



This apartment building in Ithaca, New York, is being deconstructed, piece by piece, as part of a pilot project in sustainable demolition from Cornell's Circular Construction Lab. *Photo: Felix Heisel*

Citylab + Green

Appetite for Deconstruction

To reduce carbon emissions and building waste, architectural salvage and reuse advocates across the US are racing to reform the \$8.7 billion demolition industry.

By Patrick Sisson

May 15, 2024 at 7:30 AM CDT

The death of 206 College Avenue was slow and painstaking. Over several days in January 2022, dozens of bundled-up volunteers swarmed over the three-story property, a tired wooden boarding house built in the early 1900s in Ithaca, New York. Long used as rental apartments for Cornell University students, the 13-bedroom house was set to be demolished, along with several neighboring structures of the same vintage, to make room for a new multi-use complex. But while those buildings were quickly reduced to rubble by trackhoes, the house at 206 was deconstructed, piece by piece, so that its elements could be used again.

The Catherine Commons Deconstruction Project, an effort by Cornell's Circular Construction Lab, was a large-scale pilot designed to show how building waste can be kept out of landfills. As volunteers pulled nails out of fir oak, and walnut boards and hauled lumber off to be sorted and redistributed, a team of eight workers with heavy machinery began meticulously sawing, slicing and removing 8-by-18-foot panels of the old building. The panels were trucked off to a warehouse, where they'd be taken apart and recycled.



A team of workers removes wooden window frames from 206 College Avenue. Photo: Felix Heisel

The labor that went into this process was substantially more than a typical demolition. But it avoided the societal penalties left behind at nearly every building and demo site across the US. The sheer volume of waste generated by knocking down, adding to or renovating buildings in the US is stunning: 600 million tons of construction demolition waste annually, according to the most recent EPA estimate from 2018. Roughly 75% ge ground up into aggregate and fill, and only a small share is recycled and reused, necessitating production of new material for the next project. For scale, municipal solid waste only accounts for 300 million tons every year.

“Imagine every garbage can you take to the curb,” said Felix Heisel, an assistant professor at Cornell’s College of Architecture, Art, and Planning and director of the Circular Construction Lab. “Somewhere in the background someone else produces twice that amount in your name, essentially in society’s name, via construction and demolition waste.”

Demolition is now an \$8.7 billion industry in the US, fueled by the quickening cycle of building refits and teardowns. The purpose of buildings is changing more rapidly as tastes and commercial uses shift, leading to more frequent renovations. In many downtowns, a whole generation of office buildings – no longer marketable and costly to convert into housing – may soon be meeting the wrecking ball. And the turn away from vernacular materials to industrialization, cheaper goods, and time-saving techniques like gluing has created poorer-quality structures with shorter life spans.

“New material quality levels are dropping,” said Dave Bennink, director of the Building Deconstruction Institute and owner of Re-Use Consulting in Bellingham, Washington. “Things are getting thrown away at a younger age because they are garbage, frankly. If you think the problem is bad now, wait 10 years.”



Deconstruction is far more labor intensive than traditional demolition, but the Cornell researchers hope to prove that revenue from reselling materials can compensate for added costs. *Photographer: Jason Koski, Cornell University*

Traditional demolition techniques don't just waste materials: Flattening buildings with excavators, cranes or explosives can pollute the air and water, kicking up clouds of dust laden with dangerous substances like asbestos and lead that threaten the health of nearby residents and workers alike.

In search of a greener solutions, a cadre of designers, architects, advocates and thrifty do-it-yourselfers are exploring ways of reducing and diverting the building waste stream. Alternatives to demolition include circular construction – building new projects in a way that allows raw materials and parts to be reused rather than destroyed – or deconstruction and salvage, which involves removing usable elements from buildings being taken down. Roughly 90% of buildings can be recycled or reused, according to a Delta Institute study.

Contemporary efforts to make buildings more energy efficient, which requires more complex materials, has actually resulted in structures that are harder to dispose of and reuse, according to Heisel. In effect, these efforts often increase the embodied carbon (emissions used in making the materials for construction) to bring down the operational carbon (emissions used to operate and heat the buildings).

Read more: [Climate Change Is Forcing Building Materials of Cities to Change](#)

While it's critical to reduce the climate impact of the built environment via electrification and better building envelopes, that's not necessarily the full story. Operational carbon savings – which represent 27% of lifetime carbon emissions of a building – accrue slowly over years and decades, while emissions from all-new construction materials are baked-in when the doors first open. The industry group Architecture 2030 says decarbonizing at the speed needed to track with Paris Agreement goals means a 50% to 65% reduction in building carbon emissions over the next six years. Embracing material reuse and circular construction can make the biggest difference in that short window, Heisel argues.



An A-frame home, mid-deconstruction. Photo courtesy Dave Bennink

Amid this realization, the building material reuse industry seeks to scale up. There are more than 1,500 groups nationwide devoted to reclaiming construction waste, according to [Build Reuse](#), a 30-year-old nonprofit. To expand the market, the group lobbies for policy changes, encourages workforce development and uses technology to identify and match salvaged materials for new projects. The organization has been developing a community reuse toolkit to help cities and towns follow best practices and design new policies.

Increasingly, a number of municipal efforts, including ordinances in Portland, Pittsburgh and San Antonio, seek to play a role in diverting construction waste and reusing materials. Heisel counts at least 15 such ordinances around the country so far. Tacoma, Washington, for instance, just passed an ordinance [mandating the development of a building reuse plan](#) as part of meeting its broader climate goals.

“There’s an economic development part of it, a historic preservation part of it, and an environmental part,” said council member Kristina Walker. “I certainly started with an environmental lens on this. But what makes really interesting for a city is that it touches on all three.”

Throwaway Buildings

Developers who specialize in historic properties have long repurposed old materials: The popular aesthetic of rehabbed factories-turned-condos or warehouses transformed into innovation hubs often involves displaying

old signage and original timber as trophies of authenticity. But that kind of reuse falls far short of the full-scale industrialization of the practice needed to significantly reduce emissions.

A significant part of the industry focuses on residential materials and clients, which makes sense considering the vast market for home rehabs and the do-it-yourself nature of many such projects, as well as the lower budgets and less constrained timeframes under which they operate. The demand for these materials is there, and traditional deconstruction ordinances from cities can help boost that supply. That's why the Habitat for Humanity ReStores, nonprofit home improvement stores and donation centers, make up a significant chunk of the architectural salvage industry.

Other players look like the Lifecycle Building Center, a sprawling warehouse in Atlanta's Murphy Triangle neighborhood filled with stacks, rows, and piles of doors, windows and reclaimed timber. It's so big, in fact, the unused portion of the warehouse was large enough to be used as a set for the *Walking Dead* TV show. (The center also facilitates reuse of wood and other materials from Atlanta-area film and TV shoots.)

"Everything right now within our industry is about how we scale and how our industry adjusts and evolves to support the commercial sector," said Shannon Goodman, executive director of the Lifecycle Building Center.

The commercial building industry offers both more potential for carbon savings and more hurdles. Andrew Ellsworth founded the Pittsburgh-based company Doors Unhinged in 2012 with commercial buildings in mind, noticing the huge amount of material getting tossed out from demolition sites. He literally dove in, stripping doors from an office building in Pittsburgh with his own tools, without a pickup truck or a warehouse.



A salvaged door is refinished and prepared for resale by workers at Doors Unhinged. Photo courtesy Andrew Ellsworth

Homes might go decades between rehabs, but there's a constant churn of work in commercial spaces. The American Institute of Architects found in 2022 that billings for renovations overtook new construction for the first time. While reuse saves significant carbon compared to ground-up work, there are also a lot of rehabs and

infill projects that, as Bennink says, are more about opportunity or profit than necessity. AIA data found that interior modernizations and upgrades represent a quarter of all commercial renovations, and 17.8% are tenant fit-outs.

“Over the lifetime of that office building, there can be 10 refreshes,” Ellsworth said of office buildings. “You have these materials that are practically new and super-expensive going to the landfill. And then we’re putting things back in that are essentially the same.”

Doors Unhinged evolved to fit the complications of the industry in mind. Commercial builders order from specialized vendors, so Ellsworth picked one item to focus on, and they now refurbish doors and offer a warranty for their products, since clients won’t utilize items without a certain degree of protection.



A California office complex built in the 1980s meets an untimely end: demolished to make way for a logistics hub in 2024. *Photographer: Dania Maxwell/Los Angeles Times via Getty Images*

Ultimately, all the players in the system want risk-free certainty in material supply, without added time and labor costs from deconstruction. That’s why the US lacks national reuse or embodied carbon requirements, as in France, or salvage pledges among professional building organizations. The Association of General Contractors, for example, recently released a guide to help members decarbonize their projects, but didn’t mention deconstruction.

Even architects and designers who want to use reused materials can struggle, due to client unwillingness and challenges with construction processes and building codes. Myrrh Caplan, head of sustainability at global development firm Skanska, said she’s “not seeing a huge uptick” in circularity because it can be so hard to get reused materials certified. She points to a concrete block product called Pozzotive, which utilizes reclaimed glass from construction sites. Despite the material’s environmental positives, and the fact that it was actually stronger than traditional blocks, it took the firm six years to get approval for use.

“The problem with commercial is we don’t have adequate demand, but we have infinite supply,” Ellsworth said. “Ordinances don’t work, because you’re just putting a lot of supply out there that isn’t being used. It’s like what happened with recycling in the early ’90s. Everyone was collecting recycling and then there were literally barges driving around the world, trying to figure out where to dump stuff.”



A stock of recovered fixtures await their next lives. Photo courtesy Dave Bennink

Still, a handful of success stories points to the industry's potential. In April, Bennink rescued about 300,000 pounds of doors, lights, cabinets and other fixtures from the Harrison Medical Center in Bremerton, Washington. The [Kendeda Building for Innovative Sustainable Design](#) at Georgia Tech, a timber building that opened in 2019, utilized so much salvaged and reused materials it ended up taking more out of the landfill than it sent in.

To scale up these one-off efforts, the industry needs new business models and ways of encouraging architects, contractors and developers to sign on. Goodman has been working on modular walls made from reclaimed and reused wood, pre-made to meet the needs of affordable housing projects. That way, the theory goes, you're dealing with the supply and demand problems at once and providing a regular product contractors can become accustomed to using.

Eventually, there needs to be more technological integration and transparent material data, like environmental product declarations, for used items. Goodman touts programs like [Rheaply](#), which helps track and build an online storefront for used materials, or what she calls "materials-as-a-service" systems that can provide contractors and designers information on reused pieces from buildings before they start designing new ones.

"The thing that's probably driving change more than anything is people actually being compelled to care about embodied carbon," said Goodman. "Projects have done all they can with more efficient operating systems. No it's about how we solve for embodied carbon."

Not Built to Last

To get a glimpse of what a fully reusable building might look like, see the [USA Pavilion for next year's Expo 2025](#), which recently broke ground in Osaka, Japan. Meant to be a physical manifestation of American

innovation, the pavilion is also a showcase of architectural sustainability. A pair of triangular wooden building linked by an illuminated, translucent cube, the entire structure is built to be repurposed after the event. Architect Trey Trahan, founder of New Orleans-based Trahan Architects, chose weathered wood to enable repurposing after the event, along with steel and tensile fabric recovered from the Tokyo Olympics and reusable HVAC and plumbing equipment.

Eventually, says Heisel, buildings can be designed with deconstruction in mind, making the process of taking them apart and adding them to the reuse stream far more straightforward and economical; the Design for Deconstruction movement has begun to outline ways to make this a reality, and the Circular Construction Lab conducting experiments aimed at boosting the bottom line of sustainable demolition. With Catherine Commons, they were able to show that the resale value of the products and materials in a deconstruction project can compensate for additional labor costs. It points toward the need for a different funding model, one that makes a larger upfront investment for disassembly and gets paid back over time for the sale of recuperated materials. The lab also suggests instituting a carbon tax and creating incentive programs that level the playing field for reuse and push the building industry to pay the true social cost of new materials.



An excavator makes short work of several homes in Ithaca. *Photographer: Jason Koski, Cornell University*

The current state of municipal policy on this front tends to be geared towards residential, with significant success. Portland, which broke ground with the first such ordinance in 2016, has seen the initiative divert 5 million pounds of waste from the dump annually.

Now, more cities are turning to commercial projects. Many municipal deconstruction ordinances give those pursuing reuse an advantage; promise to salvage, and you can start demolition immediately, whereas traditional demo-and-dumping requires waiting a few weeks. Incentivizing compliance is key. Tacoma seeks to collaborate with industry to design a system that will actually be utilized by builders.

“We can’t just put a mandate in place – it just doesn’t work,” said Walker of the Tacoma city council. “Other places have put mandates in place, and lack the labor force and incentive and a place for the materials to go. We have no interest in mandating something that will end up in the landfill.”

The best local policy would also lead by example. Ellsworth suggests governments set goals and policies to for public agencies to use salvage material to help establish a market for sourcing and supply. “The issues of waste

and climate change are ultimately going to land at the feet of local government,” he said. “They need to help launch the enterprises and have to be the first buyers.”

It’s also not necessary to solve the issue with one policy change or program. Smaller-scale salvage operations, such as spending just a few days stripping high-value materials from certain sites, or mandating reuse of specific commodities like glass partitions, structural steel and lighting, can help kick-start circular systems without seeking complete and time-consuming shifts.

“We’re at this point now where people are starting to see this as being something that’s more feasible,” said Ellsworth. “One thing salvaging doors did was change the nature of the conversation – from if and why to how when and where.”

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