



# Boston Deconstruction and Material Reuse Roadmap

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# Executive Summary

The Architecture, Engineering, and Construction (AEC) industry is one of the most wasteful and carbon-intensive in the world. One of the emerging best practices to tackle this growing issue, deconstruction and building/material reuse, has yet to truly take hold in much of New England. The sector needs innovation and commitment to align with the climate and environmental goals set by local governments.

The AEC industry is plagued with both real and perceived barriers to deconstruction and reuse, such as cost and schedule inflation, limited reuse infrastructure, a lack of robust field education, and gaps in solidified policy. These barriers, combined with the industry's "business as usual" attitude, have led to our highly progressive region failing to reach the cutting edge on which it so often prides itself.

Thankfully, implementing deconstruction and reuse policies and practices in the greater Boston AEC industry can occur swiftly. By adopting several best-in-class practices pioneered across other regions of the United States, designers, contractors, owners, and policy-makers can help propel this transition.

Through small changes implemented over time, along with the adoption of deconstruction and reuse policy, the Boston-led New England region can reduce waste and greenhouse gas emissions. Through the steps listed in this roadmap, a better future for the region is possible.

## Designers:

- Design with reuse in mind, taking away the burdens of buying new and the associated carbon impacts.
- Revamp specifications and drawings to promote circularity and building/material reuse
- Partner with contractors, manufacturers, owners, and reuse vendors to eliminate waste from the demolition process

## Contractors:

- Implement better onsite waste diversion policies through collaboration and adoption of emerging best practice
- Develop training and provide a guiding hand for workers and subcontractors to replace outdated demolition practices.
- Embrace technological innovation and data-driven solutions to eliminate common green building misconceptions

## Owners:

- Collaborate with designers to understand standard items that can be reused
- Allocate space typically used for attic stock to allow for storage of reusable materials
- Implement deconstruction and reuse as a method of reducing embodied carbon, and achieving Environmental, Social, and Governance (ESG) goals

## Policy Makers:

- Incentivize deconstruction and reuse through financial grants and permitting timelines
- Mimic successful deconstruction ordinances and legislation found on the West coast
- Correlate reuse policy with climate action, historic preservation, and social equity goals

# Introduction

The construction industry has a waste problem, and Boston is no exception. In 2018, the US generated **600 million tons of construction and demolition (C&D) waste - more than twice the amount of generated municipal solid waste.**

This waste has environmental, social, and public-health impacts. As local Massachusetts landfills reach capacity, our waste has to be shipped across the country for other states and municipalities to manage.

It can be difficult to put the vast amount of waste into perspective so here are two helpful statistics:

- One year of demolition waste from homes in the US is enough to build a wall 30 feet tall and 30 feet wide around the entire border of the continental USA.
- Demolition of one US home creates approximately 60 tons of waste, which is equivalent to one individual's lifetime worth of waste.

Disposing of C&D products that could be reused means we must pay for the remanufacturing of those materials, in cost and carbon.

Adaptive reuse of buildings and salvaging of materials are achievable methods of reducing greenhouse gas emissions right now.

The solution to addressing our collective waste problem is through the development of a robust material reuse ecosystem. Through reuse, Boston can reduce its environmental and carbon footprint, create jobs, decrease overall project expenses, promote social equity and contribute to the larger goals of Boston's Zero Waste and Climate Action Plans.

## The EPA has identified the following benefits of sustainable C&D waste management:

- **Creates employment and economic activities in recycling industries and provides increased business opportunities in the local community, especially when deconstruction and selective demolition methods are used. EPA's 2016 Recycling Economic Information (REI) Report showed that in 2012 the recycling of C&D materials created 175,000 jobs.**
- **Reduces purchase and disposal costs and transportation costs.**
- **Increases tax benefits through donating recovered materials to qualified 501(c)(3) charities.**
- **Minimizes the need for disposal facilities, reducing associated emissions from the transport, sorting, and disposal of landfill-bound waste.**
- **Offsets the environmental impact associated with the extraction and consumption of virgin resources and the production of new materials.**
- **Conserves landfill space.**

## Purpose

The purpose of this document is to provide everyone who participates in the construction industry with a reference point and a number of actionable takeaways to implement reuse practices in your daily work. Whether you are a designer, contractor, policymaker, building owner, developer or manager, part of an academic institution or network or NGO, or an entrepreneur, you can get involved and help contribute to creating a successful reuse market.

In addition, our goal is to create a singular document that can help share knowledge and resources to develop a singular focal point around which splintered efforts can coalesce. The current Boston market has several key parties working to improve building/material reuse and deconstruction efforts, but many of those parties are isolated from the efforts of other key players. By creating a document that can be used as a starting point, or central resource, all parties can educate themselves on best practices and avoid duplication of efforts.

## What makes Boston ready for change?

The City of Boston's commercial construction market is booming. Thousands of tenant improvement fit-outs continue every year and residential development increases in areas like the Seaport. In the first quarter of 2022 alone, nearly 15 million square feet of office space was under construction in Boston. If a successful reuse initiative can be piloted in an area like Boston, which has the added complications of building in a dense urban area with a strong union labor presence, it could be adapted for the broader New England.

Massachusetts also values its reputation as an innovation hub for science and technology. Green building rating system adoption, built environment technical improvements, and progressive building and energy codes are essential parts of this innovation.

Based on the Massachusetts Department of Environmental Protection's (MassDEP) Materials Management Capacity Study and the 2030 Solid Waste Management Plan, the state's dwindling landfill availability is creating a C&D waste ecosystem that is unsustainable in its current form. Because of this, piloting deconstruction and material reuse initiatives in the state is even more relevant and timely.



## What is Boston's current reuse market?

Boston's material reuse market is underutilized. There are a number of factors, including growing interest from the Green Building sector, limited space at landfills and transfer stations, and citywide goals like Zero Waste Boston and the Boston Climate Action plan that indicate the market is primed to grow. However, there are also many barriers related to apathy, ignorance, and misconception that must first be addressed.

## Material Reuse

Boston's supply of construction materials acceptable for reuse outweighs the demand, particularly in the commercial sector. More companies are starting to develop an interest in materials reuse, but many are hesitant to take the first steps without a clear path forward.

Currently, reuse is often seen as a one-off idea only relevant for specific items like millwork, newer appliances, equipment, and furnishings. Due to the plethora of ongoing tenant improvement fit-outs in the city, most without consideration for reuse of the materials left behind by former tenants, there is no shortage of salvageable materials, only a lack of demand for them to be reused.

This lack of demand is in part due to the lack of infrastructure to make the inventory of reused items affordable, visible to designers, as well as a lack of a clear chain of custody for the materials as they move from one project site, to storage, and ultimately to a future project site.

## Building Reuse

Historical buildings in Boston are abundant. The 2019 update to Boston's Carbon Action Plan conducted by the city found that 85% of buildings that will exist in 2050 have already been constructed in Boston.

Owners typically find it logistically easier to demolish aging buildings instead of retrofitting the spaces or promoting adaptive reuse. Often, unless a building is specifically slated to be reused, the common thought for owners and contractors is to demolish and rebuild with new materials.

Being a city and region rich in history, there is significant opportunity for, and many excellent examples of, historic building reuse occurring in Boston and surrounding areas. Adaptive Reuse and Historic preservation are always encouraged as an alternative to demolition. These approaches and the specialty considerations they require are important and deserving of their own independent report, and as such are not thoroughly explored within this document.

## Typical Barriers

There are several barriers that collectively stymie reuse innovation and implementation in Boston. These are by no means unique to this region.

### Look and Feel Concerns

Most owners and design teams want a standard that includes a new look and feel for a space. Unfortunately, this results in procuring and installing new materials even in instances where an 'industrial' or 'vintage' aesthetic is the design goal.

### Misconceptions

Misconceptions are rampant in the industry, with ideas that material reuse, salvage, and deconstruction will cause project budgets to balloon and schedules to delay. The union labor and demolition subcontractors are also often unfamiliar

with deconstruction, leading to rejection of the concept or prohibitively expensive cost estimates. In reality, an adaptive reuse project in the US reduces construction costs by 16% and shortens schedules by 18% over new construction. With escalating material prices and longer lead times for new materials, this difference is likely to increase.

### Policy Gaps

The Boston regional area has no current guiding policies or incentives promoting deconstruction and reuse. Lacking clearer guidelines, many resort to implementing green building rating systems such as LEED, WELL, or Living Building Challenge without other innovations. Without robust policy that incorporates feedback from the industry and grows with the reuse ecosystem, effective industry change cannot occur.

### Limited Training Opportunities

On the execution side, educational and training resources for project teams are severely lacking. It has become an “easy out” for many members of the AEC industry to point to a lack of developed training, or guiding hand, to justify hesitancy in deconstruction training and implementation. In many cases however, this training constitutes a simple shift in typical practices and not a complete reworking of accepted practices.

### Demolition vs. Deconstruction

While pilot programs started by the city are currently underway, many in the region still see deconstruction and material reuse as radical ideas. As a result, new projects assume that buildings and spaces should not be considered for deconstruction as demolition is the “normal” procedure. New construction and major interior renovations that do not include deconstructable materials or assemblies can further exacerbate this problem, continually pushing the problem to a later date.



# Designers

**Many architects, engineers, and interior designers are accustomed to seeing the opportunity of a blank slate after an existing space is demolished, instead of seeing the material resources at hand.**

There is opportunity for deconstruction and reuse in every part of the building but often the easiest place to start is the interiors. Recent studies show that the embodied carbon of a building’s interior may surpass that of the building core and shell due to the frequency of interior renovations over time. If these materials can be salvaged, the emissions from new material manufacturing can be avoided. Reuse would then ensure the diversion of construction and demolition waste material from landfills and repurposing wherever possible.

Despite this opportunity, many barriers limit implementation of reuse to date. These barriers include a lack of knowledge about where to source reclaimed materials and what is available, and a lack of quality assurance or warranty on the materials themselves. There is almost certainty with new materials that we will get what we specify, but if the reuse market is still niche then there is more uncertainty between the point when a designer specifies something and when a contractor purchases it. In some, but not all cases, the additional cost of union labor can lead to a higher price for using reclaimed materials than purchasing new. Often, when the topic of reuse or salvage is brought up on a project, it is already too far along to implement. Salvaged materials are difficult if not impossible to warranty and may create additional risk or liability to owners or designers.

While there is an abundance of supply, the demand for salvaged materials in the market is considerably lower. Salvaged can often be misinterpreted as old and worn. Many salvaged items can be designed into a building without anyone knowing they had a previous life, but it is also possible to find distressed items. The irony is that many designers prefer to specify new products that have been made to appear historic, old or industrial.

### What do we need to be doing?

All members of the project team need to be thinking in terms of deconstruction and reuse rather than demolition and disposal. It is the responsibility of designers to use this thinking and others will follow.

Designers can shift their mindset to consider the existing materials in buildings as valuable resources that do not need to be bought or manufactured. In early design presentations, include salvaged materials, and help your clients to see the value of existing materials too.

Furthermore, existing products are being reused or new ones installed, they should all be designed for disassembly and future reuse. This will maintain the value of these materials far into the future and help us overcome many of the challenges that are currently experienced with attempting to reuse materials. Recording the deconstruction process on the drawings will assist future contractors.

As shown by the [Design for Freedom](#) movement, understanding the social impact of our material choices is extremely challenging. The supply chains of increasingly composite materials are long and complex, spanning the world. Building with salvaged materials lessens reliance on opaque supply chains for materials at the highest risk of embedded slavery.

## How do we get there?

Start today, even with a small step. There are many ways that designers can take immediate action to start salvaging and reusing and making it easier for future designers to do so.



### 1. Integrate reuse into your designs

- Use the resources provided by [Recycling Works MA](#) to understand opportunities for reuse, how it can be cost-effective and how to include salvaging and reusing in bid documents for deconstruction contractors.
- [Think outside the box](#) about how to make existing materials desirable and repurpose them in different ways without reducing their value. For instance, structural timber salvaged from a building does not need to be reused as structural timber. Include ‘design as finish’ approach when and where appropriate, which is great for interior-only projects. Consider if the structure or mechanical systems can be exposed and used as part of the aesthetic.
- Source and specify products that support a circular economy. [Circular Product Design Framework](#) | [C2C](#)
- [Design for adaptability, deconstruction, and reuse](#) from the beginning and record how this should be achieved through documents and BIM models.
- Rename your demolition drawings to ‘deconstruction’ drawings.
- Create a draft waste management plan for a project to include in the bid documents which records the reuse or recycling intent for the different materials in the project. Include a step by step process of how deconstruction differs from demolition for certain materials. Often it is a small change but won’t be performed unless it is explicitly stated.
- Revamp your specifications to include [lower embodied carbon materials and finishes](#), or accept salvaged alternatives.
- Include methods of deconstruction on the drawings.
- Use a [data-driven design approach](#) when evaluating the benefits of building reuse, versus building new.

### 2. Develop Strategic Partnerships

- Partner with local reuse material vendors early in the design process when you identify materials that may be salvageable and of interest to them. Even better - when possible, design products and materials from these outlets into your new projects.
- Prominent regional reuse vendors to consider are:
  - [Doors Unhinged](#) - Salvaged and refurbished commercial doors.
  - [Eco Building Bargains](#) - MA regional reuse vendor for residential use.
  - [Boston Building Resources](#) - Boston-based reuse vendor and community resource with primarily residential clientele.
  - [The Furniture Trust](#) - Boston-based nonprofit offering turnkey diversion services for commercial furniture including donation to local nonprofits, resale, and recycling as needed.
  - [Habitat for Humanity Restore](#) - Reuse vendor affiliated with Habitat for Humanity with multiple locations throughout Massachusetts.
- Finding local reuse vendors and deconstruction resources is becoming easier as well, and initiatives such as [All for Reuse](#) have launched maps that help crowdsource entities that can assist in these efforts. One example is their [ecosystem map tool](#), which can help projects and owners not only find reuse resources but also help existing companies expand their market presence.
- Communicate with suppliers of materials that offer take-back programs (such as [Armstrong](#), [Shaw](#), or [Interface](#)) and update typical material libraries to remove products that don’t have take-back programs where competitors do.
- This can help identify products that are most often replaced and start by specifying or finding reuse opportunities for these, such as [furniture](#), carpet tiles, and acoustic ceiling tiles.
- Work with repeat clients, contractors and consultants to get buy-in prior to the next collaborative project.

### 3. Advocate:

- Start a conversation with clients and contractors about the opportunities for deconstruction and reuse of materials.
- Aim to understand any objections that may arise and work through them together, emphasizing the importance of your partnership and how you can develop goals for reuse together.
- Share your successes and challenges with other designers so we can all learn and move forward together.
- Don’t wait until the perfect project or case study comes along, speak up about your lessons learned even when you’re still figuring things out.

# Contractors

**By eliminating the erroneous concept that “sustainability equals higher cost” and fostering collaborative education in new systems and the changing industry, construction teams can start to see deconstruction and material reuse as the evolution of their work, and not an expensive pipedream.**

Traditionally, general contractors/construction managers (contractors) work best with a “business as usual” attitude. Builders are slow to adopt change outside of clients’ demands, as the competitive bidding atmosphere of work in this industry adds what many see as “undue risk” when incorporating in-house progressive change.

Historically, unless a client is specifically requesting a sustainable construction method or material, contractors will trend towards that with which they are comfortable. Due to the construction industry’s reliance on experience, reliability, and replicability, many contractors will work within a defined framework.

- Have we completed a similar project before?
- How can this project be replicated or bring in more work in the future?
- How much risk does a project opportunity bring to the company?
- Can a new opportunity expand opportunities into a different market share?

This long-standing framework has been clogging up innovation and sustainable change in the

construction industry for many years. Risk-averse contractors see building and material reuse as added exposure, rather than an opportunity for growth and positive industry change.

In many cases, when presented with two options (material reuse/deconstruction or regular demolition and trash removal), the contractor will price the more sustainable option so high that even a sustainably-minded owner will hesitate to take that option. By “covering costs” of the perceived added risk, many contractors shy away from meaningful change in the industry.

Furthermore, as construction and demolition schedules are becoming more condensed and accelerated, considerations for trash and material removal on jobsites transitions from an active consideration to a perceived speed bump in efficiency.

Unless the project specifications, owner requirements or municipal policy mandates waste diversion, a majority of contractors will do the bare minimum so they can increase schedule efficiency (and therefore decrease costs).

## What do we need to be doing?

Of all the groups working towards a circular economy, contractors can have the largest impact in this roadmap. By shedding the typical and comfortable “business as usual” mindset, contractors can help bring sustainable change to the building industry.

In a more informed market, contractors embrace the following:

- Diverting waste, deconstructing, and reusing materials in the estimation process.
- Engaging with the project team during preconstruction to minimize embodied carbon impacts through smart material selection.
- Working with subcontractors to understand the impacts of a changing market on schedule, labor, and material costs.
- Internally training project teams on the benefits of deconstruction, the intention of green building systems, and the impacts that traditional construction methods have on EC and the local, regional, and national waste process.

By eliminating the erroneous concept of “sustainability equals higher cost” and fostering collaborative education in new systems and the changing industry, these teams can start to see deconstruction and material reuse as the evolution of their work, and not an expensive pipedream.

## How do we get there?

The best way to transition contractors from “business as usual” to “embracing sustainable change” is to answer their questions and address their misconceptions.

### How can my project teams understand the importance?

Training grants, such as those from local resources such as [Built Environment +](#) or [Massachusetts Clean Energy Center](#), provide free workforce training for project managers, field staff, and estimators. This training can be customized to meet contractor needs, and supplemental funds are available each year.

### How do I know what I need to be doing?

Organizations such as [Re-Use Consulting](#) led by Dave Bennink have been deconstructing buildings for the last three decades across the US. In addition, [Second Chance](#) is both a reuse vendor and deconstruction workforce development training in the local region. Servicing New England, [Deconstruction Works](#) provides both residential contracting services as well as education and consulting for contractors.

### Where can all the waste typically thrown into landfills go?

Working with waste haulers, C&D guidance resources from [Recycleworks MA](#), and local reuse companies, much of the C&D waste typically generated can be properly recycled, reused, salvaged, or sold. In addition, manufacturer take-back programs have grown in scale and simplicity in the recent past, with ceiling, electronics and flooring manufacturers offering free removal and 100% recycling of their respective materials.

### The costs will be excessive and the unions won’t agree to these changes.

Many projects in the area have achieved little to no additional waste. When properly planned for and sorted, waste haulers can charge less for dumpster hauls, saving the project money. Additionally, many local deconstruction pilots are actively working with

unions to understand the impacts of jurisdiction and crew requirements. As demolition subcontractors begin to understand the nuances and changes in practice to move towards deconstruction and material salvage, current practices of risk-averse overbidding can normalize as operational ignorance is dispelled.

A common misconception is that deconstruction and reuse equates to replacing all demolition activities immediately. While this may be the eventual goal, starting the process with enhanced waste diversion and working towards deconstruction of reusable assemblies is the perfect first step. Contractors and their subcontractors need to walk before they can run.

By highlighting success stories with robust data to prove a return on investment, contractors will begin to become experts on material reuse and deconstruction to gain an edge on their competition and realign business practices to keep bid costs low.

As greater importance is placed on these changing practices, partnering with building material reuse vendors will become critical in understanding how to move items from demo sites to resale or reuse centers efficiently. Contractors are known for creative building solutions, and will do all they can to fulfill the client's needs. As clients with corporate ESG requirements continue to skyrocket, builders will need to adapt and innovate to match the changing landscape.



## Policy-Makers

**Deconstruction and reuse policy in the Boston, Massachusetts region is in its infancy. As the area begins to more broadly integrate embodied and operational carbon considerations into legislative policy, it is expected that building and material reuse policies will not be far behind.**

As of Spring 2022, Boston is in the midst of piloting a deconstruction initiative in collaboration with their zero waste goals. Additionally, state bodies like the Massachusetts Department of Environmental Protection have been incrementally improving policy around C&D waste, but do not have defined reuse or deconstruction standards.

Some local municipalities and government entities, such as the city of Cambridge and Somerville, require GBRS such as LEED for new construction and major renovations. These GBRS can promote deconstruction and reuse by increasing the required waste diversion percentages to which a construction project must abide.

Simply put, if there was a mandate that all buildings must be deconstructed and all materials reused and salvaged without carefully planned industry incubation and development, the industry would never hold its own weight. However, without a defined policy stating that reuse must be considered, many projects will instead attempt to dispose of or recycle a majority of C&D materials, rather than considering reuse vendors or manufacturer take-back programs.

### What do we need to be doing?

Mimicking other successful programs around the United States, the Boston and Massachusetts regional policies need to incorporate incentives and education to help grow the fledgling reuse and deconstruction industries.

Proper Incentivization: many West coast cities (such as Seattle WA and Portland OR) have successfully worked with contractors and owners to reduce permit times or provide financial grants for projects that move away from demolition and promote deconstruction. By reducing the time it takes to be granted a permit, schedule savvy owners will look into how they can most effectively move their projects forward.

#### Targeting infrastructure:

By requiring waste diversion reporting, as seen in Nashville TN, construction projects build up internal and external reporting rates. A requirement to disclose the end-state facility, along with waste diversion percentage, will spur projects to bolster their own methods and infrastructure and help familiarize project teams with better waste practices.



Mandating a high but achievable waste diversion proportion, such as 75 percent as seen in [San Francisco CA](#), will prompt many projects and companies to explore efficiency options to reach higher diversion goals. Many will look to find a 100 percent recycling option, like reuse companies, take-back programs, and highly recyclable materials.

Moving forward, introducing a measurable factor of disassembly or deconstruction will naturally lead to circular economy companies assisting in the removal and resale of commercial items.

By reallocating or using city-owned properties as storage space to assist reuse vendors in storage and categorization of reused materials, the question of “where does it go in the meantime?” can be solved. In San Francisco, the city has partnered with reuse organizations to provide necessary laydown and storage space to further bolster its [virtual reuse warehouse](#), while promoting the cheaper products and materials for new projects or community use.

#### Combining green building with social equity

Combining environmental and social justice has been seen to further promote the adoption of deconstruction and reuse, as seen in [Hennepin County, MN](#) (including the city of Minneapolis).

Understanding local industry needs and intertwining the needs of the community, reuse and deconstruction policies can allow for more robust funding if a project promotes both social and environmental equity.

Pre-Covid 19 pandemic, Baltimore MD had established [Details Deconstruction](#), a social enterprise that helps train individuals from low-income communities to work on deconstruction. It also began developing policy to promote residential deconstruction in the communities where deconstruction training was taking place.

#### Correlating impacts of building and material reuse to climate action

Policies and ordinances that link the embodied carbon benefits of reuse and deconstruction to climate action plans have seen great success in demonstrating the “why” behind these new policies.

Carbon Action Plans, as seen in cities like [New York](#) and [San Diego](#), help promote a timeline for the region to transition from a fossil fuel-based economy to a carbon-neutral, electrified economy.

Cities such as [Oakland CA](#) (near [Marin County](#)) and [San Francisco CA](#) have developed action plans that intertwine the impact of buildings, construction, and material reuse with carbon impacts. Once this connection is made, the natural next step emerges in categorizing embodied and operational carbon benefits of reuse and deconstruction as a way to achieve a more holistic zero-carbon future.

#### Assisting historical preservation through adaptive reuse

Link historic preservation to deconstruction and reuse as a way to maintain the culture and importance of buildings. [San Antonio TX](#) and [Milwaukee WI](#) both defined municipal legislation that promote the protection of historic buildings within emerging deconstruction ordinances, as well as sharing educational information and brochures to help the public understand the reasoning behind the shifting policies.

#### How do we get there?

We need to create policy to inspire meaningful and lasting improvements in the industry. To do so, policy-makers need to embrace stepwise change that incorporates an incentive structure while continuously improving on the lack of reuse and deconstruction infrastructure.

**Plainly stated, when starting from scratch, the following are the most effective tools across the U.S. in promoting material reuse and deconstruction:**

**Mandatory waste diversion reporting for projects, as found in [Nashville](#) via the [municipal Debris Management Review](#)**

**C&D waste recovery and reporting requirements, as found in [San Francisco](#) and [Seattle](#)**

**Deconstruction grants, allowing projects to overcome deconstruction cost premiums as found in [Oregon](#)**

**Deconstruction permit incentives**

**Robust deconstruction ordinances that combine all stakeholders and the community, as found in [Milwaukee](#), [Palo Alto](#), [Portland](#), and [San Jose](#)**

Without the infrastructure, reuse and deconstruction will only add to the waste problem the building industry faces. In Pittsburg, a well-intentioned residential deconstruction ordinance led to many becoming disillusioned with the idea due to the lack of space and market for the deconstructed residential buildings.

As Boston is a historic city, tying historic preservation to building and material reuse can help all parties involved. Keeping external facades and structural elements intact, while reusing, salvaging, and properly replacing any interior finishes or materials, will maintain the culture of the community while promoting better, healthier, and less carbon-intensive buildings.

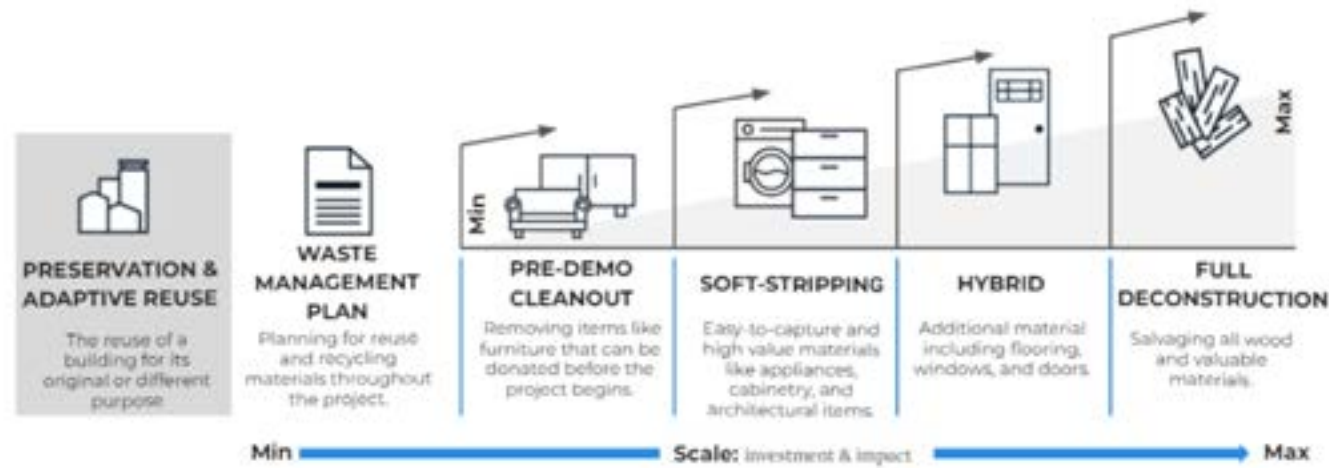
Using the current wave of social equity consciousness, marrying social equity to deconstruction and reuse can be further strengthened through location-targeted reuse and deconstruction policy. Communities that have historically been victims of environmental racism and injustice can reclaim and maintain their heritage and culture, while improving their lives through new educational programs and training deconstruction.

By bringing together all stakeholders, the process will start slowly with mandates on what is already possible, such as high waste diversion rates for projects. Introducing change through permitting brings the AEC industry into the fold and can create a strong incentive for project teams to adopt emerging deconstruction policies. Two relevant municipalities that have created robust deconstruction ordinances are [Seattle, WA](#) and [Victoria, BC](#). In both of these cases, the ordinances are the culmination of several different waste reduction efforts, spanning multiple years of community and industry involvement.

As of Winter 2021/2022, Boston began to pilot deconstruction as part of its zero-waste initiative. Through consultation with partners, a stepwise process is being developed to learn as much as possible and also be able to teach partners how to best tackle the growing need for deconstruction.

One of the strongest and most well-known non-profit organizations that helps to bring about change in the built environment is the United States Green Building Council (USGBC), the creator of the LEED rating system. While their catalog of innovative credits has historically pushed much of the industry in a much greener direction, they have also begun to recently understand the greater impact of C&D waste. In 2019, the USGBC published a [policy brief](#) on deconstruction and reuse, hoping to begin pushing broader integration of this necessary aspect of the construction process.

Combining all of these efforts, as well as collaboration with local communities to understand their needs, policy, and legislation can begin to target those who have the most to gain from these changes.



Credit: City of Boston Deconstruction Initiative



## Owners and Developers

**Owners and developers have the power to provide the largest changes to the reuse and deconstruction market. By working with design teams and understanding that reusing materials comes with reduced cost and lead times, owners can be incentivized to jump on these opportunities.**

Currently, many owners and developers are ignorant of the benefits of building and material reuse in their projects. While some sophisticated owners may understand small benefits to overall sustainable construction and design tenants, reuse is often never considered.

Most developers or large owners operate at thin margins, and typically consider any additional design or construction alternatives as too much risk, whether it be financial or temporal.

For example, in a typical tenant fit-out in a Boston office space the owners:

- Have a set idea of how they want a new space to look, based on corporate branding or vision.
- Often do not want or care about the existing material in the space.
- Do not want the financial burden of disposing of the existing material.
- Often do not understand the value of the amount of salvageable material, including furniture, carpet and ceiling tiles, light fixtures, doors, and other highly reusable materials typically left.

Larger owners/developers look to fill spaces quickly or create new projects that have a high likelihood of a significant return on investment. Buildings transitioning to life sciences work, an extremely in-demand industry, will strip existing spaces down to core and shell and look to quickly retrofit a space. Many times, in their haste to rebuild and rebrand a space, the remaining materials are seen as a nuisance, not an opportunity.

However, with the growing importance of ESG reporting, many owners are looking to improve their building practices to reflect the changing attitudes of investors and communities towards sustainable and environmentally beneficial practices.

### What do we need to be doing?

Owners and developers have the power to provide the largest changes to the reuse and deconstruction market. By working with design teams and understanding that reusing materials comes with reduced cost and lead times, owners can be incentivized to jump on these opportunities.

Large owners in the region, such as Boston Properties, CBRE, and Alexandria, often own several sizable buildings close to each other and can benefit most

from salvaging like-new products and materials to use in their other leased spaces. These owners have the easiest time piloting deconstruction projects on many of their typical quick turnover spaces.

An owner that allows deconstruction of their leased spaces and reuse of materials allows design teams to bring more potential tenants to spaces, and can decrease the upfront cost of move-ins. With the two to five-year turnover of typical spaces in the Boston market, salvaging materials such as doors, light fixtures, and furniture can allow new tenants to move in more quickly, at a lower cost, and with a much lower embodied carbon impact.

Additionally, owner contracts often stipulate that a certain percentage of materials on projects are reserved for attic stock or storage to use for material reuse laydown space. These spaces can enable owners to both quantify and categorize materials with which designers can plan new spaces.

A living stock list allows design communities to know exactly what they can work with, what matches the building space, and how much material may need to be ordered. Less waste correlates to less hassle, a request from every owner.

Going a step further, owners can address salvage and reuse in their RFP language. They can require the design to promote later deconstruction, fundamental reuse of materials in the current space, or that those materials are salvaged and donated or returned to manufacturers with take-back programs (where applicable).

## How do we get there?

While new changes in policy and legislation can certainly motivate owners to begin more fully embracing building and material reuse, owners can promote deconstruction and reuse in the region with the following steps:

1. Integrate educational materials on the benefits of green buildings, including the many financial and scheduling benefits of building and material reuse, and energy-efficient practices into building operations.
2. Develop policies that require designers to review tenant spaces for opportunities to deconstruct and reuse materials and limit C&D waste leaving owned project sites.
3. Examine attic stock and physical laydown space to determine the feasibility of storing typical building material used in tenant renovations.
4. Incorporate deconstruction and reuse as a method of lowering the embodied carbon impacts of projects, and reducing further operational carbon impacts.
5. Quantify and transparently report findings of implementing these policies to help build momentum and help refine the aforementioned policies.

In many cases, owners moving into spaces or controlling large buildings simply do not want to worry about where the previous tenants' materials are going, seeing it truly as waste and needing it gone.

By educating owners and developers about the tax incentives of donating to nonprofits, along with the benefits of guaranteed material availability on lead times and costs, many of the decisions made daily can shift towards reuse and deconstruction.

In Massachusetts, several current laws and policies are pushing building owners towards lower embodied carbon decisions. With Boston moving towards a zero net carbon standard, building and

project owners need to see that material reuse and deconstruction are great ways to lower the embodied carbon profile of a project immediately.

Lastly, corporate ESG reporting is becoming a much higher priority for many mid-size and above corporations. Public opinion towards the climate crisis and better environmental decisions is causing companies to ramp up their corporate and construction standards.

By embracing and understanding the benefits of reuse in reducing embodied carbon of projects and the reduced impact of C&D waste, owners and developers can benefit in the public eye. Several toolkits and online calculators are also available to exactly calculate the carbon, energy and waste savings of deconstruction and reuse, such as the [CLF Embodied Carbon Toolkit for Owners](#).

**Owners can address salvage and reuse in their RFP language. They can require the design to promote later deconstruction, fundamental reuse of materials in the current space, or that those materials are salvaged and donated or returned to manufacturers with take-back programs (where applicable).**



# Project Support and Innovation

**These stakeholders, while not always directly involved in project decisions, help the industry develop best practices, maximize safety and efficiency, and spur innovation.**

In the AEC industry, there are several layers of project support that typically influence decisions made before, during and after construction. These stakeholders, while not always directly involved in project decisions, help the industry develop best practices, maximize safety and efficiency, and spur innovation. NGOs, advocacy groups, nonprofits, and researchers play an important role in leading the wider industry to take action on critical matters that require expert opinions, experience, and innovative thinking.

A recent example of such action can be seen with the collaboration between [The Carbon Leadership Forum \(CLF\)](#), non-profit [Architecture 2030](#), [American Institute of Architects \(AIA\)](#), and [Structural Engineers Institute \(SEI\)](#) who have begun to address embodied carbon in the built environment through research and educational outreach.

Researchers are also crucial in improving and developing new technologies, tools, and methods. Starting with simple ideas, researchers help to explore the logistical, material and structural

problems within the built environment to spur industry innovation. While oftentimes slow to make a significant impact, breakthroughs and new products need to be first tested, refined and then adopted at scale by the construction industry. This formula has proved difficult in an industry which is slow to change and has little incentive to do so.

Generate Architecture and Technologies, a startup company out of MIT and Harvard University, headed by John Klein, is an example of research to implementation. Generate is building a five-story affordable housing block in Boston that will use their Model-C prototype “kit of parts” system. This system is a type of modular prefabrication that allows for [disassembly and reuse](#).

Ecovative is a collaboration between Columbia University, New York University (NYU), and the Massachusetts Institute of Technology (MIT) to demonstrate the feasibility of mycelium grown composite buildings [and other exciting building technologies](#). In initial pilot programs, this collaborative was able to develop alternative

material bricks that were grown in just five days, producing no waste or carbon emissions. When the structure was taken down at the end of the summer, the bricks were composted and [turned into fertilizer](#).

Researchers at Washington State University are tackling the circularity issues of gypsum wallboard (GWB) recycling and reuse by transforming GWB scrap and waste into [new building materials](#). The technology at pilot scale shreds GWB, combining the shreds with chemical binders to create both alternatives to concrete blocks (drywall waste blocks) as well as new wall systems (drywall waste walls). It is the hope that these products create a defined method of recycling and reusing GWB, with an end market of interior projects that use the drywall waste walls to replace typical wall assemblies.

Deconstruction has enormous equity and social justice benefits for the local community around a project, primarily because six times more jobs are created through deconstruction than demolition. The benefits can be maximized by working with impact driven organizations, a few of which are listed below, in one form or another.

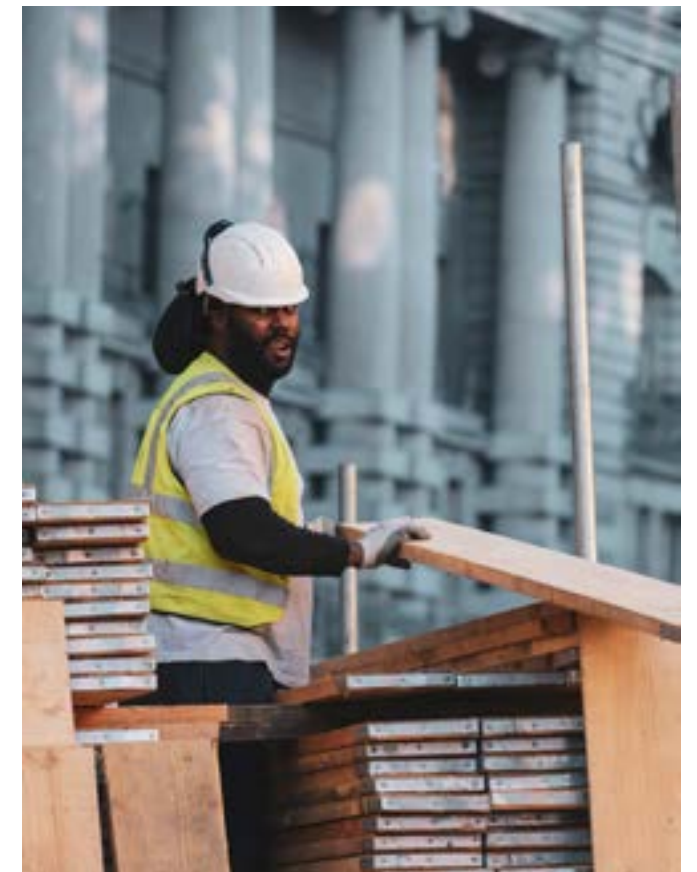
- [Second Chance](#) provides job training and workforce development for those with various employment obstacles in the Baltimore region.
- [Better Futures Minnesota](#) work with previously incarcerated men who want to make a better life for themselves, their family and community.
- [YouthBuild Boston](#) provides underserved young people with the support and credentials needed to successfully enter the construction and design industry.
- [Roca](#) works with young adults who have experienced extensive trauma and are the primary victims or drivers of urban violence. Roca supported the clean-out process of [Elias Brookings School](#).

In the local area, several nonprofits provide project support in the form of resale or marketplace services for salvaged materials. [Boston Building Resources](#) accepts donations of good-quality used and surplus building materials and sells them at discounted prices for low-income customers and other nonprofits.

[RecyclingWorks MA](#) plays a similar role, albeit as a MassDEP funded recycling assistance program. These organizations will be important in collecting data to demonstrate the feasibility of deconstruction and in connecting a fragmented network of reuse organizations across the US.

At a national scale, [Build Reuse](#) is a non-profit that encourages the recovery, reuse, and recycling of building materials, accelerating adoption of circular-economy principles within the built environment and providing a member directory of reuse professionals across the country.

[The Furniture Trust](#) works with businesses to coordinate furniture removal and donation to other local nonprofits, effectively keeping used furniture out of landfills and supporting communities at the same time.



**Six times more jobs are created through deconstruction than demolition.**



# Roadmap

<b>DESIGNERS</b>	<b>CONTRACTORS</b>	<b>POLICY MAKERS</b>	<b>OWNERS &amp; DEVELOPERS</b>	<b>PROJECT SUPPORT &amp; INNOVATION GROUPS</b>
<ul style="list-style-type: none"> <li>» Change language from demolition to deconstruction</li> <li>» Mandate mandatory waste diversion for waste leaving site in specifications</li> <li>» Specify salvage and reuse over demolition and disposal in bid specifications</li> <li>» Specify materials salvaged from the building or from reuse vendors in designs</li> <li>» Design for disassembly and reuse</li> </ul>	<ul style="list-style-type: none"> <li>» Buy from reuse vendors and sell/donate salvaged and excess materials</li> <li>» Transparently price and bid deconstruction projects</li> <li>» Use as-built BIM to record materials used in</li> <li>» Report waste diversion on all projects</li> <li>» Reduce waste on site through site efficiency improvements</li> </ul>	<ul style="list-style-type: none"> <li>» Incentivise deconstruction and reuse</li> <li>» Support incubation of new and innovative reuse companies</li> <li>» Require minimum waste diversion and reporting</li> <li>» Use deconstruction as an opportunity for training and green job growth</li> <li>» Transition demolition permits to deconstruction permits</li> </ul>	<ul style="list-style-type: none"> <li>» Change language from demolition to deconstruction</li> <li>» Mandate mandatory waste diversion for waste leaving site in specifications</li> <li>» Specify salvage and reuse over demolition and disposal in bid specifications</li> <li>» Specify materials salvaged from the building or from reuse vendors in designs</li> <li>» Design for disassembly and reuse</li> </ul>	<ul style="list-style-type: none"> <li>» Buy from reuse vendors and sell/donate salvaged and excess materials</li> <li>» Transparently price and bid deconstruction projects</li> <li>» Use as-built BIM to record materials used in</li> <li>» Report waste diversion on all projects</li> <li>» Reduce waste on site through site efficiency improvements</li> </ul>

## Conclusion

“All stakeholders in the construction industry, including design teams, owners, contractors, and policy-makers, have a pivotal role to play in helping realize a better construction process by promoting deconstruction and reuse.”

New England, dominated by progressive change flowing out of large cities like Boston, is ripe for change in the construction industry. While the idea of deconstruction and material reuse has been floating around in the industry and region for a while, changes in technology, public perception, and the realized threat of climate change have pushed these ideas to the forefront.

All stakeholders in the construction industry, including design teams, owners, contractors, and policy-makers, have a pivotal role to play in helping realize a better construction process by promoting deconstruction and reuse.

**Designers** have the ability to alter specifications, change drawings and mandate better processes in the design process. By making the choice to design with better materials and with disassembly in mind, construction projects can move from wasteful to opportunities for community enrichment.

**Contractors** can work to educate their staff and subcontractors, while making small changes to current waste practices to make sure waste is diverted from landfills. After better waste practices have been implemented, collaboration and partnership with reuse vendors and manufacturers can help keep items slated for demolition away

from waste and back into functionality.

**Owners** have the ability to assist this movement, while also keeping costs low, and tenant spaces attractive. By assisting with space and storage concerns, as well as helping develop building design standards and reusing typical materials like doors, furniture and some finishes, owners can set a profound example for others to follow.

Lastly, **policy-makers** can take inspiration from across the U.S. to draft legislation at all levels of government to ensure a lower carbon building process. Incentivizing innovation, targeting reuse infrastructure improvements, combining green building progress with social equity, linking green construction practices with climate goals, and connecting historical preservation to reuse and deconstruction are all policy goals that have proven effective and can easily be brought to our region.

While there are many paths that point towards a decarbonized future, embracing the circular aspects of deconstruction and material reuse is a path that the regional AEC industry must embrace. The current methods of C&D waste disposal, material use, and demolition will continue to tie our industry to unsustainable practices that reward few and impact many.

## Works Consulted

This roadmap was developed by the CLF-Boston/NE Deconstruction and Reuse Working Group. Any questions, comments or suggestions can be emailed to [CLFBostonReuse@gmail.com](mailto:CLFBostonReuse@gmail.com)

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# Boston Deconstruction and Material Reuse Roadmap