



Pacific Coast Collaborative

Embodied Carbon Policy Case Studies



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Introduction

The Pacific Coast Collaborative (PCC) is a coalition of government partners on the Pacific Coast of North America working together to reduce greenhouse gas emissions and create a vibrant, low-carbon regional economy by transforming energy systems, buildings, transportation, and food waste management. The PCC consists of one Canadian province (British Columbia), three US states (Washington, Oregon, and California), and six major cities (Vancouver, Seattle, Portland, San Francisco, Oakland, and Los Angeles) leading on climate action.

At the COP26 meeting in Glasgow, leaders of the PCC announced the launch of the Low-Carbon Construction Task Force, a regional initiative to advance low-carbon materials and methods in building and construction projects. Through this initiative, the PCC will create a shared regional strategy to accelerate innovation, investment, and market development for low-carbon materials by leveraging the scale of the Pacific Coast regional economy. Low-carbon materials are materials that result in fewer greenhouse gas emissions over their life cycle. These emissions resulting from material extraction, manufacturing, transportation, installation, maintenance, and end-of-life are commonly called embodied carbon.

The Carbon Leadership Forum (CLF) is supporting the work of the PCC Low-Carbon Construction Task Force—a working group with representatives from the jurisdictions—to develop a regional policy action plan. The CLF, hosted at the University of Washington, has a mission to eliminate the embodied carbon of buildings and infrastructure by inspiring innovation to create a just and thriving future.

As the map below highlights (pages 4 and 5), every PCC jurisdiction has taken the first step to policy action by including embodied carbon in their climate action plans or announcing pledges or commitments (see ‘Planned Actions’ on map). Additionally, many PCC jurisdictions are implementing or working toward government procurement policies commonly referred to as “Buy Clean.” Cities have been leading the way in implementing zoning, reuse, and deconstruction policies, and most recently, embodied carbon requirements are beginning to show up in building code proposals and by-laws.

Overall, action around embodied carbon and policy in the PCC region is growing but requires increased awareness and support to thrive. Most current actions are planned, voluntary, or impact a small range of projects or materials. A low-carbon construction action plan developed by the PCC would help align activities across the region and strengthen the ability of both the public and private sectors to take the lead on low-carbon construction.

Case Study Overview

This document highlights ten low-carbon construction policy case studies from the PCC region which are examples of successfully passed policies targeting embodied carbon. Each case explores the development process, challenges faced, and lessons learned through the policy process. Information was gathered from interviews with PCC members who were involved in the policy, publically available policy reports, as well as interviews from the implementing agency of the policy.

Existing Low-Carbon Construction Initiatives in the PCC

As of 2022, the PCC region has a wide variety of policies and programs which directly or indirectly incorporate embodied carbon. We have categorized these actions around embodied carbon into six different focus areas that are described in further detail throughout this document:



Planned Actions

Climate action plans, pledges, executive orders, and commitments.



Government Procurement

Green purchasing programs and policies like “Buy Clean.”



Zoning and Permitting

Land-use regulations and permitting incentive programs.



Building Codes and By-laws

Regulations designating embodied carbon requirements.








Deconstruction and reuse

Extending the life of a material or building to avoid embodied carbon emissions associated with new materials.

PCC Policy Action Map

BRITISH COLUMBIA

-  [BC Mass Timber Action Plan](#)
-  [Clean BC Roadmap to 2030](#)
-  [Ecocity Peer Network](#)
-  [BC funding for WBLCA tools](#)
-  [WBLCA Certificate Program](#)

Vancouver

-  [Vancouver Climate Emergency Plan](#)
-  [40% EC Reduction Target for New Buildings](#)
-  [Green Buildings Policy for Rezoning](#)
-  [Zoning Variances for Mass Timber](#)
-  [Vancouver Building By-law Amendment](#)
-  [Empty Home Tax](#)
-  [Green Demolition By-laws](#)



This policy map is a snapshot in time of current policies and programs as of 2022. This map does not reflect the many relevant policies that are proposed (i.e., bills) or that are in development by city and state agencies and have not yet gone into effect.

NOTE: Click on link to visit the website for each policy.




KEY

- | | |
|--|--|
|  Planned Action |  Zoning and Permitting |
|  Educational Programs |  Building Codes and By-laws |
|  Government Procurement |  Deconstruction and Reuse |

WASHINGTON







-  [EO 20-01 State Efficiency and Environmental Performance](#)
-  [BCBF Washington Pilot Program and Reporting Database](#)
-  [WA Materials Marketplace](#)

Seattle

-  [King County Strategic Climate Action Plan](#)
-  [Green Building Incentive Program](#)
-  [Priority Green Expedited Program](#)

PCC Policy Action Map

OREGON

-  [EO 17-20: State Agencies Consult DEQ](#)
-  [Oregon Concrete EPD Program](#)
-  [Buy Clean Oregon](#)
-  [Preferential purchasing for Oregon-made goods](#)
-  [EPD Disclosure Incentive](#)
-  [OR Residential Specialty Code](#)

Portland

-  [Portland Climate Action Plan](#)
-  [Low-Carbon Concrete Initiative](#)
-  [Residential Infill Project](#)
-  [Design Overlay Amendments](#)
-  [Residential Deconstruction Law](#)







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CALIFORNIA

-  [GHG Strategy](#)
-  [Net-Zero Carbon Continuing Education](#)
-  [Buy Clean CA](#)
-  [Caltrans EPD Implementation](#)
-  [Marin County Low-Carbon Concrete Code](#)
-  [Framework for GHG Reductions](#)


San Francisco

-  [SF Climate Action Plan](#)
-  [Construction and Demolition Debris Recovery Law](#)

Oakland

-  [Oakland 2030 Equitable Climate Action Plan](#)

Los Angeles

-  [LA Green New Deal Sustainable City Plan](#)
-  [LA Clean Construction Declaration](#)
-  [EO 25: LA's Green New Deal](#)
-  [LA Adaptive Reuse Ordinance](#)



Planned Actions

Governments of all levels make pledges, announcements, and commitments to take action on climate issues. These can consist of executive orders, strategies, frameworks, and climate action plans to name a few. City and regional climate action plans (CAPs) can include an assessment of embodied carbon, targets for reduction, timelines, and strategies for meeting those targets. Including targets and strategies in CAPs is a key foundation for developing additional policies to reduce embodied carbon and maximizing opportunities for synergies with other climate strategies.

Action plans are unique tools for mobilizing governments to coordinate across departments and levels of government and engage a broad range of external stakeholders. Low-carbon construction will require a diverse set of policies and actions to be successful. Including low-carbon construction initiatives in action plans is a great first step to coordinated action.

Many cities, states, and provinces have published CAPs, some dating back many years. To date, climate action has had a large focus on energy efficiency and reducing emissions from operations. However, in the past few years, CAPs have increasingly addressed the issue of embodied carbon in construction by focusing on emissions from building materials, including how they are made, used, and decommissioned.

The following four case studies explore the development process, stakeholders, and lessons learned from four examples on the Pacific Coast.

- **Oakland 2030 Equitable Climate Action Plan**
- **San Francisco Climate Action Plan**
- **Portland Climate Emergency Workplan**
- **British Columbia Mass Timber Action Plan**

[Learn more about Planned Actions and Embodied Carbon Policies here.](#)

OAKLAND 2030 EQUITABLE CLIMATE ACTION PLAN

How is embodied carbon addressed?

The Oakland 2030 Equitable Climate Action Plan (ECAP) passed in July 2020 includes four actions to address embodied carbon in the Buildings (B) and Materials, Waste, and Consumption (MCW) sections:

- **Reduce life cycle emissions** from building materials (B-4).
- **Support the reuse, repair, recovery, and refurbishment economy** (MCW-4).
- **Expand community repair resources** (MCW-5).
- **Establish a deconstruction requirement** (MCW-6).

The ECAP directs staff to pursue policies to reduce embodied carbon in building materials for new construction and major retrofits, with a short-term emphasis on adopting a concrete code for new construction.

The intended results of the ECAP concerning embodied carbon are to:

- **Gradually adopt more robust requirements for building materials with lower embodied carbon, specifically in concrete, asphalt, steel, and lumber.**
- **Reduce waste by stimulating the local repair and reuse economy.**
- **Improve building codes and construction practices to allow for improved recycling and reuse of building materials during deconstruction.**
- **Reduce overall Scope 3 Greenhouse Gas (GHG) emissions.**

Development

The Oakland 2030 ECAP development process took approximately two years, with significant financial and technical analysis completed in advance of the two-year timeframe. The planned actions in the ECAP were developed as part of Oakland's broader climate action planning effort led by City staff and supported by a technical consultant, Integral Group.

The actions outlined in the ECAP require follow-up implementation by various City departments, including the Planning and Building Department, Oakland Public Works, and the Economic and Workforce Development Department. The stakeholders for

embodied carbon action items included departmental representatives of Public Works and Planning and Building, the local Chambers of Commerce, waste management parties, building and trades, and organized labor.

Challenges

There was no specific opposition to these policies. However, there were some internal challenges. For example, determining appropriate dates for implementation deadlines and structuring the language to allow for rapid action when technology is sufficiently available and cost-effective. In addition, there is a general market concern with the costs and lack of product availability with new regulations that require a specific product that isn't commonly available in the market at the time of policy adoption. Staff heard this issue repeated from the construction community during stakeholder engagement.

Additionally, since the adoption of the ECAP, significant concerns have been raised about the impact of an overall shortage of construction workers, high inflation, and a potential recession will have on policies enacted in 2023 and 2024.

Keys to success

Embodied carbon policy champions were key to ensuring these requirements were included in the ECAP. Major champions included the City's Zero Waste Team (within Oakland Public Works), climate advocates, and waste advocates.

Pairing the embodied carbon planned actions with broader economic and workforce development, climate mitigation, and health actions in the full ECAP was also an essential factor in success. Additionally, collaboration with other local governments was also important in developing a healthy regional economy of low-carbon building material providers and a workforce ready to use these materials.

The focus on low-carbon concrete (and embodied carbon generally) in the ECAP builds on years of existing work and awareness in Oakland. For example, StopWaste in Oakland participated in the Bay Area Low-Carbon Concrete Code working group funded by the Bay Area Air Quality Management District 2018 Climate Protection Grant Program. The working group published model code language and other resources for local governments in the Bay Area working on low-carbon concrete.

How is embodied carbon addressed?

The San Francisco Climate Action Plan (CAP), published in December 2021, addresses embodied carbon in the Responsible Production & Consumption (RPC) section. RPC Goal 1 is to “achieve total carbon balance across the buildings and infrastructure sectors,” with a goal that by 2030, all buildings constructed will have a 40% reduction in embodied carbon. Actions include:

- Between 2024-2026, **phase in policies to reduce embodied carbon more than 10% per project** by addressing at least three product categories or building assembly types.
- By 2025, **develop a suite of incentives, policies, and/or guidelines for adaptive reuse** of existing buildings, as well as the **design and procurement of low-carbon structural materials** for new construction.
- By 2025, **establish a maximum allowance for embodied carbon of buildings**, to be adjusted at regular intervals.
- By 2025, amend existing policies to **require deconstruction of buildings and increase the source separation** of specific materials.
- By 2025, engage with designers, landlords, and lessees to **develop guidelines for tenant improvement projects** that reduce excess material purchases and support reuse distribution channels.
- By 2025, create a policy framework to **expand and cultivate regional building material reuse markets** that support workforce development, small business enterprises, and entrepreneurial innovation.
- By 2030, **create incentives for the use of renewable diesel and emerging zero-emission technologies** to reduce emissions from construction equipment at least 50% from 2020 levels.

Development

San Francisco released its first CAP in 2004, with a subsequent update in 2013. The development of the 2021 CAP sought to bridge environmental strategies and address social and racial equity. The 2021 update was a highly collaborative effort led by the San Francisco Environment Department (SFE). SFE worked closely with many other City departments to highlight commitments in the CAP. This process took several years and was extended in part due to the pandemic disruption. Many stakeholders were involved in the creation of the CAP, such as subject matter experts, practitioners, and consultants.

As a precursor to the 2021 CAP, SFE updated Environment Code Chapter 9 with an

accelerated goal to achieve net-zero emissions by 2040, which several District Supervisors sponsored. Chapter 9 sets specific carbon emission reduction targets for San Francisco. It “defines net-zero emissions as a 90% reduction in direct GHG emissions, to be reached by 2040, with the remaining 10% removed from the atmosphere using nature-based sequestration strategies.”¹ The CAP lays out strategies to reach the targets set in the Environment Code as well as a tracking and reporting system to be developed by SFE.

Challenges

The major challenges faced with creating the CAP were the competing priorities and time availability of elected officials. As for including embodied carbon, the biggest challenge was introducing a concept that was new to many groups. Initially, it took time to educate and conduct outreach. Still, as people learned more, they expressed their enthusiasm, knowing there were ways to expand green building initiatives for increased climate action.

Keys to success

Major champions of the CAP were City departments, members of the public, businesses, practitioners, advocates, and NGOs involved in the building and infrastructure sector. Overall, in the development of the CAP, it was important to take a broad view and offer multiple points of entry for stakeholders to collaborate and champion the action plan. Seeing themselves in the policy was a significant key to garnering success.

Webinars and public engagement sessions were held to encourage community participation. Leaders in SFE gave presentations to other City officials about new elements of the plan, including embodied carbon, to educate them on new topics so they were ready to discuss these elements during plan development.

Similar to the Oakland 2030 ECAP, the SF CAP highlights the community benefits of low-carbon construction, including contributing to a Just transition and resilience. Additionally, the CAP includes an equity metric to track data related to RPC.1: “Tons of rescued building materials received by non-profits and small businesses in communities with environmental justice burden as identified in EJ Communities Map.”

PORTLAND CLIMATE EMERGENCY WORKPLAN

How is embodied carbon addressed?

The City of Portland's Climate Emergency Workplan, published in July 2022, identifies embodied carbon as one of the five key sources of emissions for Portland. The plan's embodied carbon actions include goals and strategies around buildings, food, and purchased goods and services. The low-carbon construction-related actions are:

- **Investing in community-led opportunities** to rent, share, fix, and reuse goods.
- **Implementing the City's internal cost of carbon policy** which requires whole building Life Cycle Assessment and calculating the shadow cost of carbon analysis on City projects.
- **Developing low embodied-carbon policies/standards/programs** for new construction.

Development

Before the Climate Emergency Workplan was introduced, the Climate Emergency Declaration (CED) was released in June 2020.

The CED development involved a year of engagement with bureaus, community-based organizations, utilities, youth climate activists, environmental justice organizations, environmental advocacy organizations, and individual community members. In this development, the City consulted close to fifty representatives from various frontline community-based organizations and climate and environmental stakeholders. Additionally, the CED established the climate justice initiative to recognize that traditionally, those who bear the burden of climate change are often the furthest removed from decision-making tables and resources to participate in government processes meaningfully.

The Climate Emergency Workplan took less than one year to develop since it was a short-term implementation plan covering the next three years, not a full climate action plan. The Workplan describes ongoing work in disparate venues and areas rather than calling for new directions and priorities for the City. Many actions in the Workplan were included in the CED, but there is added specificity and timelines for completion outlined in the Climate Emergency Workplan.

Challenges

A significant obstacle was gaining support and consensus from stakeholders in developing the Workplan, especially various City departments. Typically, Portland's climate action plans take two to three years to develop. This enables broader stakeholder engagement and more time to build champions and supporters in the community and within City departments. However, because the Workplan is only an implementation plan for actions already directed by the Council through the CED, there wasn't as much engagement as is typical or room to adopt new measures for the City. That left many stakeholders unhappy that they didn't get their say. For example, climate activists were opposed because they didn't consider the Workplan ambitious enough and didn't have the opportunity to contribute their own action items. These items will be taken into consideration in future action plan development.

Keys to success

Environmental advocates were major champions in the development of this Workplan. There was high external pressure for the City to adopt a new plan and to be more transparent with climate data, modeling, and how the City was implementing the CED (which was just a resolution and didn't include an implementation plan). The pressure enabled broad support from the City Council to address those issues through a Climate Emergency Workplan.

BRITISH COLUMBIA MASS TIMBER ACTION PLAN

British Columbia (BC) is working with manufacturers to develop and improve low-carbon building materials, initially focusing on BC's emerging mass timber sector. BC also addressed embodied carbon and low-carbon buildings in their [CleanBC Climate Action Plan](#).

BC's Mass Timber Action Plan (MTAP) intends to expand and develop the current sector to create demand for low-carbon construction products for domestic and international markets. The MTAP aims to create jobs, support BC's transition to high-value forestry products, and reduce life cycle emissions by focusing on three overarching Planks: Economy, People, and Climate.

Embodied carbon is addressed in Plank 3, Climate, which centers on three strategies:

- **Expanding market adoption** of low-carbon building materials.
- **Supporting the use of carbon calculators** to assess and help reduce embodied carbon, such as the [Embodied Carbon Pathfinder](#) and [Impact Estimator for Buildings](#).
- **Reduce construction waste** and build a construction sector circular economy.

BC will work with industry and others to decarbonize the full spectrum of building materials, focusing on mass timber and then developing momentum among producers of other key construction materials.

Development

The Office of Mass Timber Implementation was established in 2020, and the MTAP was released in April 2022. The Office of Mass Timber referenced and collaborated with CleanBC (BC's environment roadmap to 2030), and StrongerBC (BC's economic plan). A Mass Timber Advisory Council was also established to guide the MTAP's development. The Council comprises sixteen BC thought leaders representing a broad range of interests related to mass timber, including Indigenous leaders and major stakeholders from the forest product manufacturing, development, and construction sectors. The Province will also work with First Nations communities, rural communities, and equity-seeking groups as the mass timber sector advances in BC.

Challenges

Low-carbon building materials are emerging as a new policy area. Support for mass timber is a positive early step in profiling high-performance materials, complementing important work underway to reduce emissions from other building materials (e.g., low-carbon concrete).

Keys to success

One of the key factors for success was having political champions for this policy, including the BC Premier and Minister at the time. In addition, BC's early successes as a mass timber innovator provided a valuable foundation for future growth. One example is the University of British Columbia's 18-story Brock Commons student residence.

A focus on demonstration has been essential to success. From 2020 to mid-2022, the Province of BC invested CAD 13.37M to accelerate the use of mass timber through research, building demonstration, education, training, and communications. For example, the [Mass Timber Demonstration Program](#) has helped a dozen mass timber projects come to fruition and has funded several research projects to drive innovation in the sector.

Lessons learned

Building policy is decentralized and requires buy-in from multiple sectors, departments, levels of government, and industries. Because of this, it was key to mobilize the government to use all available policy levers.

Using the MTAP as a starting point and moving forward, there are a few different ways intersecting policies can address embodied carbon in BC:

- **Building codes at the national level can provide a baseline and targets for embodied carbon reduction.**
- **Permitting and zoning in cities can allow innovative low-carbon buildings to showcase the best of BC's construction technology while actively lowering embodied carbon across the built environment.**
- **Developing the market will allow for better, affordable choices for low-carbon building materials.**



Government Procurement

Green procurement policies focused on lowering the carbon emissions of government-purchased building materials are often referred to as “Buy Clean.” Buy Clean policies create a demand for lower-carbon construction products and, therefore, signal manufacturers to invest in lower-carbon practices, encouraging a shift toward lower-carbon options in the broader construction materials market.

Public spending on buildings, transportation infrastructure, and other projects is responsible for about a third of the total embodied carbon of US construction.² Procurement for transportation is an area where state governments are uniquely positioned to lead. For example, Washington State’s Department of Transportation uses about one million tons of asphalt and 0.5 million tons of concrete.³ California’s Transportation Department uses about four million tons of asphalt and two million tons of concrete.⁴

Buy Clean policies use a combination of reporting requirements, carbon limits, and incentives:

Reporting: Projects must collect Environmental Product Declarations (EPDs) for a list of construction products set by the policy. While the scope of each policy differs by jurisdiction, the most common materials included are concrete, cement, and steel. An increasing number of policies also include asphalt when purchasing for roadways is included.

Limits: Products must meet Global Warming Potential (GWP) limits. Depending on the policy, these may be set at the industry average to limit only the worst polluters or may be set lower to push for substantially lower-carbon products (if applying to a smaller subset of projects).

Incentives: Some policies include tax credits or other support for manufacturers to create EPDs. Other mechanisms, such as bid incentives, have been introduced in variants of Buy Clean.

Procurement policies like Buy Clean can be applied at the federal, state, or local level and can be used by private building owners. In addition, EPD reporting requirements and GWP limits can be integrated into the specifications for a project.

[Learn more about Buy Clean policies and Embodied Carbon here.](#)

Buy Clean California ([Public Contract Code: 3500 - 3505](#)) sets the maximum allowable Global Warming Potential (GWP) for the following products if purchased for California state buildings and transportation:

- **Structural steel**
- **Concrete reinforcing steel**
- **Flat glass**
- **Mineral wool board insulation**

California was the first state in the US to pass a Buy Clean policy in 2017, known as Buy Clean California (BCCA). This policy required the California Department of General Services (DGS) to set limits on the maximum allowable GWP per unit for structural steel, concrete reinforcing steel, flat glass, and mineral wool board insulation used on specific State projects. In addition, DGS was directed to set GWP limits at the industry average using data from facility-specific Environmental Product Declarations (EPDs) or industry-wide EPDs based on domestic production data. BCCA intends to reduce embodied carbon on California state projects and to provide a benefit to manufacturers who are already making an effort to reduce embodied carbon by manufacturing lower-carbon construction materials.⁵

Development

In the development process of BCCA, it was important to consider the implementation of the policy:

- DGS needed to divide categories into **subcategories** since there was a high level of GWP variation between products in a specific material category. This led to two subcategories of mineral wool board and three subcategories of structural steel.⁵
- DGS created a **database** to collect EPDs and store data on agency purchases. Agencies were also permitted to use their own EPD collection process.

- Internal **education** for agencies on how to comply with the law and external education for suppliers, including training around EPDs, was an important step in implementing the law.⁵ DGS coordinated quarterly workshops and training to awarding agencies on defining materials and evaluating EPDs.

Challenges

The current BCCA policy (as of 2022) covers structural steel, concrete reinforcing steel, flat glass, and mineral wool. There were three proposed amendments to add concrete, finish products (such as carpet and wallboard), and additional insulation products to the BCCA, but they did not pass. The industry has expressed concerns that only addressing mineral board insulation would create an unequal playing field for other insulation material producers.⁵ Additionally, advocacy organizations have expressed concern about concrete and cement being excluded from the bill.

Keys to success

DGS chose to exercise something similar to the rulemaking process by engaging external stakeholders from the beginning of implementation. Upon release of the initial methodology, DGS received over one hundred comments and integrated these suggestions into their implementation of the law. By engaging the industry early on, they had the ability to access data they otherwise would not have had.

Another major lesson learned was to dedicate sufficient staff time to establish the program and identify agency policy champions early on to coordinate the implementation of the policy.

Buy Clean Oregon ([HB 4139](#)) requires the Oregon Department of Transportation to set policies to reduce embodied carbon from the following products:

- **Concrete**
- **Asphalt**
- **Steel**

Buy Clean Oregon targets embodied carbon reductions through purchases of concrete, steel, and asphalt by the Oregon Department of Transportation (ODOT). Large quantities of concrete and asphalt are used during the construction and maintenance of transportation infrastructure. There are no specific embodied carbon limits or reduction targets in the legislation, but there are EPD requirements for selected demonstration projects starting in December 2025 or earlier. Buy Clean Oregon intends to reduce the carbon footprint of concrete, asphalt, and steel purchased by ODOT.

The law also requires ODOT to conduct a cradle-to-grave project LCA of a selected set of the department's construction and maintenance activities. This is unique among current Buy Clean policies, which have previously focused only on cradle-to-gate EPD data. Additionally, materials can be added to the covered product list without legislative approval.

Development

In drafting this policy, language from other Buy Clean policies like California and Colorado were considered. Stakeholder negotiations also played a significant part in the development of the language. Oregon Concrete and Aggregate Producer's Association (OCAPA), the Asphalt Pavement Association of Oregon, Representative Rayfield, and BlueGreen Alliance led the bill negotiations and development, garnering input from stakeholder groups like the Oregon Department of Environmental Quality, Oregon Department of Administrative Services, ODOT, the NGO community, the Carbon Leadership Forum, and industry and manufacturing associations. The law also set up a technical advisory committee.

Challenges

The American Wood Council submitted an opposition letter to the bill because they were not involved in the initial negotiations. However, even though wood wasn't included in the bill, the legislation does give ODOT authority to add new materials to the EPD requirements through rulemaking rather than new legislation. Other concerns expressed

by policymakers and stakeholders were:

- Sufficient **staff capacity and understanding** of how this would affect ODOT's operations, responsibilities, and staffing workload.
- Many stakeholders expressed a desire to enhance **road durability** as a sustainability measure. This discussion informed the bill requirements to conduct whole-pavement LCAs.
- Concerns about scope creep, cost of **EPDs**, whether everyone needed an EPD, and the trust in the results of EPDs.

Keys to success

The City of Portland's Low-Carbon Concrete Initiative, passed in 2019, helped pave the way for Buy Clean Oregon to be passed in 2022. The Portland Initiative included requirements for product-specific concrete EPDs on City projects, pilot tests of lower embodied carbon concrete mixes, and defining GWP thresholds for the mixes. This meant that more EPDs were already available in Oregon and local producers were familiar with the requirements that ODOT would be implementing.

A critical lesson learned from Buy Clean Oregon was to bring all stakeholders to the table early on to establish goals. Trade associations and industry support were significant in the development of bill language. For example, OCAPA was one of the major champions of Buy Clean Oregon because it was agreeable to their industries' membership, and they believed in the basic tenants of the bill. Additional lessons learned include:

- It was helpful to have a **GHG inventory** of ODOT operations⁶ that included the impacts of purchasing building materials. This inventory showed that procurement dominated the agency's GHG emissions and was a primary reduction target.
- Establishing a **technical working group** to advise ODOT was also an excellent way to address stakeholder concerns and provide a forum for future program development and implementation input.
- Including measures in the bill to provide **funding to assist small producers in obtaining EPDs**, which addresses concerns about small producers' disadvantages when competing on public projects.

Washington passed budget provisos in the 2021-23 operating and capital budgets to establish a pilot study to test the requirements of Buy Clean Buy Fair Washington and to create a reporting database to collect environmental impact and working conditions data for **structural concrete, reinforcing steel, structural steel, and engineered wood**.

The [Buy Clean Buy Fair \(BCBF\) Washington Pilot Program and Reporting Database](#) was passed as budget provisos in 2021 and completed in December 2022. Legislators have introduced a BCBF bill in Washington State two times previously, but neither passed.

The pilot study required the University of Washington to create a reporting database for BCBF and conduct a case study and pilot analysis of 2-10 pilot projects that test the requirements set by the bill. Five total projects were selected in the final study.

The “Buy Fair” component of the pilot and BCBF bill is unique to Washington State, which requires that health and working conditions data, such as health product declarations and information about the employees working at the production facility, is to be collected in addition to environmental data. The goal of the “Buy Fair” component is to promote high labor standards in manufacturing facilities and to pursue opportunities to ensure that new jobs created by Buy Clean are jobs that meet Washington’s goals for worker health and equity as well as the environment.

As of 2022, the Washington Department of Commerce and CLF published a final report which evaluated the feasibility of BCBF data reporting requirements and identified areas for improvement in potential future BCBF programs. The full report and summary document can be found on the [CLF webpage](#).

Development

The pilot study and reporting database were included in the budget to support future policy implementation and program development related to embodied carbon. In addition, the pilot aimed to increase awareness about EPDs and the other components of BCBF, as well as to speed the implementation of a future BCBF bill by creating the reporting database that Commerce could use. The image on the right is a screenshot of the BCBF database user interface.

Challenges

The concrete and wood industries have expressed concerns about reporting with EPDs, the flexibility of the type of EPD required by the law, and reporting requirements around health product declarations and working conditions. A significant obstacle is that the reporting requirements in BCBF are more comprehensive than similar Buy Clean laws in other states. In addition, since this will be the first in the nation Buy Clean bill to address working conditions, there is some confusion on how to comply with these requirements.

The previous BCBF bills have not passed out of the legislature in the last two sessions, which have been busy with other energy- and climate-related work.

A stack of light-colored concrete pavers is shown in the foreground, arranged in a neat pile. The pavers are rectangular with slightly irregular edges and some surface texture. They are set against a background of a construction site with gravel and some sparse vegetation.

Zoning and Permitting

City urban planning and building regulations such as zoning and land use policies, incentive programs, and permitting requirements are important levers for encouraging low-carbon construction early in the design process. This is an area where it is key for cities to take the lead, given their jurisdiction over local building regulations.

Narrowing the range of emissions early on in a project maximizes the opportunities for embodied carbon reductions on a project. These policies impact the range of embodied carbon reductions possible on a project, such as limiting what land is available for projects and setting constraints for density, massing, and height.

Unlike codes, which establish the minimum requirements for a project, zoning and permitting policies can push teams to pursue best practices and inspire innovation by tying low-carbon construction strategies to incentives like density bonuses or reduction of parking requirements. Cities are in a great position to design policies and programs that align with local capabilities and available solutions.

[Learn more about Zoning and Embodied Carbon Policies here.](#)

SEATTLE GREEN BUILDING INCENTIVE PROGRAM

The Seattle Department of Construction and Inspection (SDCI) has two different programs that incentivize embodied carbon reductions: the Priority Green Expedited permitting program, and the Green Building Standard.

- **Priority Green Expedited** shortens the time it takes to obtain a building permit for new construction in exchange for meeting green building requirements. This program primarily relies on third-party green building certifications, with additional requirements related to embodied carbon. For example, embodied carbon is considered by requiring EPDs for structural concrete and a primary structural frame for steel.
- The **Green Building Standard** is a land use code incentive that provides additional development capacity for new construction, depending on the zone and proposal. Embodied carbon is considered by offering options that meet the lead dust mitigation requirement, including retaining existing structures, salvage, and deconstruction.

Both incentives require third-party green building certification. For instance, Built Green 4-Star certification or LEED Gold are minimum acceptable certifications. Project teams may address embodied carbon within those programs to achieve the required certification level.

Development

Seattle's Green Building Incentive Program requirements were established as part of the overall work to update the City's green building incentives starting in 2020-2021. The SDCI staff, primarily the Green Building Program Manager, worked on these updates. In addition, an ad hoc advisory committee comprised of City staff and Mayor's office staff met several times to lay the framework for this new policy. This resulted in a new Director's Rule that became effective in March 2021 (the same time as the 2018 Seattle Energy Code). No legislative changes were necessary for this implementation.

SDCI relied on references from other policies to develop this incentive program:

- [Marin County 19.07.020](#) in part to define the type of EPD
- Leadership in Energy and Environmental Design ([LEED](#)) (Materials and Resources credits)
- [Built Green](#) (EPD credit)
- [Living Building Challenge](#) (Imperative 11)

- Embodied Carbon in Construction Calculator ([EC3](#)) tool
- [Carbon Leadership Forum](#) Policy Toolkit (various documents)
- City of Vancouver ([zero emission buildings](#), Carbon Policy Review Report)
- [City Policy Framework for Dramatically Reducing Embodied Carbon \(CNCA\)](#)

Stakeholder engagement during development focused on future users of the incentives, including builders, developers, and architects.

Challenges

A challenge when creating this program was determining whether or not GWP targets should be included in addition to the EPD requirement to limit embodied carbon for structural concrete and steel. Ultimately, the team decided only to require disclosure of an EPD. Additionally, detailing the requirements for the EPDs to ensure the criteria was aligned with international standards proved to be challenging. For example, deciding whether to require cradle-to-gate or cradle-to-grave EPDs.

Relying on embodied carbon related credits or points within the allowed green building certification program is one approach that was not used because some certifications either do not address embodied carbon or address it in different ways. For instance, if the incentives required a LEED EPD credit that was more restrictive than other certifications, this could prevent participation in the SDCI incentives. SDCI attempts to create a level playing field for certifications and does not require one particular certification organization.

Lessons learned

The process of developing and implementing this program was complex and time-consuming. In addition, it required a high level of building expertise within the implementing department. Hiring a separate staff or consultants to work on the program would have sped up the process and helped address the many complexities.

The program is new, and only some projects have been completed under this policy. In the future, adopting existing policy language or using a model code would be very helpful.



Building Codes and By-laws

Over the past few decades, advancements in building and energy codes—and in the underlying research on reducing operational energy consumption and related GHG emissions—have stimulated changes in building design and operation. In contrast, embodied carbon has been excluded from building code conversations until the past few years. No state or province-level case studies yet exist, but a few city examples have updated their codes to address low-carbon construction.

Two approaches for including embodied carbon in code amendments have been introduced: a material-focused approach and a building-focused approach.

- A **material-focused approach** requires reporting a product's carbon footprint through an EPD. The EPD is compared against an embodied carbon limit set by material type per unit of material.
 - ✎ One example is the [Marin County Low-Carbon Concrete Code](#). For more information, see this summary published by StopWaste to learn about the code development process.
- A **building-focused approach** requires a whole building Life Cycle Assessment (WBLCA). The results of the WBLCA are then compared to an embodied carbon target or limit set by the code. The targets or limits are typically normalized by unit floor area and differ by building type, similar to how energy use intensity targets are set for operational energy.

Both approaches include establishing thresholds such as project size and material quantity that limit the range of projects required to meet these code requirements. Given the current state of code development related to low-carbon construction, these requirements typically cover only a narrow range of large projects.

[Learn more about Codes and Embodied Carbon Policies here.](#)

VANCOUVER BUILDING BY-LAW AMENDMENT

The City of Vancouver can regulate the design and construction of buildings by adopting by-laws. This is unique within BC and allows the Vancouver City Council to address issues not addressed by the BC Building Code.⁷ In May of 2022, the City Council approved changes to the [Vancouver Building By-Law](#) related to energy and carbon, resilience, and embodied carbon.⁸ The specific change regarding embodied carbon, effective July 2023, established three requirements for large new construction projects:



Measurement

Complete a WBLCA at the time of building permit application to compare the embodied carbon against a standardized baseline.



Limits

Demonstrate (via the WBLCA) that the proposed building is not more than double that baseline. Effective January 2025, embodied carbon must be reduced by 10-20% compared to the standardized baseline.



Sourcing

Effective January 2025, buildings must also comply with one of three options for responsible materials: sustainable sourcing standards, disclosure of material ingredients, or construction waste diversion and design for disassembly.

These changes intend to build industry-wide literacy and familiarity with embodied carbon and how to reduce it, and then for the first time, begin to regulate reductions of embodied carbon in large new construction. The above changes do not apply to 1-3 story residential buildings.



VANCOUVER BUILDING BY-LAW AMENDMENT

Development

Changes to the by-law were first contemplated in the Embodied Carbon Strategy in Vancouver's Climate Emergency Action Plan, approved by the City Council in November 2020.⁹ Following this approval:



Two staff in Vancouver's Green Buildings Team led the by-law changes, which sit within the Sustainability Group in the City's Planning Department. One staff worked on embodied emissions, and the other on operational emissions and resilience. When the project began, the City formed an internal working group and an external advisory group to advise on policy design and begin early testing of the proposed changes. This was punctuated by periodic check-ins with the standing Green Buildings Steering Committee, which consists of the General Managers of the relevant City departments (Planning, Development and Building, Engineering) and the relevant directors within those departments. This steering committee provided approvals to proceed to the next project stage and to bring the report to Council.

In developing the policy, a great deal of advice from the external advisory committee, which was assembled from industry experts and key stakeholders, helped shape the policy design. Policy research from consulting firms also supported the development. Key stakeholders included developers, LCA and embodied carbon experts, architects, engineers, the Province, the federal government, concrete producers, the wood industry, contractors and trades, and home builders.

Challenges

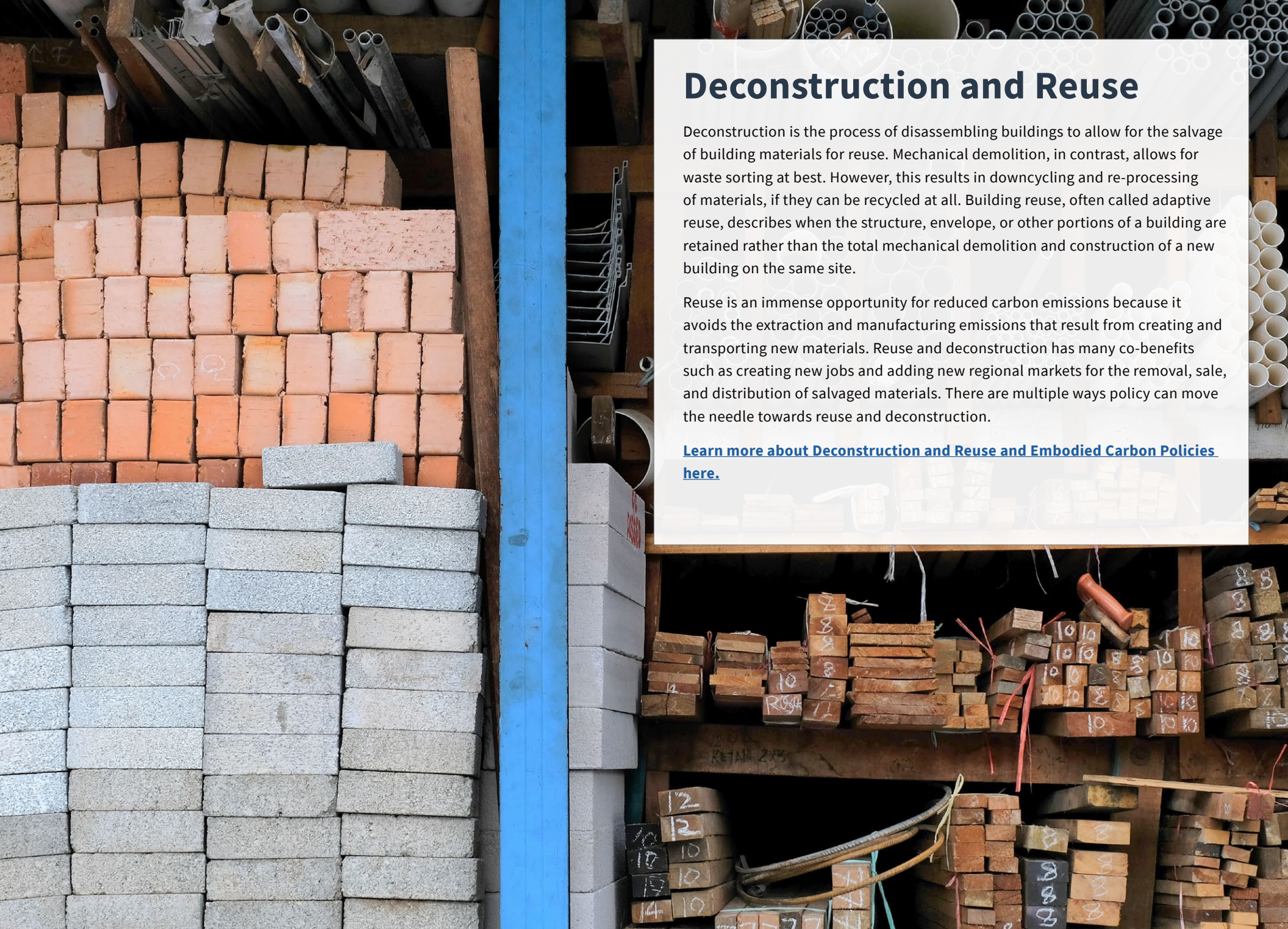
This policy faced no direct opposition; however, developers did raise concerns in a few areas. Their key concerns were: not adding significant new costs to housing construction, providing adequate time to adjust building practices, and not adding to permitting or construction schedules.

The most significant obstacle faced was informing and engaging with key stakeholders about what embodied carbon is, how designers and builders can reduce it, the best available estimates of costs or savings opportunities for construction, and whether this would disrupt current permitting and construction schedules. Once the City was able to inform and engage with key stakeholders and address these concerns, and, where necessary, conduct further research and build a shared understanding of the relevant information, there were no major obstacles faced by staff in developing and gaining approval for the policy changes.

Keys to success

Major champions of this policy included architects, engineers, and LCA and embodied carbon experts. The development and construction industry were generally supportive and acknowledged embodied carbon as an important issue to be addressed. Additionally, some individual local champions and embodied carbon groups, such as the local chapter of the Carbon Leadership Forum, were extremely supportive throughout the process. This support made success much more likely.

Furthermore, building an industry understanding of embodied carbon, with specific case studies and cost studies, was the most important prerequisite to regulating embodied carbon reductions. Actions that build this shared body of knowledge, such as industry capacity building, incentive programs, or leading examples of public buildings, would be helpful to any jurisdiction seeking to advance embodied carbon reductions.



Deconstruction and Reuse

Deconstruction is the process of disassembling buildings to allow for the salvage of building materials for reuse. Mechanical demolition, in contrast, allows for waste sorting at best. However, this results in downcycling and re-processing of materials, if they can be recycled at all. Building reuse, often called adaptive reuse, describes when the structure, envelope, or other portions of a building are retained rather than the total mechanical demolition and construction of a new building on the same site.

Reuse is an immense opportunity for reduced carbon emissions because it avoids the extraction and manufacturing emissions that result from creating and transporting new materials. Reuse and deconstruction has many co-benefits such as creating new jobs and adding new regional markets for the removal, sale, and distribution of salvaged materials. There are multiple ways policy can move the needle towards reuse and deconstruction.

[Learn more about Deconstruction and Reuse and Embodied Carbon Policies here.](#)

PORTLAND RESIDENTIAL DECONSTRUCTION LAW

This case study highlights Portland's Residential Deconstruction Law ([Ordinance No. 187876](#)), which regulates the hand disassembly of houses and duplexes built before 1941 to maximize the salvage of building materials for reuse. Materials from these houses are then reused in new projects and avoid the embodied carbon impacts associated with extracting and processing new materials.

Development

The inspiration for Portland's Residential Deconstruction Law was the City's interest in lowering the environmental impact of removing houses to accommodate larger housing complexes. In addition, the goal was to reuse building materials and decrease the recycling, burning, and landfilling of these products.

Shortly after the law was introduced, the Oregon Department of Environmental Quality (DEQ) analyzed material data from 36 house deconstructions in Portland and then modeled a mechanical demolition scenario to determine the carbon impacts of deconstruction versus mechanical demolition. DEQ found that the average house deconstruction resulted in a net carbon benefit of 7.6 metric tons of carbon dioxide equivalent.

Portland's deconstruction policy efforts began in earnest in early 2015. The Portland City Council directed the Bureau of Planning and Sustainability (BPS) to convene a stakeholder group and report back in three months with recommendations on advancing deconstruction in Portland. Accordingly, BPS established the Deconstruction Advisory Group (DAG) in April 2015, consisting of home builders, deconstructionists, historic preservationists, neighborhood advocates, salvage retailers, and hazardous material experts. The DAG recommended a phased approach, beginning with incentives in the form of grants, then introducing requirements that could be expanded over time as the deconstruction industry and market matured.

The deconstruction grant program began in September 2015 and ran for two years (overlapping with the deconstruction ordinance through the first year). In October 2016, Portland became the first city to require deconstruction and material salvage for its oldest and most historic houses. Specifically, any house or duplex built in 1916 or earlier, or designated historic, regardless of age, had to be fully deconstructed by a certified deconstruction contractor. Houses built before 1917 typically represent one-third of all house demolition permits annually. In February 2020, Portland raised the year-built threshold to 1940 or earlier, which captures an additional third of all house demolition

permits - meaning that two-thirds of all house demolition permits are now subject to the deconstruction ordinance requirement.

There were a variety of stakeholders consulted throughout the development of this ordinance. Some of these included: home builders, neighborhood advocates, historic preservation advocates, hazardous material experts, deconstruction firms, salvage retailers, permitting staff, construction and demolition recyclers, and the regional waste authority.

Challenges

Initially, the primary obstacle was deciding which bureau would implement a deconstruction ordinance. Since there was a permit review and inspection component, it was logical that the Permitting Bureau should take on these functions. However, this was not an option due to workload and staffing concerns. Ultimately, the Bureau of Planning and Sustainability took on the implementation and ongoing administration of the ordinance. This has proven to be the best solution since there is a vested interest within the Bureau to ensure the program runs smoothly and that the best results are achieved.

When this policy was introduced, there were no specific groups who opposed it, but there were some who expressed concerns. For instance, home builders approved of deconstruction and salvaging building materials in a broad sense, but they were concerned about additional cost and time associated with deconstruction. Their concern was that any additional cost related to mandating deconstruction would be passed on to buyers of new homes built on the site. Concerns about price and duration were addressed in program implementation and code language. Over the past six years, the cost to deconstruct a house has decreased, and the cost to mechanically demolish has increased. Today, the two approaches are competitive in price.

Keys to success

Portland was the first city in the nation to implement a deconstruction policy of this kind. However, the concept of using a year-built threshold and historic designation for demolition-related regulations was borrowed from Vancouver, BC.

Major champions of this law included neighborhood groups who were concerned about ever-increasing demolitions following the great recession, deconstruction contractors and salvage retailers (both for- and non-profit), and historic preservation advocates.

PORTLAND RESIDENTIAL DECONSTRUCTION LAW

Neighborhood support was pivotal in obtaining initial Council direction to advance deconstruction, which later proved critical to passing a substantive policy. Portland's already existing deconstruction and salvage ecosystem were also helpful in this process. This community was able to address many questions that the development community had around deconstruction (e.g., cost, duration, capacity).

Lessons learned

- **Train and certify** deconstruction contractors before the ordinance's effective date.
- **Implementation and ongoing administration** should be kept within the Sustainability Bureau.
- Figure out how to **prevent mechanical demolitions from spreading hazardous dust**. These impacts should be internalized to the cost of the project and not the adjacent neighbors. This will increase costs for mechanical demolition and more closely represent the true cost of conducting a demolition. Deconstruction already limits dust and removes lead-based paint by hand.

There were a few items that the jurisdiction would do differently:

- Figure out how to **ensure that nonprofits benefit** from this ordinance. For example, having a minimum threshold and donations to nonprofits count for additional weight (i.e., for every pound of material donated, it counts towards two pounds of meeting the salvage minimum).
- Consider a **minimum salvage quantity** (although this would add additional administrative time for the City and contractors).

Several suburbs of Portland are considering deconstruction requirements. Portland's trained and certified deconstruction contractors could serve these nearby communities. The hope is to strengthen the entire reuse and deconstruction system and not rely only on Portland's resources for projects.

Finally, it's important to remember that deconstruction ordinances are not a one-size-fits-all regulation. Using a year-built threshold to determine what is subject to the ordinance is a good way to calibrate to local conditions. Care must be taken to size the scope of the ordinance to balance contractor capacity and material demand.



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