RMI

A Marketplace for Equitable Building Retrofits

How Lessons from Massachusetts Can Help Scale Decarbonization to Meet Climate Goals

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About RMI

RMI is an independent nonprofit, founded in 1982 as Rocky Mountain Institute, that transforms global energy systems through market-driven solutions to align with a 1.5°C future and secure a clean, prosperous, zero-carbon future for all. We work in the world's most critical geographies and engage businesses, policymakers, communities, and NGOs to identify and scale energy system interventions that will cut climate pollution at least 50 percent by 2030. RMI has offices in Basalt and Boulder, Colorado; New York City; Oakland, California; Washington, D.C.; Abuja, Nigeria; and Beijing.

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Executive Summary

Decarbonizing existing buildings is challenging. We need to make it simpler, more affordable, and commonplace to achieve climate goals.

The majority of US buildings that will exist in 2050 are already standing. This means that decarbonizing inefficient existing buildings that run on fossil fuels is fundamental to meeting local and global climate goals. Yet the typical retrofitting process depends heavily on owners and is fraught with uncertainty. Conflicting guidance, high costs, fragmented financing, and administrative burdens are all significant hurdles that both owners and service providers face. These challenges posed by current practices, processes, and methods impede the widespread adoption of retrofitting strategies aimed at enhancing building performance and reducing carbon pollution.

A thriving market for building decarbonization can facilitate easier and more affordable pathways for stakeholders.

In recent years, RMI has undertaken strategic efforts to accelerate deep energy retrofits for the affordable housing market segment across Massachusetts in order to eliminate on-site fossil fuels, maximize energy efficiencies, significantly reduce carbon emissions, and enhance thermal comfort and indoor air quality for low- and middle-income residents. The ongoing initiative is designed to catalyze the growth of a viable regional market for building decarbonization, paving the way for others to follow and to scale the effort nationally. By developing, refining, and sharing industry best practices, processes, and strategies, we hope to enable other regions to apply and adapt them to those geographies as well as other building typologies and market segments.

This report outlines our progress to date and synthesizes experiences from various building decarbonization "lighthouse projects." These projects serve as exemplary models, demonstrating innovative strategies and technologies that significantly reduce carbon emissions. The first part of this report details notable observations that enable or inhibit decarbonization projects. **Key enabling components** such as energy efficiency improvements, extensive stakeholder engagement, and advanced building materials are described, and **common challenges** are identified, including difficulties with decarbonization assessments, financial barriers, and administrative burdens.

The second part distills lessons learned into suggested **crucial paradigm shifts** to support a broad and durable change in the market, such as adopting holistic building design approaches and integrating standardized frameworks. As a result of direct project engagements, RMI has devised **foundational and strategic actions** to create a landscape conducive to building retrofits that benefit low-income households.

Key Takeaways

These insights are designed to address decarbonization challenges across diverse geographies and market segments, promoting industry growth, an equitable process, and rapid adoption at a scale that aligns with climate targets.

Notable Observations of the Current Market

- Extensive alignment across stakeholders invested in achieving climate goals fosters more momentum in developing and supporting a pipeline of projects.
- Transparent knowledge sharing and exchange of project data can better inform incentive program design and raise the level of regional technical proficiency.
- Complex processes, administrative burdens, technical challenges, insufficient market capacity, economic barriers, and delayed identification of decarbonization work leads to inefficiencies and missed opportunities that hinder the rapid scale of decarbonization initiatives.

Paradigm Shifts Proposed

- Stakeholders could shift from viewing buildings as a collection of isolated components to evaluating buildings as comprehensive systems in order to leverage efficiencies with envelope-first and integrated project delivery approaches.
- Stakeholders could shift from conducting assessments on a building-by-building basis to developing standardized assessments and calculation tools that enable expedited decarbonization feasibility analysis and encourage scalable solutions.
- Stakeholders could shift from focusing on the incremental cost difference between a decarbonization retrofit and a business-as-usual renovation to capturing the full value of the retrofit that comprises all expected direct and indirect benefits over the life of the building.

Foundational and Strategic Actions Suggested

- Build market capacity with innovation and R&D to bolster more efficient, cost-effective solutions and methods. Foster collaboration within the industry to drive technological advancements and best practices in building decarbonization.
- Cultivate an ecosystem of collaborating stakeholders to align supportive building decarbonization policy and financing. Integrate decarbonization into existing roles and agencies to support a more favorable landscape with lower economic barriers and better access to grants, subsidies, and financing.
- Streamline the decarbonization retrofit process to engage property owners and key stakeholders early in the process, enhance adoption across various project types, and distribute benefits equitably.

This research underscores the critical need for a viable market and a streamlined process to make building decarbonization more accessible and cost-effective. By integrating key components, addressing the identified challenges, encouraging necessary paradigm shifts, and implementing strategic actions, stakeholders can stimulate a thriving market for building decarbonization and drive significant progress toward a low-carbon future.

A Marketplace for Building Decarbonization

Introduction

Existing buildings are a significant contributor to global greenhouse gas (GHG) emissions.[i] As carbon emissions accumulate in the atmosphere, their impact on global warming intensifies. This means that emissions released today will have at least three times greater impact than future emissions in causing the planet to overheat by 2050.[1] Reducing current carbon emissions promptly is therefore imperative, given their heavier weight compared with future polluting emissions.

There is an urgency to develop a robust market for building decarbonization in order to meet climate targets.

Dramatically reducing this climate pollution requires retrofitting existing buildings to improve energy efficiency and integrate zero-emissions and renewable energy sources. A recently published report indicates that approximately 92% of the national residential building stock would require a retrofit in order to align with climate targets.[2] This **resource** provides market guidance on scaling decarbonization retrofits of existing residential buildings in the United States and interactive, data-driven dashboards and tools. This will not only require full electrification of all systems and appliances but may also include varying levels of improvements to the building envelope. (See ***What is a decarbonization retrofit?***)

Decarbonizing the nation's current residential building stock will necessitate a dramatic increase in the current standard efficiency retrofit rate.[3] Present-day industry practices may not reflect the technical expertise needed, and local markets may not yet have the capacity to deliver on this endeavor. In fact, research has found that the current market delivery capacity is declining and is not able to sustain a steady state for baseline building needs, especially in the face of any deferred maintenance.[4] This warrants a clear shift in stakeholder behavior and industry practices. Efforts to induce and support this shift should be focused on scalable solutions, favorable policies, and programmatic systems.

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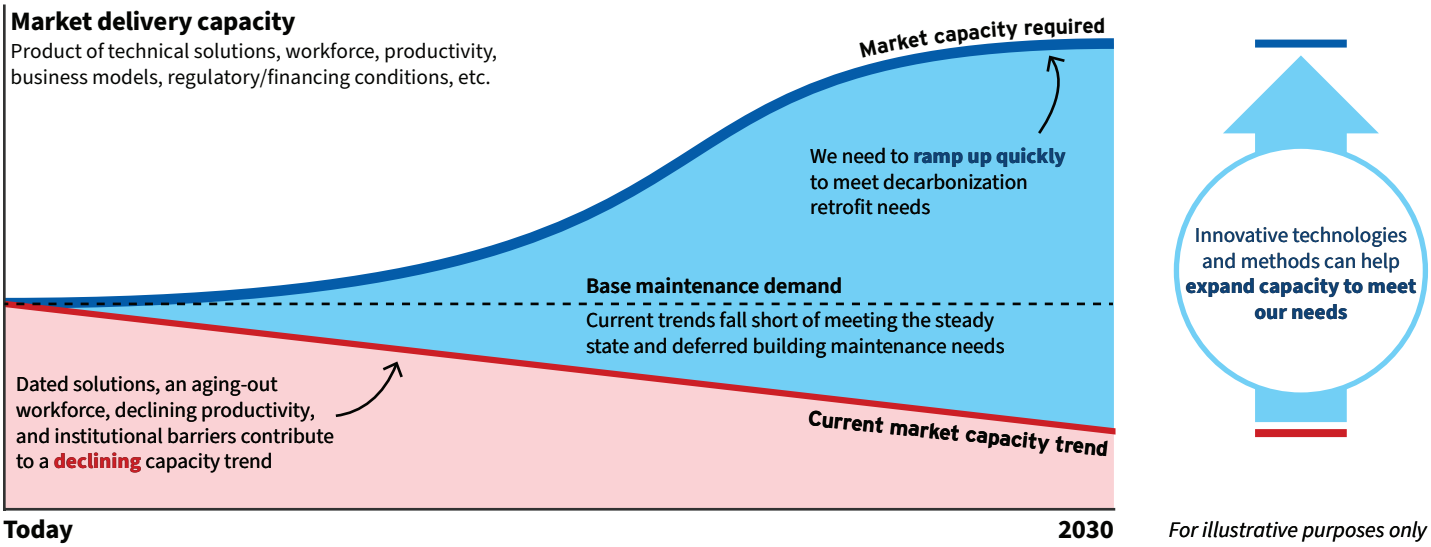
i Nationally, building operations contribute to 23% of annual US GHG emissions (see **https://rmi.org/insight/financing-building-decarbonization-leveraging-a-sector-wide-carbon-model-to-prioritize-capital-flows/**), with urban areas representing a large portion due to denser development. In cities such as Boston, Massachusetts, buildings alone account for 68% of emissions (see **https://www.boston.gov/departments/environment/bostons-carbon-emissions**), compared with 35% of statewide emissions (see **https://www.mass.gov/info-details/massachusetts-clean-energy-and-climate-metrics**).

Developing a viable market for building decarbonization can reduce costs and accelerate the pace of energy retrofits, thus increasing the value of the national residential building stock while driving down emissions. A thriving market encourages innovation, competition, and efficiency, while also signaling demand and spurring further R&D. As the market matures and industry proficiency grows, implementation costs will decrease, making retrofits more accessible and commonplace. To foster a supportive environment for building decarbonization, key stakeholders must collaborate as they enhance programs, policies, and technical and financing solutions. Additionally, a compelling business and social case for decarbonization that emphasizes the value of non-energy benefits can be helpful in increasing adoption to make retrofits more mainstream.[5] Establishing systems and frameworks that effectively shift the market is especially critical now, as the window to hit climate targets gets smaller, and incentives and funding opportunities become available.

What is required to foster a thriving market and what are tangible steps that key stakeholders can take to support it? A vital first step is to reimagine how buildings are constructed, renovated, operated, managed, and financed to prioritize energy efficiency and decarbonization. Subsequently, the systems and the processes in place within the ecosystem must be streamlined and made equitable to accomplish this progression. And finally, innovative technologies and processes can then bridge the gap in project delivery with advanced and replicable approaches to retrofit buildings better, faster, and at a lower cost. Exhibit 1 illustrates how advances in solutions and practice, such as showcasing the feasibility of innovative construction methods, material supply chains, and supportive workforce development could address capacity constraints in the buildings sector.

This report offers strategies for propelling market-driven initiatives and aligning stakeholders on building decarbonization goals. The following sections provide an overview of RMI's insights gained from cultivating a viable market for building decarbonization in Massachusetts. It begins with an overview of RMI's experience in fostering a marketplace for building decarbonization of affordable multifamily housing (AMFH). Through close collaboration with key stakeholders and tactical efforts to shepherd deep energy retrofit projects

Exhibit 1 Innovative technologies and methods can help achieve necessary growth in market capacity



RMI Graphic

through feasibility and construction, RMI has identified prevailing challenges and the key shifts necessary for integrating decarbonization into industry best practices. These outlooks can also begin to formulate decarbonization programming. The report concludes by spotlighting strategic actions vital for achieving and further supporting the development of a robust market to scale building decarbonization.

Cultivating an ecosystem of stakeholders, processes, programs, and policies to advance from conventional practices is central to a sustained market shift.

The identification of these challenges and strategies emerged from specific experiences supporting deep energy retrofits in the Massachusetts market. However, similar insights from a series of decarbonizing affordable housing convenings hosted by RMI across various geographies suggest a broader relevance.[6] Engagements like these in the AMFH sector have been useful in validating the similarity of common challenges addressed in this report. Technical solutions may differ across building typologies and climate zones, yet the observations, lessons learned, and actionable steps are very applicable to other market sectors and regions. Cultivating a decarbonization marketplace can benefit various building types and ownership structures by streamlining processes, equitably providing accessible resources, and enhancing cost-effective retrofit approaches.

What is a decarbonization retrofit?

This report refers to building retrofit efforts that achieve operating performance levels that align with US climate targets — decarbonizing US building stock before 2050. In this context, a decarbonization retrofit eliminates on-site fossil fuel use, operates with low power and thermal loads, obtains all energy from a carbon-neutral grid or local carbon-neutral resources (currently or before 2050 under a planned scenario), and reduces impact on the grid through demand reduction and grid interactivity.[ii]

Some buildings can reach this goal mainly with electrification of all building equipment and appliances; however, many more will require varying levels of energy efficiency measures and improvements to the building envelope to reduce energy loads and impacts on local grid infrastructure. **Deep energy retrofits (DERs)** represent the most comprehensive level of decarbonization retrofits capable of reducing energy use, associated operating emissions, and utility burdens. DERs are more than standard weatherization; they prioritize enhancing the thermal capacity and airtightness of the building envelope as the initial approach to decarbonization, preceding system electrification. Depending on existing conditions, envelope improvements may include added exterior insulation, cladding, roofing, or new windows. Combined with high-performance all-electric mechanical systems and appliances, these projects significantly reduce building site energy use intensity (EUI)[iii] and remove all on-site and in-unit combustion. This can provide other non-energy benefits such as long-term resilience, passive survivability, and better indoor air quality.

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ii The previously referenced market guidance report on retrofits uses the term "zero-carbon aligned" to describe this concept. **https://advancedbuildingconstruction.org/market-guidance-report/**.

iii EUI is a common metric of building energy performance. It represents the annual energy usage of the building divided by the floor area (commonly expressed in annual kBtu per square foot) (see **https://www.energystar.gov/buildings/benchmark/understand-metrics/what-eui**).

Accelerating Building Decarbonization Retrofits

Inspired by innovative whole-building retrofit projects in Europe,[9] RMI launched a market facilitation initiative to streamline decarbonization retrofits in US multifamily buildings to support an equitable energy transition away from fossil fuels (**see inset box**).[iv] This initiative had an objective to build market capacity for building decarbonization by demonstrating the technical aspects of the streamlined retrofit process while simultaneously aggregating demand from multifamily building owners with similar typologies.

RMI and its partners identified common building types and potential scalable prefabricated envelope and mechanical systems that could be demonstrated over multiple properties. RMI hypothesized that this demand aggregation could lower costs and signal to key industry stakeholders — such as local and state agencies, manufacturers, and retrofit providers — the need for easily deployable retrofit solutions and corresponding financial support. Key performance indicators for the successful implementation of this initiative included reducing carbon emissions from existing buildings, aggregating sufficient demand for a viable project pipeline, and achieving material and labor cost reductions. These efforts would directly benefit affordable multifamily households and local economies with the creation of the demand for these projects and expansion of the workforce.

Initial assessments and ongoing efforts quickly revealed that prefabrication and bulk procurement alone did not fully address the challenge of rapidly scaling building retrofits. Energy modeling and preliminary cost estimating did show that prefabricated panelized solutions significantly reduced energy loads and tenant disruption at a lower installed cost than traditional site-built methods. However, during this discovery stage, several important considerations emerged that were equally critical to integrate into the strategy in order to establish a viable market for decarbonization.

An Equitable Energy Transition

Equitable decarbonization necessitates that relevant resources and solutions be accessible to affordable housing properties. This ensures that the benefits of these retrofits and of the transition to clean energy, such as improved indoor air quality, thermal comfort, and energy resilience, reach communities that have historically been marginalized by housing policies and developments.[7] These communities often bear the brunt of adverse effects of GHG emissions, experiencing higher temperatures, more extreme weather events, greater flooding, and poorer indoor and outdoor air quality. Additionally, affordable housing residents frequently live in housing with unaddressed health and safety concerns and inadequate heating, cooling, and ventilation systems. To maximize benefits, solutions to ease the retrofit process should ensure access to available support and financing, minimize resident disruption, and prevent long-term tenant displacement and undue energy burdens.[8]

iv REALIZE is a market facilitation platform that seeks to establish high-volume net-zero carbon retrofit delivery programs across the United States. Focused on two regional areas, California and Massachusetts, market facilitation activities include aggregating retrofit demand while coordinating the supply chain to deploy high-quality prefabricated retrofit packages that are easy to install and are financed in part through utility cost savings (see **https://rmi.org/our-work/buildings/realize/**).

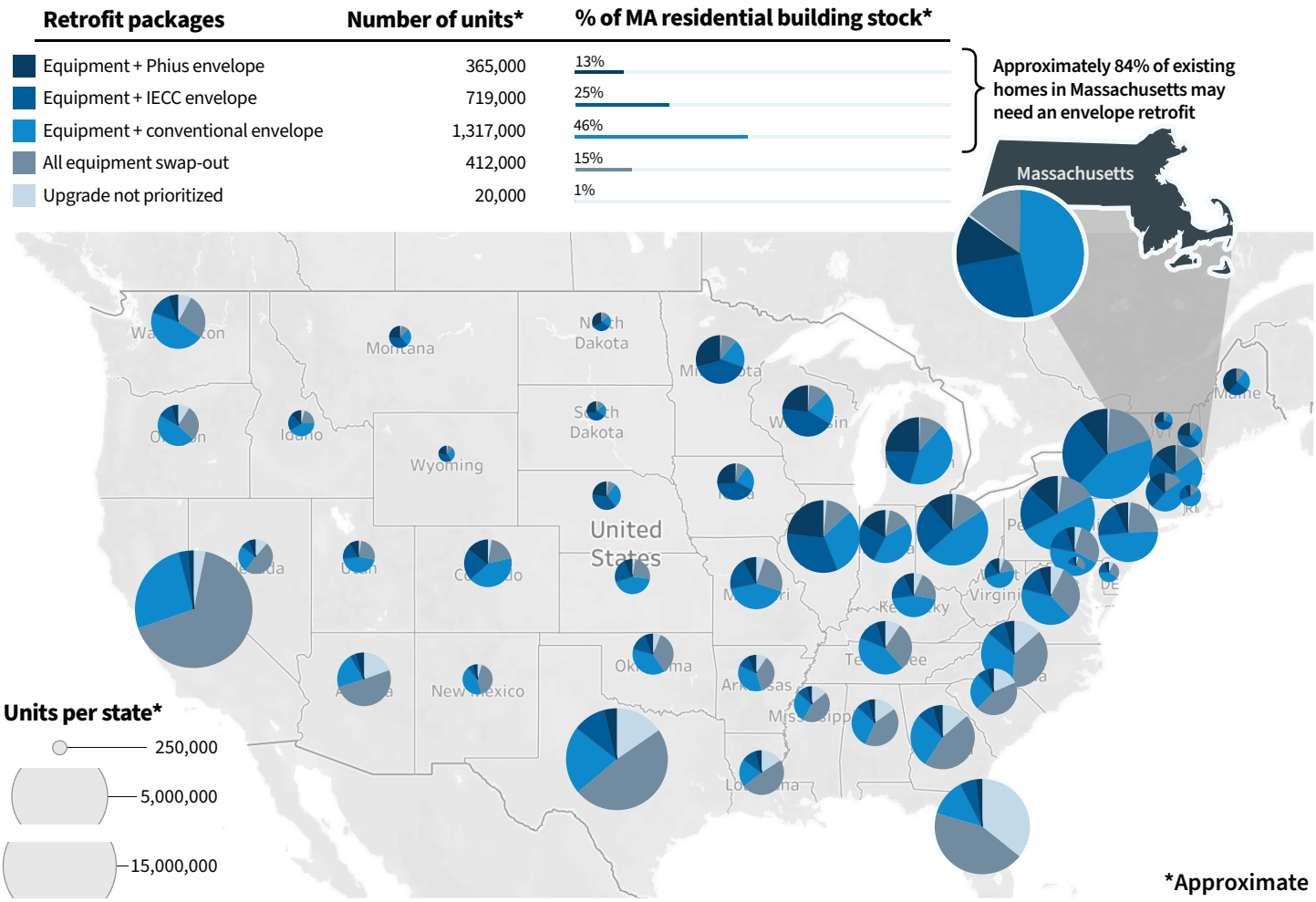
First, due to the diverse conditions of US residential properties and the differing circumstances among AMFH owners, achieving consistent, widespread aggregated demand across various properties, budgets, and schedules has been difficult to accomplish. Compounding the challenge of demand aggregation was the predicament of circular causality, which remains an ongoing issue. Manufacturers are hesitant to reduce pricing without a contractual guarantee of a predicted volume of product, and similarly, owners have been reluctant or unable to commit at an early stage. Second, it was clear that more flexible, yet still replicable and scalable, technical solutions to accommodate varying building types and site constraints were needed to enhance retrofit adoption, especially in regions with aging building stock. Finally, the retrofit project delivery process — from project scoping to financing and construction — was and still is very complex and needed to be made easier and more equitable.

From these discoveries, it became clear that successful implementation depended on addressing common challenges not only with viable technical solutions, but also supporting streamlined programmatic design and establishing a system for equitable funds distribution. These initial lessons laid the foundation for RMI's ongoing efforts, described in the following sections, over the past few years to cultivate a marketplace for the equitable decarbonization of existing buildings.

Realizing the Potential in Massachusetts

In 2021, RMI partnered with Local Initiatives Support Corporation (LISC) to create a decarbonization market catalyzation program called the 1000 Apartment Challenge (1000AC).[10] The 1000AC originated with objectives to facilitate a retrofit pipeline, support owners through the retrofitting process, and showcase innovative decarbonization solutions for common building typologies that drastically improve building performance and demonstrate a viable local market for building decarbonization. This provided a platform to apply these initial lessons, advance equitable building decarbonization, and align AMFH with the Massachusetts climate goals and policies. Massachusetts is an ideal location to cultivate a marketplace for retrofits thanks to its favorable state housing and climate policies, a diverse but aging building stock in a cold-climate region, and the presence of proactive building owners.[11] Furthermore, over 80% of the state's residential stock will require envelope improvements paired with electrification to decarbonize, as shown in Exhibit 2 (next page).[12]

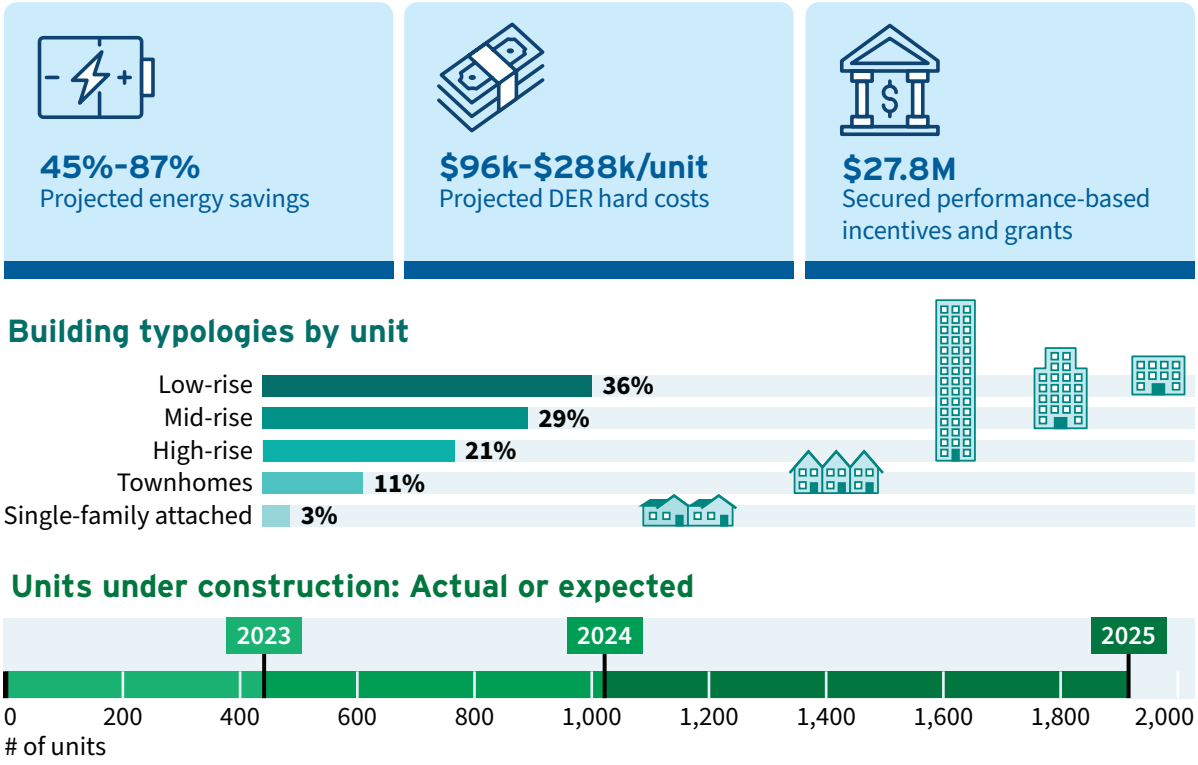
Exhibit 2 Market guidance for decarbonization retrofits of residential building stock: National and Massachusetts



RMI Graphic. Source: NREL Residential Building Stock Analysis, **https://public.tableau.com/app/profile/nrel.buildingstock/viz/ABCMarketGuidanceforZero-carbonAlignedResidentialBuildings_16759824008870/Introduction**

Through the 1000AC, RMI and LISC facilitate a robust pipeline of DER projects (see Exhibit 3, next page), fostering the growth of Massachusetts's AMFH decarbonization market. RMI and LISC connect owners with technical providers, manufacturers, and supplementary funding sources, while offering direction on project scope, energy reduction targets, and comparative cost estimates. The 1000AC provides guidance to building owners on the benefits of elevating the retrofit scope of work beyond standard renovation or weatherization. Intervention has proved to be most effective early in the project schedule, when owners can be encouraged to integrate comprehensive building improvements through DERs. Achieving this requires extensive collaboration and diligence, as participants need to identify suitable building candidates and align projects with relevant incentives and approaches to efficient decarbonization. As a result, participating projects are currently targeting between 45% and 87% energy reductions from baseline through electrification and DER measures. The corresponding emissions also decrease drastically.

Exhibit 3 A dashboard of 1000AC projects and summary statistics



(All statistics are based on available data as of May 2024 and subject to change)

* Note costs for projects in upper range are driven by challenging existing building constraints. The weighted average DER hard cost of projects with available cost data is approximately $160k/unit.

RMI Graphic. Source: RMI analysis

These projects represent a range of building typologies and decarbonization retrofit strategies; no one universal solution applies (see Exhibit 4 on the next page for a sampling of approaches). RMI collaborates with architects, building scientists, and contractors to advance means and methods beyond conventional construction approaches, crafting adaptable technical solutions for cold climates. This involves exploring innovative, replicable, and scalable approaches to envelope improvements and mechanical system electrification. Envelope solutions include exterior over-cladding with prefabricated components or site-built methods and an interior approach when exterior over-cladding is not feasible. Mechanical solutions include centralized, decentralized, and packaged systems, depending on existing building infrastructure.

Accelerating the development of a variety of solutions can raise the standard of current retrofit practices while mitigating perceived risk, reducing construction costs, expediting construction timelines, and minimizing disruption to tenants. It is important to note other relevant factors, such as the embodied carbon and electrical grid infrastructure impacts of decarbonization retrofits, which can better inform industry practices and decision-making (refer to the Appendix for more details on these considerations). These efforts provide owners and the industry with more viable options to achieve enhanced energy savings.

Exhibit 4 A sampling of 1000AC projects representing common typologies and retrofit approaches

Typology	Envelope approach	All-electric mechanical approach	EUI reduction
 **Single-family attached**	Exterior site-built: insulated overcladding with new windows and new insulated roof	Heating and cooling: decentralized air source heat pumps Ventilation: energy recovery ventilator (ERV) system Hot water: electric resistance water heater	50%
 **Townhome**	Hybrid exterior site-built: insulated overcladding, new windows with prefabricated extension frames, and new insulated roof	Heating, cooling, and ventilation: decentralized combined ERV and air source heat pump Hot water: heat pump water heater	69%
 **Low-rise**	Interior site-built: insulated furred-out perimeter walls with new windows in existing openings and new insulated roof	Heating and cooling: central variable refrigerant flow (VRF) system Ventilation: new fresh air supply distribution paired with existing exhausts Hot water: electric resistance water heater	55%
 **Mid-rise**	Exterior panelized: insulated prefabricated panels with integrated windows and new insulated roof	Heating and cooling: central VRF system Ventilation: central ERV system, new HVAC distribution installed between new envelope panels and existing facade Hot water: central air source heat pump	87%

Note: Refer to **case studies** for more in-depth information on these and other retrofits.

RMI Graphic. Source: RMI analysis

In the nascent stages of a significant market shift, supportive programs like the 1000AC can play a pivotal role in demonstrating a market demand for more technical capacity within the industry, more innovative solutions, and more financial support. As of spring 2024, there are just over 1,000 affordable housing units in the 1000AC pipeline expected to be completed or under construction by the end of 2024, partly showcased in a series of **case studies** prepared by RMI.[13] For the residents and communities, these improvements also contribute to overall well-being through enhanced indoor air quality, with better ventilation, thermal comfort, and energy resilience, all while addressing decades of deferred maintenance. In the context of scaling a building decarbonization market, these projects alert key industry stakeholders that these projects are feasible and there is a definitive need to enhance product availability, programs, and policies, along with corresponding financing solutions.

Notable Observations of the Current Market

Based on experiences with the 1000AC, RMI has identified a few notable observations of the current building decarbonization market in Massachusetts that underpin the steps to meaningfully advance market practices and capacity. These observations highlight both enablers of and inhibitors to progress. Partnerships and knowledge sharing emerged as foundational enablers driving the necessary paradigm shifts and actions needed for broad and durable change in the market. The challenges observed in the project delivery process underscore the need for the proposed changes to ensure a smoother transition for market-wide adoption of building decarbonization.

Partnerships, Partnerships, Partnerships

Stakeholders can maximize impact and capitalize on insights from project successes and challenges. They can also leverage effective relationships to transition building decarbonization retrofits into commonplace practices. This involves strategic alignment with industry partners and continuous data collection and knowledge sharing.

Massachusetts boasts a broad array of stakeholders deeply invested in achieving climate goals, many of whom are directly involved in supporting and enhancing housing. Through the 1000AC, RMI and LISC recognized the value in those stakeholder relationships and insights to create more momentum in developing a pipeline. This has included working closely with the Massachusetts Clean Energy Center (MassCEC) on building performance standards, technical solutions, and program design. MassCEC also acted as a vital liaison to entities such as the Mayor's Office of Housing in Boston, the Massachusetts Department of Energy Resources (DOER), regional utility providers (Eversource and National Grid), and the utility-supported Low-Income Energy Affordability Network (LEAN) incentive program. Engagement expanded to include housing agencies, financing stakeholders, and other supportive community development organizations, such as the Executive Office of Housing and Livable Communities, Massachusetts Housing Partnership, and MassHousing, as crucial pathways to shaping and influencing supportive policies and programs.

Collaborating with a broad network of stakeholders and establishing effective relationships are essential for catalyzing projects and accelerating market growth.

To achieve maximum effectiveness, engaging stakeholders must involve multiple approaches. Alongside direct interactions with agencies during project engagements, RMI consistently collaborates with industry experts and pioneering practitioners to streamline construction methods and develop innovative technical solutions, aiming to expedite project delivery, maximize energy reductions, and minimize construction disruption and costs. Through the national **Advanced Building Construction Collaborative**, RMI regularly interacts with and supports manufacturers and material suppliers to foster innovative solutions and construction methods, and to effectively integrate these into projects.

This report underscores both the significance and the value of stakeholder engagement in the development of a decarbonization market and showcases the depth and range of these engagements. This emerging ecosystem and open exchange heighten the collective awareness of industry players in identifying optimal DER building candidates, approaches, designs, and technologies to enhance scalability.

A Platform for Knowledge Sharing

The 1000AC serves as a platform for both influence and knowledge exchange by collecting, synthesizing, and sharing market research and project data. Preliminary retrofit performance and cost data from the 1000AC projects can provide model framework and resources for project planning. Project-based energy target and cost data collected can inform and influence more effective and targeted incentive program designs for an equitable, streamlined, and systematic process for building decarbonization. Early project data from the 1000AC informed the design of various incentive programs for AMFH retrofits, leading to the robust incentive offerings now available to owners in Massachusetts. Additionally, this data can serve as a proxy for a preliminary assessment, helping to set owner expectations regarding both costs and projected energy savings of prospective projects.

The buildings sector is historically a risk-averse group. It is not unusual for industry providers and contractors to resist new and innovative retrofit methods based on an assumption of risk or prohibitive costs. Through extensive knowledge exchange and sharing of project design data, the 1000AC provides a platform to influence adoption, reducing perceived risks with resources and case study analyses. These lighthouse projects are opportunities to increase technical proficiency and raise the level of standard practices in the industry. Sharing project-specific energy performance, technical details, and cost information can expedite the learning curve and provide proxies for initial assessments.[v]

v For an example of knowledge sharing, listen to a recent podcast from one of RMI's strategic technical solution providers discussing the innovative details of some of the 1000AC projects: **https://passivehouseaccelerator.com/podcast/187-saving-buildings-is-cheap-prefab-retrofits**.

Challenges Faced at Each Phase of Project Delivery

The successful project delivery of a decarbonization retrofit involves numerous steps, management of expanded scopes of work, incorporation of deferred maintenance and electrification-enabling measures, and the navigation of multiple funding applications. Often, DER initiatives are driven by forward-thinking owners who recognize the potential in maximizing a building's performance and resilience through a comprehensive DER approach. Difficulties exist within the phases of project management, decarbonization scoping, technical solutions, and financing. It is common for the onus to be on the owner to assemble qualified project teams, comprehend the spectrum of achievable performance targets, and manage the administrative burdens unique to these projects. Adding to the complexity, DER projects for affordable housing involve intricate capital structures that rely heavily on subsidies and financing from a multitude of sources with distinct applications and prerequisites, including local municipalities, state agencies, federal agencies, and utilities. All of those sources often need to be integrated into the base financing for the project to move forward.

Property owners regularly encounter hurdles throughout the project delivery process.

Despite supportive state and local climate policies, the complex nature of decarbonization retrofits poses significant challenges for owners that prevent the achievement of transformative scale in building decarbonization. Drawing from RMI's experience in Massachusetts, Exhibit 5 (next page) illustrates a snapshot of common decarbonization process concerns and questions frequently encountered.

Markets have an opportunity to address these difficulties with targeted and effective decarbonization programming or tools. As examples, RMI partnered with Enterprise Community Partners and Housing Partnership Network to launch an online resource called the **Affordable Housing Decarbonization Hub** in early 2024. The hub aggregates and organizes resources for the national AMFH community to support decarbonization efforts. Additionally, the MassCEC Building Electrification and Transformation Accelerator (BETA) program seeks to leverage these kinds of insights and resolve similar challenges within commercial building decarbonization.[14]

Exhibit 5 Common questions faced by owners throughout the retrofitting process

Project Management

Decarbonization projects rely heavily on the owner's knowledge and initiative. Without regulatory pressure or a clear program intake process, many owners default to conventional practices that may not meet decarbonization objectives.

- Which regulatory or resilience issues are relevant and how does decarbonization increase or decrease risk?
- How does an owner plan decarbonization across portfolios?
- How can I plan for a future retrofit?
- How do I find out about the application process? Do I have the administrative capacity?
- How would I know if this building is suitable for a DER?

Decarbonization Assessment

A critical preliminary step is to forecast potential decarbonization retrofit solutions with an energy performance target, implementation plan, and cost estimate based on a building's existing conditions.

- What is a decarbonization assessment and when should I get one?
- What kind of energy performance should be expected and how will this benefit the building and occupants?
- Who can provide this assessment and what will it cost?
- How do the recommendations get integrated into the scope of work? Will I need a new design team?

Technical Solutions

After defining performance goals, the next challenge for decarbonization retrofits is finding the best technical solution for envelope interventions and high-performance mechanical systems with attention to streamlining construction, reducing costs, and limiting tenant disruption.

- What is the best retrofit solution construction approach for this building?
- Will this retrofit be very disruptive? Will tenants need to be relocated?
- How will this retrofit impact the budget or maintenance schedule of building operations?
- Is the building facing a planned rehab including envelope or mechanical work?

Financing Considerations

Most subsidized, deed-restricted affordable housing follows financing cycles, but major capital replacements or emissions regulation violations can necessitate renovations outside this cycle. This creates funding uncertainties and increased administrative burdens.

- What will the project cost with decarbonization scope?
- Is this property facing an on-cycle financing event or is this mid-cycle?
- What supplemental funding is available, and will this project qualify?
- When will this funding be allocated and will this funding cause a delay in the project?

RMI Graphic

What Does It Take to Shift the Market?

The challenges identified in the previous section stem from uncertainties in retrofit scoping, excessive administrative burdens, and financial support. This section of the report proposes key paradigm shifts and strategic foundational actions for decarbonization alignment, derived from lessons learned through direct engagements in Massachusetts, to address these barriers. Catalyzing the growth of a viable regional market for building decarbonization presents an evolving landscape. Stakeholders can implement new practices and retain the flexibility to shift and pivot. Ideally, this approach will create an ecosystem conducive for retrofits, benefiting households and advancing climate goals.

Key Paradigm Shifts for Decarbonization Alignment

RMI's interactions with stakeholders across Massachusetts revealed a need for key paradigm shifts in industry perspectives. These shifts are the fundamental building blocks to reach industry alignment and scale a viable building decarbonization market. Shifting from business-as-usual (BAU) renovations to strategic, high-value, and attainable decarbonization retrofits requires new perspectives from stakeholders, owners, project teams, and funders alike. Stakeholders can reinforce a more innovative environment for retrofits with attention to how the industry views buildings, approaches assessments, and evaluates costs.

Whole-Building Thinking: Envelope-First and Integrated Project Delivery

Basic weatherization and system electrification are crucial aspects of building decarbonization; however, these practices often fail to maximize overall operating emissions benefits and can overlook valuable non-energy benefits. Buildings are fully interactive systems, rather than just collections of components. An **envelope-first** retrofit approach prioritizes the enhancement of the building's envelope by optimizing efficiencies with airtightness and thermal performance before sizing the mechanical equipment. This approach significantly reduces energy loads and is an effective way to manage grid demands. A high-performance building envelope and high-performance mechanical system can also offer non-energy benefits, such as prolonging the building's life span, enhancing indoor environments, improving passive survivability, and reducing utility cost burdens. This approach epitomizes the building-as-a-system mindset and holds greater potential for long-term climate resilience and substantial reductions in energy loads.

Implementing decarbonization retrofits requires **integrated project delivery** with close collaboration among technical providers, building scientists, owners, and contractors from the outset to clearly communicate project performance goals.[vi] Given that building systems and components are interdependent, retrofit endeavors are best served by an integrated project delivery process in achieving building performance objectives. The 1000AC project teams used this methodology to stay hypervigilant about meeting performance goals, tracking project costs, and limiting disruption to tenants. Exhibit 6 shows how various stakeholders can transition to whole-building thinking to support decarbonization and the potential impact.

Exhibit 6 How could whole-building thinking support decarbonization?

Key Stakeholders	Paradigm Shift for Decarbonization Alignment		Impact
	From	To	
Incentive program administrators, funding agencies, or housing agencies	Programs that fund individual electrification or itemized weatherization components	Performance-based incentive programs from modeled or measured energy efficiencies	Funding for individual components may deter owners from embracing a comprehensive retrofit design for their buildings and limit long-term performance goals.
Incentive program administrators, funding agencies, or housing agencies	Limiting or restricting financial product sources	Ensuring that supplemental, incentive, or other financial and funding products are compatible with other base financing sources	Base financing is often not adequate to cover total development costs. All available financial support needs to be braided and stacked together for projects to move forward.*
Owners and portfolio managers	Reactive maintenance and retrofits as identified in Capital Needs Assessments	Proactively planning for decarbonization and prioritizing envelope efficiency measures	This shift encourages a whole-building approach to maximize operating performance, optimize the timing of electrification, and minimize tenant disruption. It can accommodate a zero-over-time approach.

* *Braided and stacked* is an industry term that refers to applying and combining all available funding sources in one project. This could be a combination of base financing and incentive grants or loans.

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vi Practicing what it preaches, RMI implemented an integrated project delivery process during the design and construction phases of the RMI Innovation Center in Basalt, Colorado, to achieve ambitious project goals (see **https://rmi.org/our-work/buildings/scaling-zero-net-carbon/rmi-innovation-center/design-process/**).

Standardize the Scope: Buildings Can't Be Snowflakes

Although every building is unique, relying solely on a highly individualized building-by-building approach for a decarbonization assessment and project scoping is time consuming and inefficient, especially considering the urgency of climate goals. The projects in the 1000AC that received technical assistance to determine the decarbonization scope of work from the onset of the project delivery realized smoother alignment with available funding sources and were more likely to move forward. This early action helps establish whole-building project goals, identifies potential construction methodology or implementation issues, enables more informed decision-making, and reduces delays caused by redesign.

Shifting current industry practice to a systematic, typology-based assessment framework facilitates rapid scaling of retrofit solutions.

As a proxy for a full assessment, portfolio owners and managers can utilize a typology framework, categorized by common building traits, combined with historical energy performance and cost data from similar projects to create a preliminary decarbonization scope for a building or group of buildings. This method, shown in Exhibit 7, aligns certain building typologies in specific regional and climate areas with an estimation of existing energy performance, a scope of possible envelope and mechanical intervention packages, the associated energy and GHG savings expected from the retrofit, and a preliminary construction cost estimate. This exercise provides building owners with a clear, data-driven picture of what to expect in terms of cost, energy savings, and GHG reductions early in the process, on a building or portfolio level. Owners and managers can make more informed decisions about pursuing decarbonization measures with a better understanding of potential outcomes.

Exhibit 7 **Steps to applying typology frameworks to large portfolios**

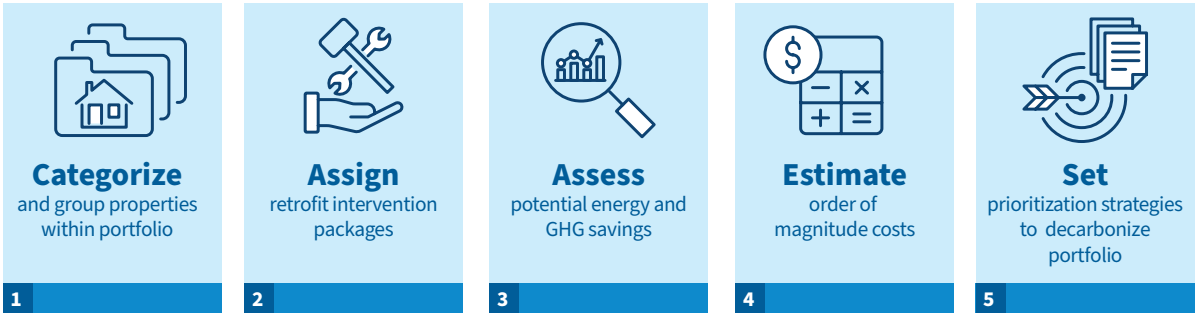

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Exhibit 8 How could standardizing the scope support decarbonization?

Key Decision Makers	Paradigm Shift for Decarbonization Alignment		Impact
	From	To	
Funding agencies or incentive program administrators	Limited guidelines on retrofit strategy or methods	Prioritization of replicable retrofit solutions that set precedents and best practices for specific typology solutions	Standardized retrofit solutions have the most potential to streamline project scopes, reduce costs, and develop systematized programs.
Decarbonization program administrators, architects, engineers, and energy consultants	Conducting feasibility assessments on a building-by-building basis	Developing standardized intake templates and calculation tools for expedited and economical decarbonization assessments	This shift overcomes the financial and technical barriers of a preliminary assessment. It encourages providers to create scalable solutions, which can help solidify a commitment to a scope of work early, which is often necessary for competitive funding applications.

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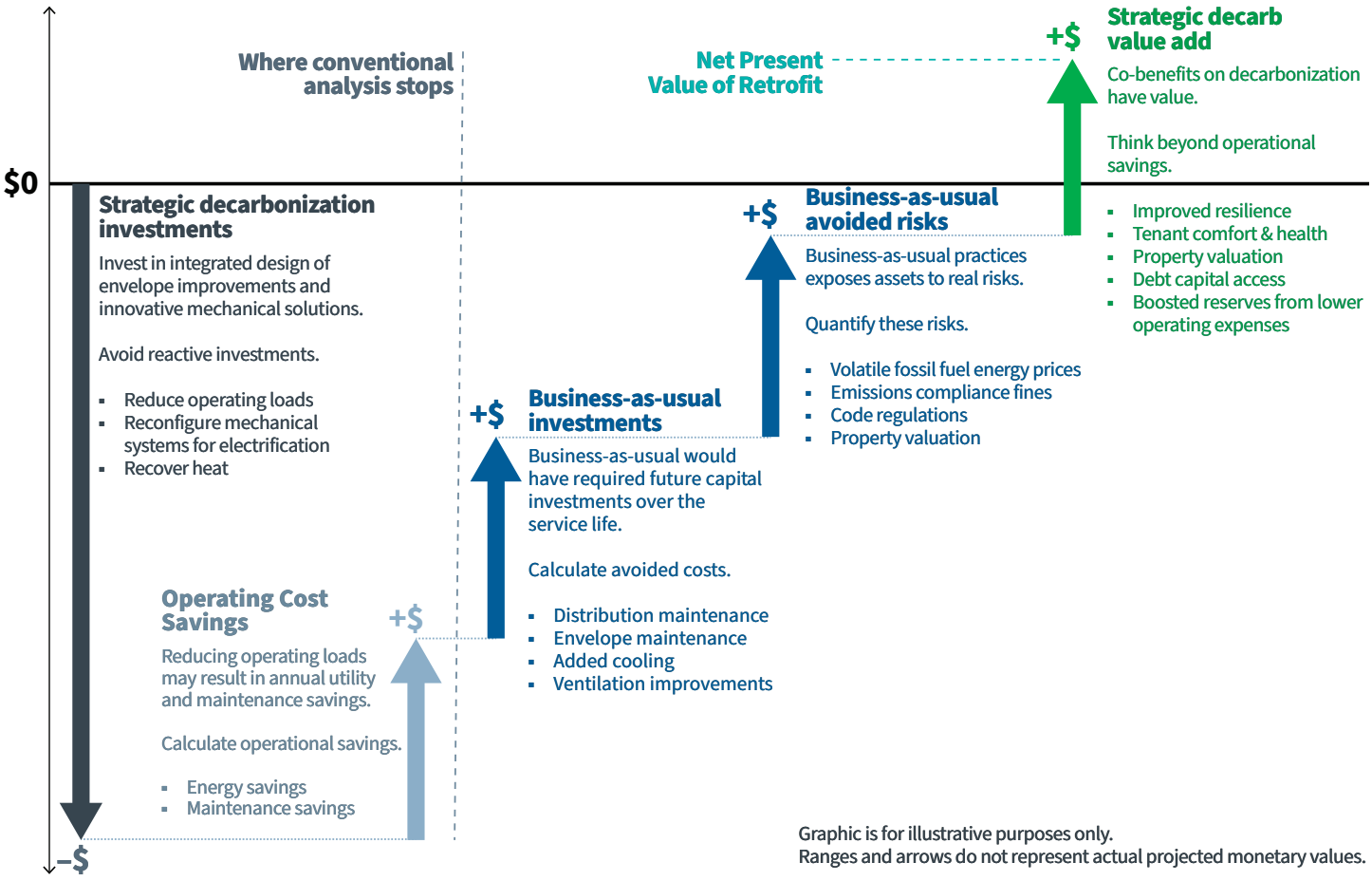
Standardizing scopes across portfolios can spur innovative design and construction approaches by streamlining solution development. This also enables demand aggregation by pooling projects with similar needs, facilitating more focused and effective capacity building in construction and workforce development. When combined with typology frameworks, standardized retrofit solutions can scale the application of innovative, repeatable intervention packages. Exhibit 8 outlines which high-impact actions key stakeholders can adopt to make decarbonization retrofits more prevalent.

Look Beyond Incremental Costs

Stakeholders commonly inquire about the additional cost of decarbonization compared with a BAU renovation. Pinpointing the incremental cost difference between a decarbonization retrofit and a BAU renovation is both challenging and less useful than it seems, given the substantial variation in base scope and existing conditions among projects. Focusing solely on up-front capital costs overlooks the long-term benefits and risk mitigation associated with the retrofit. Although the initial investment for a DER may be higher, the long-term benefits include reduced energy consumption, lower utility costs, compliance with regulations, tenant thermal comfort with cooling, and enhanced building resilience. Exhibit 9 (next page) proposes the net present value of the retrofit to include these indirect benefits and the value of avoided future risks from not doing the retrofit.

> **Calculating the cost difference between an electric and a fossil-fueled system oversimplifies the value and goal of decarbonization.**

Exhibit 9 Calculating the net present value of decarbonization



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Additionally, as building energy codes advance, many BAU renovations will be subject to energy efficiency code regulations, thereby increasing scope and costs, narrowing any incremental cost gap. Beyond operational cost benefits, consolidating retrofit efforts into one intervention (when logical, taking into account the condition of existing systems and funding) minimizes disruption, tenant relocation costs, and soft costs from renovations that will likely be required in the future because of equipment failure, climate uncertainties, or changing regulations. Exhibit 10 (next page) details what it means to key decision makers to look beyond incremental costs and the ways this shift can support rapid scaling of building decarbonization.

Exhibit 10 How could looking beyond the incremental costs support decarbonization?

Key Decision Makers	Paradigm Shift for Decarbonization Alignment		Impact
	From	To	
All stakeholders	Basing project value on the incremental cost gap from BAU renovation	Creating a value proposition that captures the net worth of the building improvements over time — including avoided costs, non-energy benefits, and vulnerability to climate risks	Budget baselines from a BAU renovation are inconsistent and are not conducive to comparison. Buildings are long-standing assets that provide direct and indirect value to occupants. First costs do not consider long-term benefits and risk mitigation associated with the retrofit.
All stakeholders	Itemizing project component costs	Developing standardized intake templates and calculation tools for expedited and economical decarbonization assessments	Component costs may misinform owners, agencies, or key stakeholders because of the integrated design nature and long-term advantages of decarbonization retrofits.
All funding agencies	Individual financing	Supplemental, incentive, and other financial and funding products that are compatible with other base financing sources	The level of public subsidy in US markets for innovative technologies is often not adequate to cover total development costs. All available financial support needs to be braided and stacked together for projects to move forward.

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Foundational and Strategic Actions

Based on direct experience in projects and policy implementation, a comprehensive and multipronged strategy to overcome the identified obstacles hindering building decarbonization and to catalyze market development could include actions that:

- **Bolster market capacity with innovative technical solutions**
- **Create a more favorable landscape with supportive policy and financing mechanisms**
- **Streamline the process with a systematized and programmatic approach**

Build Market Capacity: Support Innovation

Projects leading the charge on shifting market practices can experience challenges and added risks from new approaches and innovative technologies, but the value in spurring and inspiring change should not be overlooked. For some projects, leveraging advanced building construction methods in retrofit designs can offer notable benefits, achieving greater building performance through innovative construction practices and technologies. These methods are an integration of industrialized construction with energy-efficient solutions, deployed with the purpose of decarbonizing the built environment, scaling solutions, and achieving market delivery capacity to meet national retrofit needs.[vii] For example, solutions such as

vii Industrialized construction refers to the application of modern manufacturing and installation practices to optimize construction. These practices can include prefabrication, standardized or repeatable elements, automation, advanced digital tools, and highly integrated workflows.

prefabricated panelized envelopes or integrated, multifunctional HVAC systems, which harness innovative design and off-site manufacturing to streamline on-site installation, have the potential to modernize and accelerate the building retrofit industry.

Industrialized construction has more potential for overall market cost reduction and scalability than traditional methods that focus on site-built components.[15]

Advanced building construction methods, such as industrialized and prefabricated retrofits, employ means to reduce construction timelines, limit tenant disruption, and create prospects for an inclusive workforce and local economy. Efficiencies gained through the manufacturing, installation, and logistical process support a reduction in total project costs, especially in projects subject to on-site prevailing wage requirements. Lighthouse projects that employ advanced building construction means and methods are standardizing scopes, testing and verifying new technologies, building workforce expertise, and demonstrating demand to the market. Exhibit 11 highlights the responsibilities of key stakeholders in advancing innovation and the associated impact on developing a viable market for building decarbonization.

Exhibit 11 How can stakeholders advance innovation?

Key Stakeholders	Action	Impact
Industry professionals: project teams, architects, engineers, sustainability consultants, general contractors	Think outside the box. Pioneer innovation and integrated project delivery into design and construction methods; build expertise and applied skills across analysis, design, manufacturing, and installation essential for high-performance building decarbonization.	Although working beyond conventional practice may seem risky to some, it can create a competitive advantage, positioning providers for success in the face of new federal funding and emerging emissions regulations.
Funding and financing agencies	Incentivize market capacity building by supporting innovative and scalable projects and the development of emerging products and manufacturers.	Financial backing from established agencies facilitates the predevelopment and construction phases of these projects. As more projects receive funding and showcase innovative solutions for common building types, the market not only gains momentum by leveraging lessons learned and repeating successes, but also sends a market signal for increased solution development.

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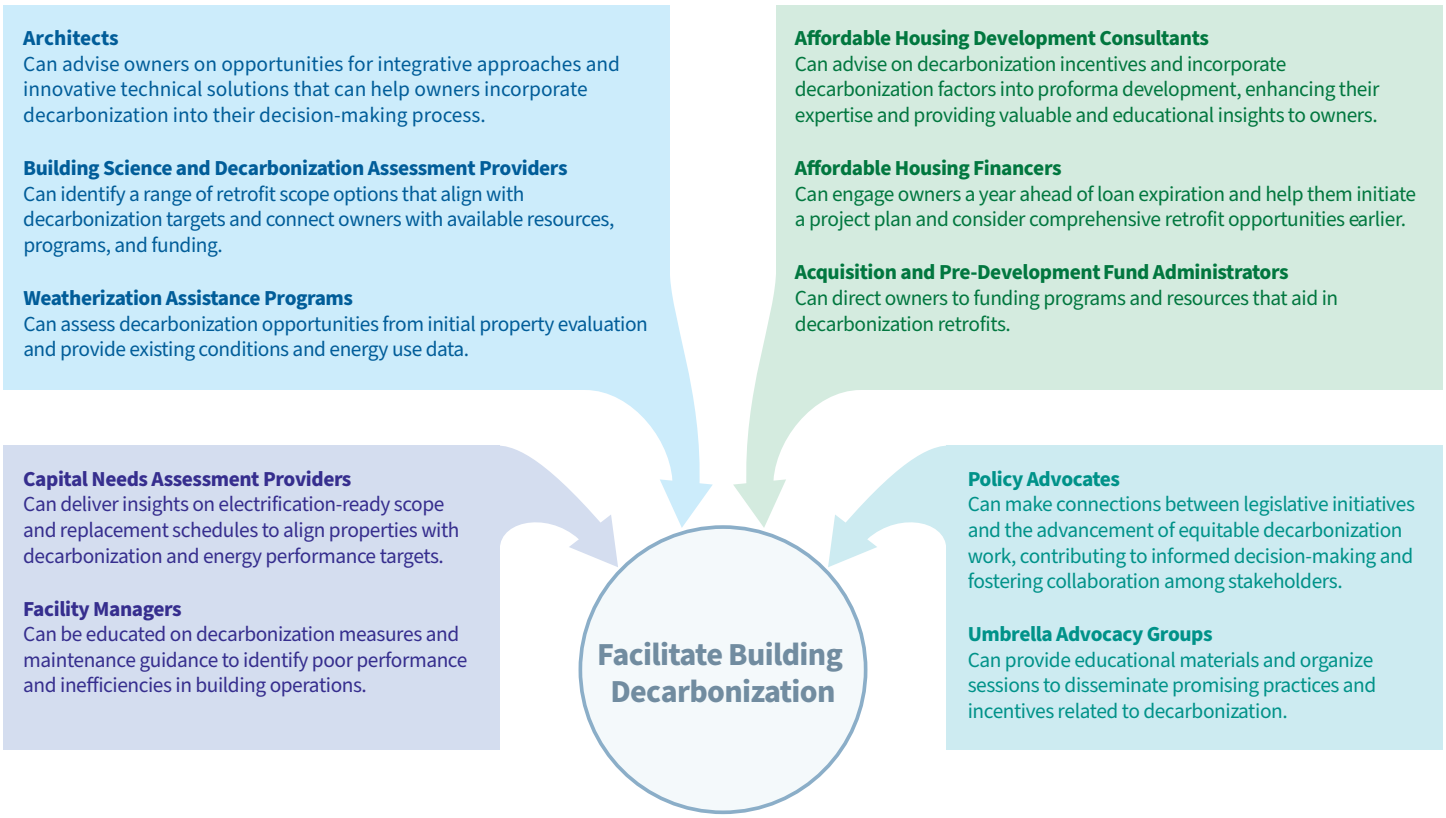
Create a Favorable Landscape

An ecosystem of enabling stakeholders will help create a favorable landscape to advance building decarbonization. Although multiple stakeholders operate within this network, unclear roles and a lack of coordination often impede the initiation and eventual attainment of decarbonization goals in projects. Educating and empowering stakeholders to take an active role within this landscape can facilitate processes and enable the relationship building necessary for effective policy and corresponding financing. Therefore, intentional coordination and integrated financial support are crucial for shaping a landscape that will foster efficiency, progress, and scalability in building decarbonization efforts.

Leverage Intervention Points

Often, owners are faced with the responsibility of driving project performance goals. However, various entities already engaging with owners can also play a central role in positioning decarbonization retrofits early in the process. There are numerous opportunities for process development involving relevant stakeholders at pivotal early project delivery stages. Opportune intervention points can help expand the market for decarbonization; ease the burdensome process; and make decarbonization retrofits more accessible, equitable, and financially viable for property owners. Exhibit 12 illustrates how these stakeholders could serve critical intervening roles in getting projects that are primed for decarbonization into the pipeline.

Exhibit 12 Strategic intervention points to leverage throughout the retrofitting process



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Properties with planned envelope and mechanical repairs or replacements are particularly suitable candidates for DERs. Understanding the best retrofit approach for specific properties is crucial for all involved parties. Even if a building is not currently a good candidate for a DER, it is important to keep these intervention points, capital needs, and the related performance targets in mind, as most buildings will eventually need retrofits to align with climate goals. Whatever the building event or intervention point may be, a decarbonization retrofit should be the first option considered. Educating stakeholders and owners about the factors influencing a project's feasibility for decarbonization is essential for initiating more projects into the retrofit pipeline at an early stage.

Integrate Decarbonization in Supportive Agencies

State energy offices, housing agencies, utilities, and other organizations that provide funding and financing to support AMFH retrofits have a particularly influential role in building out the retrofit pipeline. They can enhance their effectiveness by integrating decarbonization into their existing operations and programs, and by promoting interagency collaboration. Although establishing a new, dedicated decarbonization program might seem simpler and reduce short-term disruption, such a program risks becoming siloed, which could hinder the development of long-term, scalable solutions.

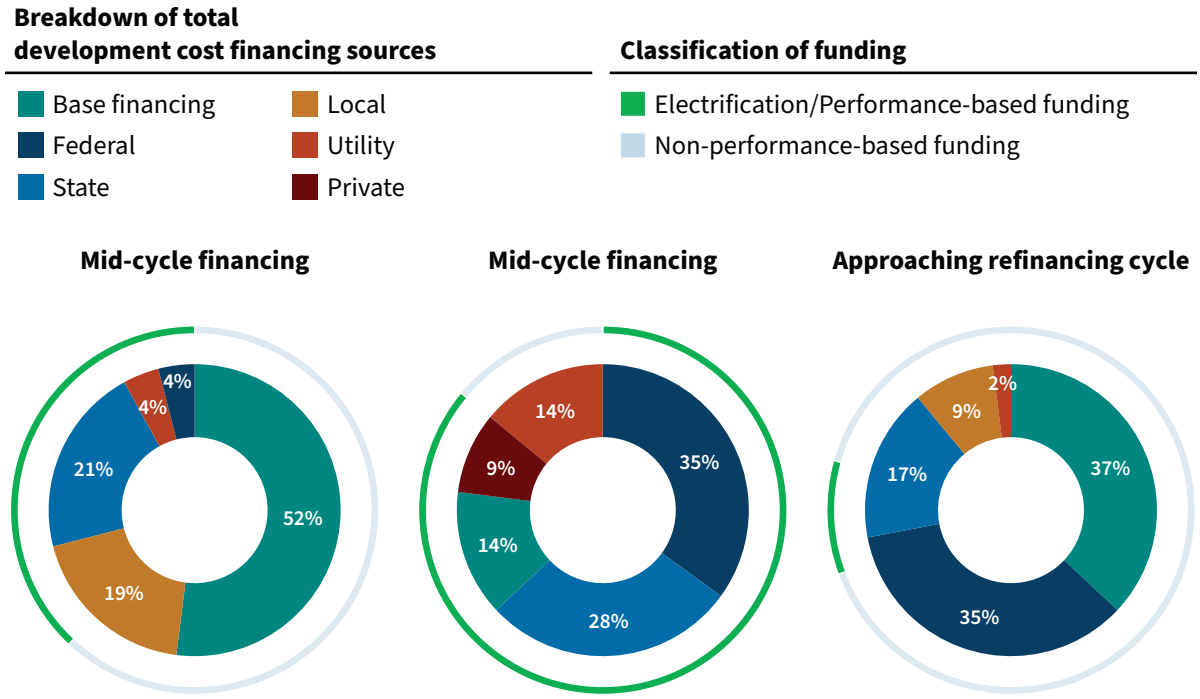
Integrating decarbonization across supportive agencies requires deepened partnerships and coordination. Agencies should share insights on successes and challenges to drive alignment and efficiency. Instead of focusing solely on climate solutions, agencies should integrate equity and climate action into all policies, programs, and departments. For instance, qualified allocation plans (QAPs), which outline allocations and project criteria for low-income housing tax credits, can incorporate requirements and preferential scoring for decarbonization assessments and targets. Additionally, to enhance alignment, agencies should connect decarbonization initiatives with related efforts such as workforce capacity building, utility rate reforms, and policies on embodied carbon.

Synchronize Financing

Effective financing and funding mechanisms are crucial throughout the decarbonization process to initiate projects and drive market change. Currently, projects can access a range of grants, tax credits, and incentives tailored to support building owners leading this market shift. However, the effectiveness of these incentives depends on the administrative capacity of the owner to apply for all available funds and seamlessly stack and braid them together. Exhibit 13 illustrates the varying sources of funding for three different financing structures of 1000AC properties undergoing DERs. Also represented is the proportion of performance-based funding these projects are expected to receive. Given the varied capital structures involved in projects, coordination and agreements among agencies are essential to maximize available funding.

Affordable housing owners encounter numerous obstacles in improving their buildings. Owners depend on reliable and predictable funding to accurately plan capital improvements and retrofits, yet the process to claim these resources is highly complex. Access to supplementary funding at various project stages is essential for building decarbonization. To date within the 1000AC, 290 units have been allocated a total of $27.8 million from competitive applications to federal, state, local, and utility decarbonization incentive programs. The 1000AC played a pivotal role in preparing projects to apply for and access available performance-based funding. Openly disclosing fund allocations helps stakeholders identify funding gaps, recognize successful initiatives, and make funding more accessible.

Exhibit 13 Examples of capital stack breakdown based on source, performance prerequisites, and financing cycle



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Streamline the Process: A Systematized Approach

The current process of decarbonizing existing buildings is fragmented, complex, costly, and administratively burdensome, relying too heavily on proactive owners to champion projects. This poses a significant obstacle to scaling retrofits to the volume and pace needed to meet climate targets, especially as states gear up to distribute resources allocated under the federal Inflation Reduction Act (IRA) and from other sources. Creating a central application process to coordinate all possible funding sources can improve accessibility to various funding while establishing a more durable, systematized program that can operate consistently even as funding sources change over time. Expanding the sheer number of "shovel-ready" projects sends a market signal, encouraging technological innovation and capacity building. Efforts like these not only address the urgent need for decarbonization but also pave the way for a more efficient and resilient buildings sector.

Experience from RMI's direct engagements with projects and program stakeholders in Massachusetts and other regions underscores the importance of establishing a programmatic approach and structured pipeline. It suggests that a replicable and programmatic framework for building decarbonization should integrate fundamental components such as a decarbonization assessment, a consolidated application process, and streamlined coordination of available funding, as outlined in Exhibit 14.

Additionally, it should incorporate innovative technical solutions, a compelling value proposition for retrofits, and aggregated demand across the pipeline. This approach, involving key enabling stakeholders and property owners, seeks to ease intake and execution and enhance adoption across various project types. Exhibit 15 (next page) highlights the potential impact of various initiatives that stakeholders can adopt to streamline the building decarbonization process.

Exhibit 14 Elements to streamline the retrofit process

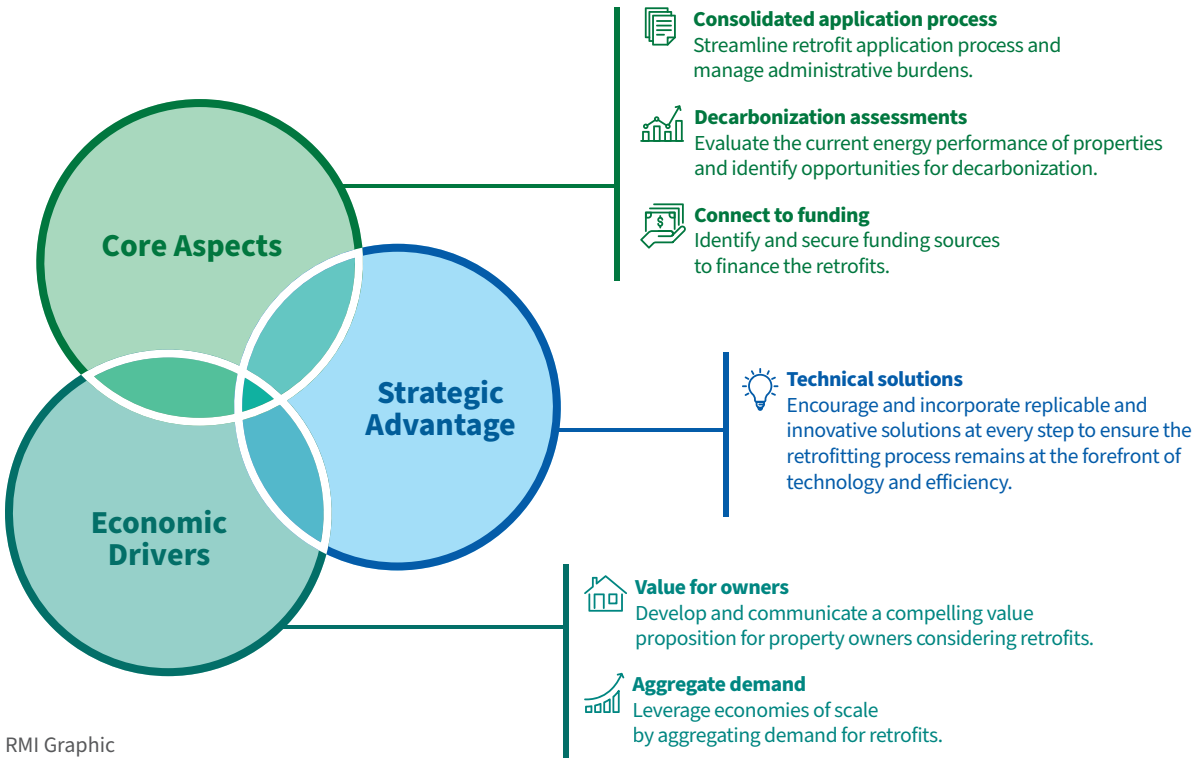

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Exhibit 15 What are some considerations for streamlining decarbonization retrofits?

Challenge	Initiatives to Streamline the Process	Impact
Administrative burdens	Centralized application process with technical assistance programs and effective policy and program design	Reduces owner due diligence and project management burdens. This can attract more projects to the retrofit pipeline and create more equity in incentive distribution.
Decarbonization scoping	Predevelopment funding and technical assistance for a decarbonization assessment	Provides invaluable information for owners to use in defining project scopes and costs, maximizing energy efficiencies, assembling project teams, and pursuing available performance-based funding.
Financing stacking	Flexible financing and funding options for renovations both on and outside regular financing cycles; recognize that these resources need to be reliable, braided and stacked for maximum impact	Uncertainty or misalignment in any financing component can delay the process. Reliable funding sources that can be used in complementary ways, can be equitably accessed, and have consistent requirements make long-term decarbonization planning possible for owners.
Financial planning	Agencies and program administrators of incentive funding engaging with owners to understand their financing landscape and collaborate on workable solutions to simplify capital needs	Performance-based incentives are typically disbursed post-construction or after specific milestones. This delay in funding can necessitate extensive financial planning or expensive bridge loans to cover up-front costs. Engagement between funding agencies and owners can help set expectations and find solutions that facilitate a project's financial plans.

Note: For more information on the challenges of and recommendations for streamlining technical assistance programs, effective policy and program design, and flexible financing and funding options, visit RMI's Multifamily Affordable Housing Toolkit (see **https://rmi.org/multifamily-affordable-housing-decarbonization-toolkit/**).

RMI Graphic

Programmatic Approaches in Practice

In Massachusetts, DOER is pioneering steps toward a programmatic approach by offering predevelopment grants for decarbonization assessments, proactively contracting qualified technical assistance providers, and providing project grants for decarbonization project implementation. All these initiatives are managed within the same agency and envisioned as a continuum. This integration of funding with technical guidance aims to reduce administrative burdens, consolidate points of contact, and ease the fragmented process for owners. Further consolidation of efforts and funding streams, along with increased cross-agency collaboration, will be crucial for streamlining the project pipeline.

As federal and state incentives help drive deployment, housing agencies in Massachusetts are analyzing portfolios to integrate decarbonization at scale and implement appropriate budget mechanisms. Concurrently, the establishment of the Massachusetts Community Climate Bank aims to provide consistent funding and financing products to support these and other projects. The coordination among stakeholder agencies has been critical in beginning to understand the scope of what needs to be done to meet state decarbonization goals. This collaborative effort is instrumental in identifying gaps and generating resources based on thorough scope analyses and positioning the resources to fill those gaps.

Conclusion: Charting the Path Forward

Buildings should support residents and surrounding communities in the best possible way — including clean and affordable housing for marginalized communities overburdened by pollution and high energy costs. The IRA represents an unprecedented federal investment in making US homes and buildings more energy efficient, safe, and healthy for today's households and for future generations. Additionally, in aggregate, funding from state, local, and utility entities represents an even larger pool of resources.

There has never been a better time to support equitable building decarbonization.

Decarbonization can be at the core of that holistic improvement, giving people better and more affordable places to live. With this recent surge in momentum and continued growth in building decarbonization methods, both understanding the urgency and necessity for scalable retrofit solutions and enabling systems to achieve climate goals is paramount. There is an immediate opportunity to establish more enduring and systematic processes and programs that can expedite distribution of resources and induce durable market shifts that drive building decarbonization.

Throughout RMI's regional work in Massachusetts, the primary aim remains consistent: to develop a replicable model applicable to diverse building types and regions in order to drive the rapid scale of building decarbonization. As the real estate market evolves with advancements in technology, materials, construction practices, and financing mechanisms, innovative and climate-friendly retrofits emerge as a key solution for rapidly reducing building operating emissions and mitigating the compounding impact of carbon emissions and cost burdens that these tenants, communities, and building owners have historically faced. RMI remains dedicated to encouraging equitable decarbonization and fostering clean and healthy communities in Massachusetts and beyond.

Appendix

Other Considerations for Building Decarbonization

Embodied Carbon in Retrofits: Decarbonization efforts must encompass the entire carbon footprint, including both operational and embodied carbon emissions. The materials and energy required to reduce operating carbon emissions in buildings will have a significant carbon footprint, underscoring the importance of integrating this consideration into the design process. RMI's report ***Transforming Existing Buildings from Climate Liabilities to Climate Assets*** delves into the embodied carbon associated with retrofits.[16] It emphasizes the importance of making informed decisions on low-carbon retrofit solutions to realize rapid reductions in operating carbon emissions.

Additionally, **HomebuildersCAN** is an RMI-supported community platform that provides guidance for contractors to measure and reduce the embodied carbon emissions of construction. A forthcoming resource will analyze possible building envelope strategies, such as improving airtightness, that reduce operating carbon emissions and enhance energy efficiency yet have minimal cost and embodied carbon impacts.

iStock photo

Electrical Grid Impacts: Electrifying buildings now to reduce emissions is also dependent on a clean electrical grid powered by renewable energy. Although it is important to be wary of how fossil fuel–powered electricity could inadvertently counteract climate goals as more buildings electrify, there is reason to believe that waiting for a fully clean grid is not a practical option. Renewable energy generation has grown significantly in recent years, and it is on track to becoming the most dominant and affordable option in the electricity sector. Expectations are that solar and wind generation will grow exponentially in the 2020s.[17] Additionally, there are opportunities to minimize grid impacts through efficiency-first retrofits. Extensive envelope improvements are a key component to drastically improving building efficiency, reducing energy loads, and (therefore) minimizing dependence on the electrical grid. Rooftop solar and battery storage are other ways these projects can minimize grid impacts on site. Although grid impacts should be considered, they should not discourage DER projects.

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