consistent.

Observation 4 - Because fuel switching introduces cost dynamics that weatherization did not, comprehensive decarbonization planning must include operating cost analysis across the full project scope.

Ensuring participants understand operating cost implications requires engaging with the full project scope before any single program begins. When the advising relationship started before other program participation, there was an opportunity to evaluate how changes across weatherization, heating, and electrification would interact and affect overall operating costs. It is

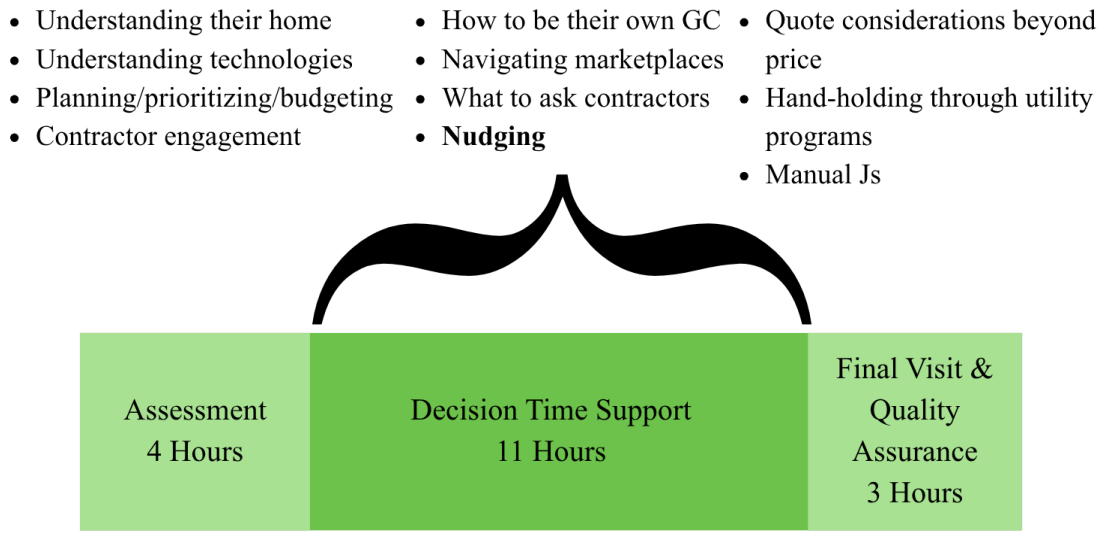
necessary for households to understand not only the potential benefits but also the tradeoffs associated with different sequencing and combinations of measures, including cases in which energy use declines but operating costs increase depending on fuel type and rate structures. While Mass Save and the low-income programs have their own operating cost protections, the pilots added broad planning visibility across the full scope. Households ultimately make decarbonization decisions for a range of reasons — comfort, equipment age, environmental values, and health among them. Holistic planning ensures those decisions are made with full information, whatever the primary motivation.

These observations informed how the pilots approached planning in practice. Effective comprehensive planning required translating these dynamics into something a household could act on.

The development of actionable decarbonization plans was critical for participants to move forward. The central challenge shared by each of the pilots was bridging the gap between identifying required measures and implementing them. *An actionable plan answers three questions:*

- ***What to install and why*** *— specific enough that a participant can have an informed conversation with a contractor.*
- ***When*** *— in what order to engage programs, trades, and projects so that each step sets up the next correctly.*
- ***How to execute*** *— what to communicate to each trade, what a well-specified proposal includes, and how to evaluate whether the work aligns with the overall plan.* For the Triple Decker affordable pathway, it meant translating a whole-building vision into a workable scope across braided funding sources, a task requiring sustained coordination between the program, the building owner's representatives, and the implementing contractors.

Programs typically underinvest in support at critical decision points. The first significant decision points arise when participants must determine which measures to prioritize, identify qualified contractors, and enter those conversations with sufficient context to communicate their goals and understand what is being proposed. Reviewing quotes is equally critical. Decarbonization scopes are complex, and many participants require support to evaluate whether a proposed design and equipment are a good fit for their specific plan. Many of the decisions made at these points in the process are ones the participant cannot easily revisit later. These pilots provided this critical decision-time support, designed as a customer resource, not as a replacement for contractor expertise but as a support layer for a process that requires more coordination and technical judgment than typical home improvement projects.



The relative importance of a static plan versus ongoing advisor access was dependent on participant preference, with some participants preferring written guidance they could reference independently and others relying heavily on direct advisor contact. From a program design perspective, however, the more consequential finding was about scalability. Plans and tools designed to address execution guidance — next steps, sequencing, and how to navigate the contractor process — reduced the volume of repetitive advisor conversations, lowering per-participant costs and allowing advisor time to be concentrated on decisions that were genuinely home-specific or required real-time judgment. Programs operating under resource constraints benefit from designing toward that division deliberately.

In the Triple Decker affordable pathway, support looked different, providing ongoing technical advising to the implementing contractors and housing authority staff rather than to individual occupants, but served the same function.

Across each of the pilots, the underlying support model remained consistent. Establish a comprehensive plan, embed as much execution guidance as possible into scalable tools and documentation, and reserve direct advisor time for decisions that are home-specific or require real-time judgment. The guidance provided was similar across all pilots, but it was tailored to different decision makers and priorities. In owner-occupied settings, that support was directed at the homeowner; in the Triple Decker affordable pathway, at the housing authority staff and implementing contractors who held decision-making authority.

3.2 The Contractor Marketplace Is Not Oriented Toward Decarbonization. Programs Have to Build the Systems to Compensate.

For most homeowners that engage contractors independently for energy efficiency and electrification improvements, the marketplace delivers functional outcomes. The primary challenge arises at the whole-home scale, where coordination across multiple systems and trades becomes necessary. Contractors operate within their own trade's scope, optimizing for their own project rather than the homeowner's broader decarbonization goals. Equipment gets sized to a contractor's risk tolerance rather than the home's actual load. Sequencing and coordination across

trades falls to no one, and contractor recommendations do not always align with available incentives, leaving value unclaimed. Most homeowners will not recognize these gaps until long after the work is complete.

The existing economic structure of the contractor market does not incentivize whole home decarbonization approaches. A whole home decarbonization project touches nearly every system and assembly in a building, but each individual trade does a relatively modest piece of the work. This represents a relatively unattractive project profile from a contractor's perspective. Specialized contractors have narrowed their scope over time because it made business sense, with fewer trades, more repeatable work, and better margins. Decarbonization requires the opposite orientation, and without changes to program design or market incentives, there is little economic pressure on contractors to broaden their scope. **The multi-service contractor is a partial solution rather than a comprehensive one.** The closest market-driven response these pilots encountered was the multi-service contractor, bringing multiple trades such as heat pumps, electrical, and solar under one roof. The distinction that matters, however, is not contractor type but orientation. A multi-service contractor tends to fit the home's needs into the trades they offer. A decarbonization general contractor (GC), in its most effective form, starts with the home's needs and draws from whatever combination of trades and solutions those needs require, approaching the full building as an integrated system. Programs that rely on multi-service contractors without recognizing this distinction risk whole-home planning gaps that those contractors are not structured to address. The pilots found that general contractors with this orientation produced better whole-home outcomes, though that model was rare in the market. **Quality gaps were consistently observed, and approved networks are not enough.** Enrollment in a program network establishes minimum qualifications but does not ensure quality at the individual job level. These pilots found that meaningful quality assurance required structured review at two distinct points in each project. Pre-installation design and quote reviews addressed decisions that are difficult or costly to reverse once equipment is selected and work begins. Post-installation site visits identified problems with completed work that would otherwise go undetected. An approved contractor list at the front-end addresses neither.

A secondary benefit of sustained contractor engagement was incremental behavior change over time. Contractors are responsive to program incentive structures, and access to additional funding and leads gives them a practical reason to align their designs with program guidance. Repeated working relationships can also build better practices that carry into work outside the program. The Triple Decker affordable pathway illustrated this shift: the implementing contractor began the pilot defaulting to ductless mini-split heads throughout, and by the end had delivered at least three buildings with ducted systems and purpose-built soffits.

3.3 Decarbonization Programs Operate Within a Broader Program Ecosystem. Understanding That Fit Is Essential.

These pilots operated within a broader program ecosystem. They ran alongside a well-established collection of residential energy programs, utility programs, low-income weatherization programs, and state and federal tax incentives that collectively represent one of the most developed residential energy support ecosystems in the country, built over decades of investment in Massachusetts. Understanding how a new pilot fits into that ecosystem was essential to designing a program that added value, rather than duplicating or creating gaps.

The established programs in this ecosystem are well-designed for their purpose. The challenge these pilots encountered was that a holistic decarbonization plan sometimes calls for measures, sequences, or scopes that no single program was designed to fund.

Eligibility misalignment was a recurring challenge. A decarbonization plan might call for an unvented roof assembly that does not fit a standard program's eligible measure list, a panel upgrade sized for a future EV rather than current electrical loads, or a particular sequencing of measures that optimizes for the participant's long-term plan rather than the current program cycle. The decarbonization plan is reasonable from a whole home perspective but creates misalignment with programs designed around a different set of priorities. Pilots need to map these mismatches before finalizing their own scope, and be designed to fill the gaps, not to fight the programs.

Barrier removal represents a critical component of program design. In Massachusetts, mainstream programs provide funding for many common barriers to energy work, including knob and tube wiring, asbestos abatement, mold remediation, and vermiculite removal, though more complex cases can require additional participant funding beyond what program budgets cover. A second category of barriers sits in an intermediate category between remediation and general home maintenance. Unlike conditions that present direct health or safety risks, these are conditions that can interact with or affect the durability of energy improvements. In some cases, such as basement moisture in older foundations, envelope tightening measures can increase relative humidity levels, potentially leading to moisture and mold risk in other parts of the home. Low-cost interventions such as gutter repairs and sump pumps often addressed the most significant sources of moisture infiltration before envelope work proceeded. In others, such as deteriorated soffits, fascia, or siding with active water penetration, proceeding with insulation or air sealing before repairs are made undermines the durability and effectiveness of the energy work itself. Both dynamics fall outside standard program eligibility due to their variability and cost, and both require flexible program funding and case-by-case judgment to navigate. These pilots used flexible funding to address both categories, focusing on the lowest-cost interventions that would allow the broader project to move forward. Designing a pilot with flexibility to address varying barriers is both more efficient and more impactful than duplicating what mainstream programs already handle. **Braiding multiple incentive and funding sources** was required in these pilots. Coordinating across programs increased the depth of measures taken and stretched participant budgets further than any single program could have achieved which introduced significant administrative complexity. Each program structures their eligible measures differently, and aligning those structures for a single project required careful navigation. A separate but related challenge was cash flow. Most programs reimburse after project completion, requiring participants to float significant upfront costs; a manageable burden for higher-income households but a real barrier for others. The pilots addressed this through advance payments at contracting and early milestone payments, but the underlying tension between program reimbursement structures and participant cash flow is a design challenge that scaled programs will need to solve more systematically. Programs need to budget for complexity, build the coordination capacity into the program design, and prepare for more time and staff capacity than anticipated to be utilized.

The implications for program designers vary significantly depending on program context. Established programs seeking to incorporate more comprehensive decarbonization elements should assess where participants disengage, whether eligibility misalignments are constraining

completion rates, and whether complementary programs exist that could extend participant outcomes without duplicating existing effort. New programs and pilots face a distinct set of questions: what gaps exist within the broader ecosystem that no established program is positioned to address and how can program architecture be designed around those gaps while leveraging the incentives and resources that already exist. Pilots also serve an evidence-generation function, by demonstrating what is achievable, informing the evolution of established programs over time, and providing the basis for advocating toward more flexible, holistic program approaches. In both cases, the foundational step is the same: map the ecosystem before finalizing program scope, recognizing that its depth and composition will vary considerably by state and region.

4. Conclusion

The Cross-Pilot Findings surfaced structural features needed to decarbonize this type of housing stock today. They appeared in different forms across every pilot context.

Holistic planning from the outset is essential. Decarbonization decisions are deeply interdependent; sequencing of measures matters, and a typical plan spans many years. The tools, templates, and processes a program builds should carry that thinking, embedding the decision points, sequencing logic, and operating cost analysis into the process itself rather than leaving those judgments to individual advisors or participants. **Build quality systems around the contractor marketplace in its current form**. The structural economics of whole home decarbonization don't reward contractors for thinking beyond their trade. Multi-service contractors are the closest market-native response, but are a compromise, not a complete solution. Qualified networks and training help, but both rely on knowledge transfer rather than guarantees of what a specific technician delivers on a specific job. Pre-installation design and quote reviews catch decisions that are costly or difficult to reverse once work begins, while post-installation site visits identify execution problems that would otherwise go undetected. The depth and formality of both can be calibrated to program budget and capacity, but some version of each, applied consistently, adds meaningful quality assurance beyond what a contractor network alone provides. **Map the program ecosystem before finalizing program scope.** The relevant questions differ depending on whether a program is being newly designed or an existing program is evolving toward more comprehensive decarbonization. Established programs should assess where eligibility misalignments or barriers are limiting completions, while new programs should identify gaps that existing programs are not positioned to fill and design around those gaps while leveraging available incentives and funding. In both cases, understanding the ecosystem before designing around it is foundational.

Across all programs, the post-assessment work is where outcomes are most strongly determined. These pilots invested heavily in supporting households through planning, contractor engagement, and the decisions that cannot easily be revisited. That sustained support was a defining feature of every pilot and a consistent factor in participant follow-through. Massachusetts is not a typical starting point. Mass Save is among the strongest state efficiency programs in the country, and the state was actively evolving toward decarbonization during the period these pilots ran. The influence of these pilots, however, was concrete. Subsequently, Abode trained Mass Save advisors statewide on decarbonization, the Home Energy Assessment was expanded to incorporate decarbonization measures and data collection developed through the pilot, and the Mass Save report was updated to more explicitly surface decarbonization

opportunities. The program landscape that exists now is materially different prior to the Decarbonization Pathways Pilot launching in 2022, and Mass Save continues to move in the direction of decarbonization.

The dynamics these pilots surfaced are not unique to Massachusetts. Every state faces the same contractor marketplace transition, the same challenge of sustaining households through a multi-year process, and the same question of how to deliver holistic support within real program constraints. What Massachusetts now has, after these two pilots and several years of working through these problems, is an evidence base with structural findings that are relevant to any market.

AI Disclosure

This paper was developed with assistance from Claude (Anthropic). The AI was used to support outline development, iterative drafting and refine language through an extended editing process. All content was derived from source materials internally generated through the design and management of these programs, including program reports, lessons learned documents, presentations, and cohort data. All content was reviewed, directed, and edited by the authors, who are responsible for the accuracy of program descriptions, findings, and conclusions.