Options To Reduce Greenhouse Gas Emissions Attributable To Building Materials

BCD Building Codes Division

Department of Consumer and Business Services

Prepared by Oregon Building Codes Division for the Oregon Legislature in accordance with HB 3409 (2023)

December 30, 2024

Table of Contents

Executive summary

This report is submitted in compliance with the requirements of House Bill 3409 (2023), sec. 7, which mandates the delivery of a report that includes "findings and recommendations on options for, and the feasibility of, reducing greenhouse gas emissions that result from materials used in building construction." This report explores embodied carbon reduction paths for the Oregon state building code as well as options for addressing embodied carbon outside of the code. This report may be accessed at https://www.oregon.gov/bcd/codes-stand/Documents/2024hb3409-sec7-legreport.pdf or by contacting the Building Codes Department at bcd.info@dcbs.oregon.gov to request a copy.

The Building Codes Division (BCD) contracted with two consulting organizations, RMI (formerly Rocky Mountain Institute) and the New Buildings Institute (NBI), to provide a background study on climate impacts from the buildings. The resulting study is entitled *Findings and Recommendations on the Use of Lower Carbon Materials in the Statewide Building Code and Other Means for Reducing Greenhouse Gas Emissions Attributable to Building Materials* (for short, this is referred to as Companion Technical Report by RMI/NBI) and is cited throughout this report.[1] That study, which is submitted in conjunction with this report, is a wealth of technical information that is accessible and is worthy of review. This report is informed by that study, as well as by contributions from BCD's Policy and Technical Services (PTS) and consultations with Oregon Department of Environmental Quality (DEQ), and aims to provide advice and education to policy makers in the Oregon Legislature.

Oregon's building codes already incorporate efficiency standards, notably including water and energy efficiency standards, and building occupants in Oregon have benefited from the early adoption and continual improvement of efficiency codes. Historically, efforts to reduce the environmental impacts of buildings have focused on the operational emissions associated with construction-related processes or heating and cooling of the finished building. In response to these efforts, operational emissions in buildings have generally been reduced over time. This leaves embodied emissions, the form of pollution arising from resource extraction, manufacturing, transportation, installation, maintenance, and disposal of building materials and their components, as well as from processes and ingredients used in the construction of buildings, as a larger share of building carbon footprint.

About 39% of humanity's current greenhouse gas (GHG) emissions result from buildings operations. Included in that 39% is 7% in the form embodied emissions, which is pollution arising from resource extraction, manufacturing, transportation, installation, maintenance, and disposal of building materials and their components, as well as from processes and ingredients used in the construction of buildings.[2] While this report focuses on prioritizing reductions of these embodied emissions, it is important to consider operational and embodied emissions in tandem, as they both represent substantial opportunities to improve buildings' impacts on the climate.[3] Overall, reducing embodied emissions from buildings is a critical short-term opportunity, as these emissions are already expended before a building is occupied.

---

[1] Ariel Brenner, Rebecca Esau, et al., *Findings and Recommendations on the Use of Lower Carbon Materials in the Statewide Building Code and Other Means for Reducing Greenhouse Gas Emissions Attributable to Building Materials*. NBI and RMI, 2024. ("Companion Technical Report by RMI/NBI")

[2] World Green Building Council | Bringing embodied carbon upfront

[3] See page 14 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

Oregon is a leader in voluntary actions to reduce embodied emissions of buildings. Through state legislation like House Bill 3409 (2023), Executive Order's 17-20 and 20-04, BCD is taking action to consider global warming potential (GWP) as a metric for measuring and evaluating embodied emissions of building products and the lifecycle of buildings. BCD looks to DEQ for expertise on efforts in quantifying GHG emissions as well as their body of work on estimating potential for GHG reductions in the state. Initiatives by DEQ have included incentives and have led to the development of over 1500 Environmental Product Declaration (EPD) documents for concrete mixes by Oregon's concrete producers, whole building life cycle assessment (WBLCA) training and software licenses for designers throughout the state, pilot projects that tested lower embodied emissions materials and strategies, as well as provided experience to construction teams, and incentivizing building reuse.

However, embodied carbon has not yet been fully integrated into the model codes and has challenges related to enforcement. Additionally, the cost-benefits to the consumer and to the construction industry are not yet well known. BCD acknowledges those issues will need to be considered and addressed, from training the workforce and evaluating the supply chain, to determining appropriate enforcement mechanisms in order to implement embodied emissions reductions policy in building code as well as outside of code. Feasibility concerns, such as the EPD market, parallel movement of other agencies who are active leaders in this realm, impacts on housing, and diversity, equity and inclusion impacts have all been balanced and weighed in applying BCD's principles of code adoption and code authority. Overall, market readiness will be a key consideration for policy makers moving forward.

BCD has identified three distinct paths under the statewide building code for Oregon to immediately address embodied emissions and begin realization of emissions reductions in building construction. Feasibility was a key component in considering what paths to include in this report. These are the implementation approaches that seem most viable and effective for the boards to get started on now for the next code cycle, though further review and market transformation may be needed to operationalize them in the short term. The policy analysts, code specialists, and administrators at BCD can answer questions, provide expertise, and support.

Recommended Paths

BCD has identified three distinct paths for Oregon to address embodied carbon and realize embodied emissions reductions in buildings:

Building reuse
Retain the maximum amount of a building's existing structure when being repaired, added to, or altered. Explore Oregon's building reuse project data.

Environmental product declaration reporting
Through EPDs, analyze GWP data of Oregon's building materials to develop material-level embodied emissions limits and reduction targets.

Whole building life cycle assessment reporting
Through WBLCAs, analyze GWP data to develop Oregon's building-level embodied emissions limits and reduction targets.

Foreword: Inequity in Oregon

Oregon has a long history of inequity, beginning before statehood and continuing into the current day. Examples of racism and structural inequity abound, from John Beeson's documentation of the abhorrent treatment of Native Americans in the mid-1850s[4], through Oregon's racial exclusion laws at statehood[5], continuing into the modern societal structural inequity that persists in Oregon today.[6]

Accordingly, it is important to begin by acknowledging systemic inequity. In Oregon, certain people or communities are advantaged over others due to historic and current systems of oppression. Diversity, Equity, and Inclusion (DEI) are tools to combat inequity, and are also the explicit policies of the Department of Consumer and Business Services (DCBS) and the State of Oregon. DCBS is committed to providing Oregonians with equal access to its programs and services, as well as fair and equal employment opportunities. DCBS employees will treat all people with dignity and respect, and will not discriminate on the basis of race, color, ancestry, national origin, age, marital status, gender, gender identity, gender expression, sexual orientation, political or religious affiliation, veteran status, or physical or mental disability.[7]

By law, Oregon's building codes exist to protect the "health, safety, welfare, comfort, and security of the residents of this state who are occupants and users of buildings."[8] Buildings are for the people that use them. Consequently, this report seeks to imbed DEI throughout the document. In order to do so, this report references and is guided by the work of Oregon's Racial Justice Council (RJC).

In 2021, Governor Kate Brown proposed legislation to create the RJC. In her testimony to the Oregon Legislature, she states:

> Government intervention to disrupt and dismantle systemic bias and structural racism must be prioritized to counter hundreds of years of racism, oppression, and colonization so that we achieve the goal of redistributing the power, influence, opportunities, and distribution of resources in order to achieve a racial just Oregon. Because of historic inequities and complicity of Oregon legislation and the disproportionate impacts to Oregonians, we must change how we listen to, engage with, respond to, and support Black, Indigenous and People of Color (BIPOC) and Tribal members in Oregon.[9]

[4] The Oregon Encyclopedia | John Beeson (1803-1889), William L. Lang
[5] The Oregon Encyclopedia | Black Exclusion Laws in Oregon, Greg Nokes
[6] Resources on Race, Racism and Health Disparities, Oregon Health & Sciences University
[7] Oregon DCBS | Diversity, Equity, and Inclusion
[8] Oregon Legislature | Oregon Revised Statues 455.020
[9] Oregon Legislature | HB 2167 - Codifying the RJC (February 2021)

This legislation, HB 2167 (2021)[10] was enacted into law and created the RJC. In 2023, in her forward to the RJC's annual report, Governor Tina Kotek underscored the continued need for the work of the council. She said:

> As we endeavor to build an Oregon where all Oregonians can thrive, we must continue reckoning with our country and state's long history of racism and discrimination. Institutional racism and systemic barriers have created a legacy of deep disparities, perpetuated inequities, and denied access to opportunity, security, safety, and health for Oregon's Black, Indigenous, Native American, Tribal, Latino, Asian, Pacific Islander, immigrant, refugee, and communities of color. We have to acknowledge past and present racially discriminatory and exclusionary policies that are still felt in communities today, and work proactively to fix them.[11]

The RJC states a vision, and broadly organizes it into six categories: Criminal Justice, Health Equity, Housing and Homelessness, Environmental Equity, Economic Opportunity, and Education Recovery.[12] This report maintains that stated structure, as does the Companion Technical Report by RMI/NBI that informs this report.[13] Ideally, this combination of embedded DEI work and simultaneous mapping, where possible, to the vision of the RJC, will make this report a useful, deliberate tool acknowledging past and present racially discriminatory and exclusionary policies, while simultaneously providing options to proactively to fix them.

[10] Oregon Legislature | HB 2167

[11] See "Message from the Governor", Office of Governor Tina Kotek | 2023 Racial Justice Council Report

[12] See "The Vision", Oregon Racial Justice Council | Homepage *(retrieved November 13, 2024)*

[13] Ariel Brenner, Rebecca Esau, et al., *Findings and Recommendations on the Use of Lower Carbon Materials in the Statewide Building Code and Other Means for Reducing Greenhouse Gas Emissions Attributable to Building Materials*. NBI and RMI, 2024. ("Companion Technical Report by RMI/NBI")

House Bill 3409 (2023) and Building Codes Division

House Bill 3409 (2023), Section 7, requires DCBS to deliver a report to an interim committee of the Legislative Assembly related to the environment no later than December 31, 2024. The report "shall include the department's findings and recommendations on options for, and the feasibility of, reducing greenhouse gas emissions that result from materials used in building construction, based on the findings of the department and after consultation with the Department of Environmental Quality,"[14] including:

1. Studying the use of lower carbon materials in the statewide building code or applicable specialty code; or
2. Other means for reducing greenhouse gas emissions attributable to building materials that DCBS identified after consultation with DEQ.

This report was created by BCD, on behalf of DCBS, to fulfill the HB 3409(7) requirements. To make this report, BCD undertook a number of actions, including:

- Recruitment of a sustainability policy analyst to BCD.
- Contracting with third party experts from RMI and NBI to deliver a study of findings on options for reducing GHG emissions that could be effective alongside Oregon's state building code principles.
- Hosting of a kickoff summit, in collaboration with DEQ, that included presentations by regional experts in embodied emissions reductions work.
- Ongoing collaboration with DEQ for technical review and consultation.
- Analysis of the scope of Oregon's new and existing commercial and multifamily building construction, including new construction, alterations, additions, and repair.
- Review and analysis of Oregon specialty codes, including the Oregon Structural Specialty Code, Oregon Energy Efficiency Specialty Code, Oregon Residential Specialty Code, and the Oregon Mechanical Specialty Code.

History of building codes in Oregon

In 1973, Oregon established a statewide building code, composed of a series of specialty codes, each of which addresses a specific area of construction. BCD is now responsible for adopting, administering, and enforcing this statewide code that governs construction in Oregon. BCD, together with its advisory boards, is tasked with adopting building codes applicable throughout Oregon.[15] The specific rules and regulations enacted by BCD are detailed in Oregon Administrative Rules Chapter 918. The statutory provisions that govern the adoption, administration, and enforcement of the statewide building code are in Chapter 455 of the Oregon Revised Statutes (ORS). Each of the specialty codes is based on a national

[14] Oregon Legislature | House Bill 3409 (2023)

[15] See Appendix B – Board Composition

code model, and ORS 455.110 specifically requires BCD to "conform insofar as practicable to model building codes" when making updates to the codes. BCD follows national model code development cycles and makes updates every three years, incorporating Oregon-specific modifications. Additionally, certain federal and state legislation related to construction, safety, or building practices can also influence the regulatory framework that guides BCD in adoption and enforcement of building codes in Oregon.

BCD works collaboratively with over one hundred building departments in local jurisdictions around the state to administer and enforce the state's structural, electrical, mechanical, plumbing, and energy building codes and laws. Because the building code is consistent across the state, builders know that they are able to rely on consistency and predictability in completing their projects to code. Having one statewide standard has resulted in exemplary compliance rates as designers, building officials, inspectors, contractors, and other stakeholders are all able to train to one standard, regardless of where in the state the project is located. These high compliance rates are key to promoting safe and efficient buildings for all Oregonians.

BCD works with Governor-appointed advisory boards, comprised of representatives from a broad range of stakeholder groups, including: the design and construction industries, local building officials, public utilities, state agencies, and the general public. Together, BCD and the seven advisory boards work to adopt and amend a state building code using a process that ensures all stakeholders' voices are heard. BCD's Principles of Code Adoption[16] form the foundation by which the boards act. Before an advisory board approves a change to the code, they must find that the "added cost, if any, is necessary to the health and safety of the occupants or the public or necessary to conserve scarce resources," underscoring the importance of balancing cost, safety, and environmental conservation.[17]

BCD has existing statutory authority to regulate construction in Oregon. BCD's approach is to maintain product neutrality and adopt codes that protect fire life safety, unless otherwise directed by the legislature. To adopt or update a building code, BCD first identifies the appropriate model code. Next steps include soliciting proposals from stakeholders, appointing a code committee, holding code committee meetings, and then forwarding the code committee recommendations to the relevant board. The board reviews the committee's recommendations at a public meeting and, if desired, may vote to approve code changes. After that occurs, BCD staff conduct public outreach and rulemaking concluding with codification.

Separate from developing and administering the statewide building code, BCD also issues trade licenses and certifications to qualified businesses, individual tradespeople, and building inspectors. Managing these licenses and certifications helps maintain an educated and competent work force in Oregon's construction industries and supports economic development throughout Oregon. BCD and the appropriate advisory boards are partners in the code change process and have established Oregon as a national leader for building codes that are technically and economically feasible, protecting building occupants and conserving Oregon's resources.

[16] See Appendix A – BCD Principles of Code Adoption

[17] Oregon Legislature | Oregon Revised Statues 455.030(2)(b)

Climate change relating to construction

The United Nation's Intergovernmental Panel on Climate Change (IPCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."[18] On earth, increased levels of emitted carbon dioxide (CO_2), methane, and other GHGs to the global atmosphere are causing climate change by which the sun's energy, being trapped in the atmosphere by GHGs, radiates back to the earth's surface and increases the world's temperature.

GHG emissions happen largely due to human activities, especially those from the fossil fuel industry, deforestation, and industrial processes.[19] Human populations are driving climate change by increasing GHG emissions through upward demand on the need for:

- Energy, as emissions from the burning of fossil fuels
- Products and materials, as emissions from industrial processes
- Housing and economic growth, as emissions from expansion of urban areas and infrastructure
- Food and agribusiness, as emissions from deforestation for agriculture or development

Buildings are associated with two types of GHG emissions: operational carbon and embodied carbon. About 39% of humanity's current GHG emissions result from building operations, such as the heating and cooling of a finished building – and construction-related processes. Included in that 39% is 7% in the form of pollution arising from resource extraction, manufacturing, transportation, installation, maintenance, and disposal of building materials and their components, as well as from processes and ingredients used in the construction of buildings.[20] This is embodied carbon of buildings, and for the purpose of this report, is synonymous with embodied emissions.

Construction projects shape built environment in both urban and non-urban environments. For the purposes of this report, Oregon's current square footage (SF) of existing buildings as well as the SF of Oregon's estimated new construction through 2050 were estimated for analysis, as shown in Table 1.

Building type	Total Oregon New Construction SF (2025-2050)	Current Oregon SF estimate 2024
Multifamily above 3 stories	260,959,513	644,600,000
Small Commercial (50,000 square feet or less)	596,490,454	1,473,400,000
Large Commercial (over 50,000 square feet)	261,769,192	646,600,000
Total New Construction 2025-2050	**1,119,219,159**	**2,764,600,000**

[18] Masson-Delmotte, V., et. al., (2018), *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. IPCC*

[19] Environmental Protection Agency | Sources of Greenhouse Gas Emissions

[20] World Green Building Council | Bringing embodied carbon upfront

Table 1: Oregon's current and projected square footage of buildings.[21]

Every building constructed has a profound environmental implication, and making informed decisions on how they are built, maintained, and eventually decommissioned is essential to reducing their environmental impact. Life Cycle Assessment (LCA) is a type of comprehensive analysis that identifies environmental impacts associated with a building product, process, or activity from its inception to its end of life, including energy use, emission, and waste generation. In architecture and the construction industry, LCA is divided into different stages of a life cycle, denoted as stages A, B, C, and D, with each stage encompassing specific phases (A1, A2, etc.) and processes.[22]

Figure 1 illustrates product lifecycle stages and phases, which are: A1–A3: production stage (embodied emissions); A4–A5: construction stage (embodied emissions); B1–B7: maintenance use stage (embodied emissions); B6–B7: operational use stage (operational emissions); C1–C4: end-of-life stage (embodied emissions); and D: beyond the lifecycle (embodied emissions). Embodied emissions have the potential to be represented in every life cycle stage, although not typically in B6 and B7, which are the use of energy and water in a building. The life cycle stages A1-A5 and B1-B5 have measurable embodied emissions due to the production, construction, and use of a building's structure and enclosure.

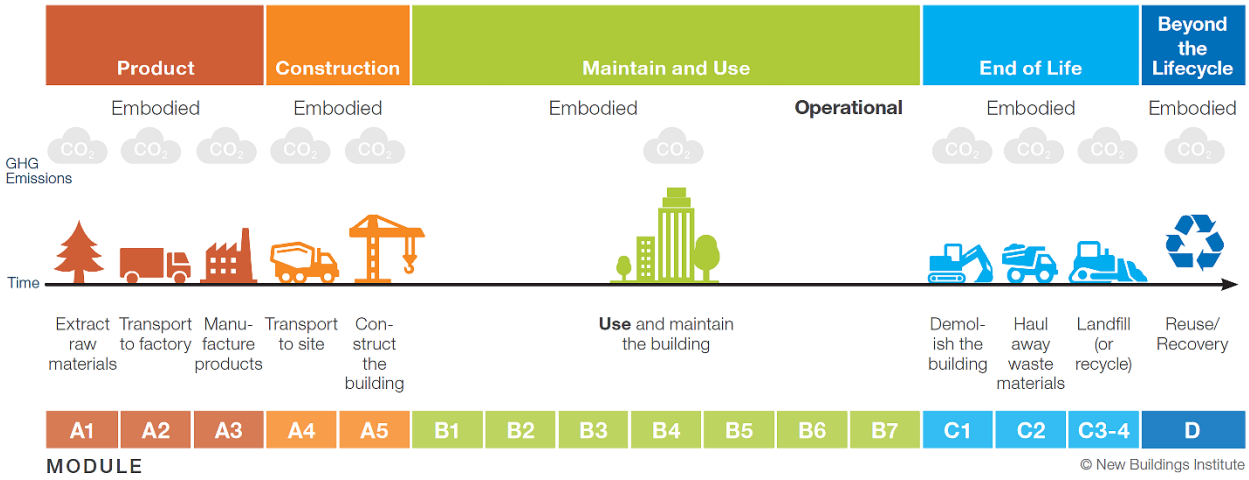

Figure 1: Product lifecycle stages and phases (source: New Buildings Institute)

Focusing on embodied emissions from buildings, especially those associated with the early phases of building materials' lifecycle, are important because of the timing at which they occur – these are the first emissions from a new building. Prioritizing reductions of these immediate emissions will help to more quickly stop the accumulation of GHGs in the atmosphere.

Oregon's contributions to greenhouse gas emissions

Oregon law and policy repeatedly recognize the danger that GHG emissions pose to Oregon's environment, including but not limited to: passage of the Oregon Sustainability Act[23], statutory

[21] See page 102 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[22] Anavitor | A Journey Through Life Cycle Assessment (LCA)
[23] Oregon Legislature | Oregon Revised Statutes 184.423

establishment of a dedicated committee[24] to address climate change, establishment of statutory GHG targets[25], establishment of statutory clean energy targets[26], procurement policies that address climate change[27], and via executive order, declaring climate change a threat to Oregon and to the wellbeing of Oregonians.[28]

Most human activities that result in GHG emissions arise ultimately as a consequence of consumption, which includes the purchase of energy, goods and services by households and governments. Such emissions can be inventoried using a method called a "consumption-based emissions inventory". Oregon pioneered this practice, commissioning the first consumption-based greenhouse gas emissions inventory at a subnational scale in North America, for calendar year 2005. Oregon DEQ subsequently updated the inventory for years 1990, 2010, 2015, and 2021. As of 2021, Oregon's buildings and infrastructure are responsible for approximately 29% of the total of Oregon's consumption-based emissions.[29] Notably, building and construction materials account for approximately half of those emissions.[30]

Reducing embodied emissions from buildings is a critical short-term opportunity, as these emissions are already expended before a building is occupied. BCD looks to DEQ for expertise on efforts in quantifying GHG emissions as well as their body of work on estimating potential for GHG reductions in the state. Initiatives by DEQ have included incentives and have led to the development of over 1500 EPD documents for concrete mixes by Oregon's concrete producers, WBLCA training and software licenses for designers throughout the state, pilot projects that tested lower embodied emissions materials and strategies, as well as provided experience to construction teams, and incentivizing building reuse.

Quantification of embodied emissions attributable to buildings and building materials

Global Warming Potential (GWP) is the most common metric for measuring and evaluating embodied emissions over the lifecycle of a building or product. GWP is reported in units of carbon dioxide equivalent (CO2e), a standard measurement that normalizes and combines the impact of the various GHG involved relative to an equivalent unit of carbon dioxide over a given period of time. Typical units for reporting GWP are as kilogram CO2 equivalent units (kg CO_2e) or as metric ton CO2 equivalent units (Metric tCO2e). These measurements describe what is commonly called the "carbon footprint" of a building. Quantifying embodied emissions of buildings involves the concept of a baseline impact and a reduction from the baseline. For purposes of reporting a baseline or setting a reduction from a baseline, targets or limits are typically expressed in kgCO2/m2 by building type.

[24] Oregon Legislature | Oregon Revised Statutes 468A.216
[25] Oregon Legislature | Oregon Revised Statutes 468A.250
[26] Oregon Legislature | Oregon Revised Statutes 469A.410
[27] Oregon Department of Administrative Services | Sustainable Procurement 107-009-0040
[28] Office of Governor Kate Brown, (2024). *Executive Order No. 20-04 Directing state agencies to take actions to reduce and regulate greenhouse gas emissions.* Office of the Governor, State of Oregon
[29] See page 26 of Throckmorton, J, et al. (2024), *Opportunities To Reduce Greenhouse Gas Emissions Caused By Oregon's Consumption.* Oregon Department of Environmental Quality
[30] See page 27 of Throckmorton, J, et al. (2024), *Opportunities To Reduce Greenhouse Gas Emissions Caused By Oregon's Consumption.* Oregon Department of Environmental Quality

Embodied emissions quantification in construction materials can be realized in two ways: either through each stage of an individual material's life cycle, or by accounting for the impact of a whole building over the building's life span. Both methods rely on EPD documents as the primary mechanism for reporting GWP data. An EPD is a "quantification of the environmental impacts of a product, throughout the product's life cycle, such as global warming potential, smog creation, ozone depletion and water pollution, in a single, comprehensive report that is a transparency document used to assess and communicate the environmental impact of construction products".[31] EPDs can include manufacturer and product data, such as material attributes, manufacturing processes and locations, and resource use. At minimum, EPDs include LCAs that analyze cradle-to-gate life cycle stages (e.g., raw material extraction/supply, transport to factory, and manufacturing of products), or life cycle stages A1-A3, but can also cover a cradle-to-grave analysis, which includes transportation to a site, installation, use, maintenance and end of life (e.g., recycling or disposal).

GWP data is also used for embodied emissions quantification when completing WBLCA. WBLCA is an "analysis of an entire building system and components, including inputs, outputs, and potential environmental impacts of a product or system over its lifetime, from initial extraction of raw materials through manufacture, distribution, use, and final disposal.'[32] Similar to an energy model, WBLCA can be used to demonstrate a building's GWP percentage reduction from a modeled baseline or to compare a proposed design to a maximum CO2e limit per floor area. WBLCAs can cover as many parts of the building as there is available GWP data, usually via EPDs. The impact of building materials and construction is broken down into the various life cycle stages, from the extraction of raw materials through the disposal of materials at the end of a building's life. Typically, WBLCA policies call for a consideration of the materials that go into a building's structure and enclosure and use assumptions about future life cycle stages to complete a scope for a building's life span reference a period somewhere between 60 and 100 years.[33]

EPDs are intended to be published for consumers to use in their material selection process. The concept of an EPD is based on standards by the International Organization for Standardization (ISO) that ensure all products are evaluated against the same criteria. The EPD is developed from a product category rule (PCR) which set the data requirements for a give product category. Creating the EPD requires a complete LCA, which includes collecting, analyzing and verifying product data, as well as getting independent third party verification and registration of the EPD, prior to being published by the EPD program operator. Figure 2 shows the creation of an EPD.

[31] See glossary of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[32] See glossary of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[33] See page 23 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

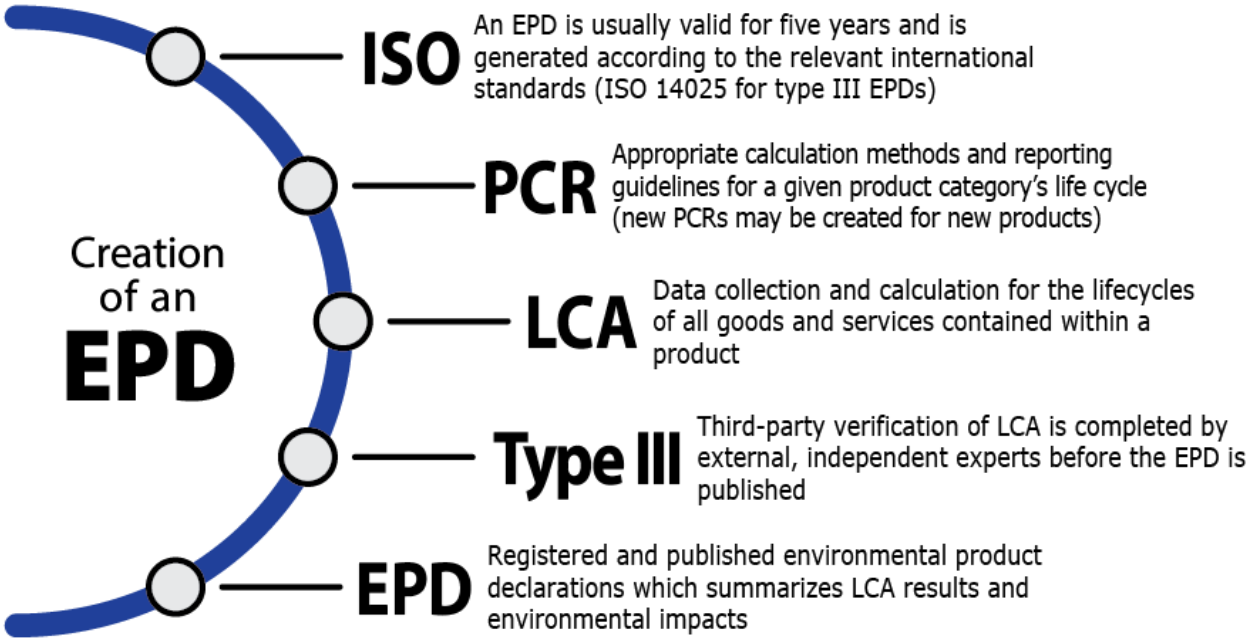

Figure 2: Creation of an Environmental Product Declaration

The number of manufacturers producing EPDs for their products is rapidly growing worldwide. However, the market for EPDs is still underdeveloped and inconsistent across geographic regions. Online databases are the preeminent tools for finding and comparing EPD documentation. Since the launch of the Embodied Carbon in Construction Calculator (EC3) tool[34] in 2019, a first-of-its-kind, free online database of construction material EPDs, there have been over 93,000 EPDs added to its database, with over 81,000 EPDs belonging to US manufacturers. Figure 3 shows the estimated global growth in number of EPDs between 2012 and 2024.

[34] Building Transparency | Embodied Carbon in Construction Calculator (EC3)

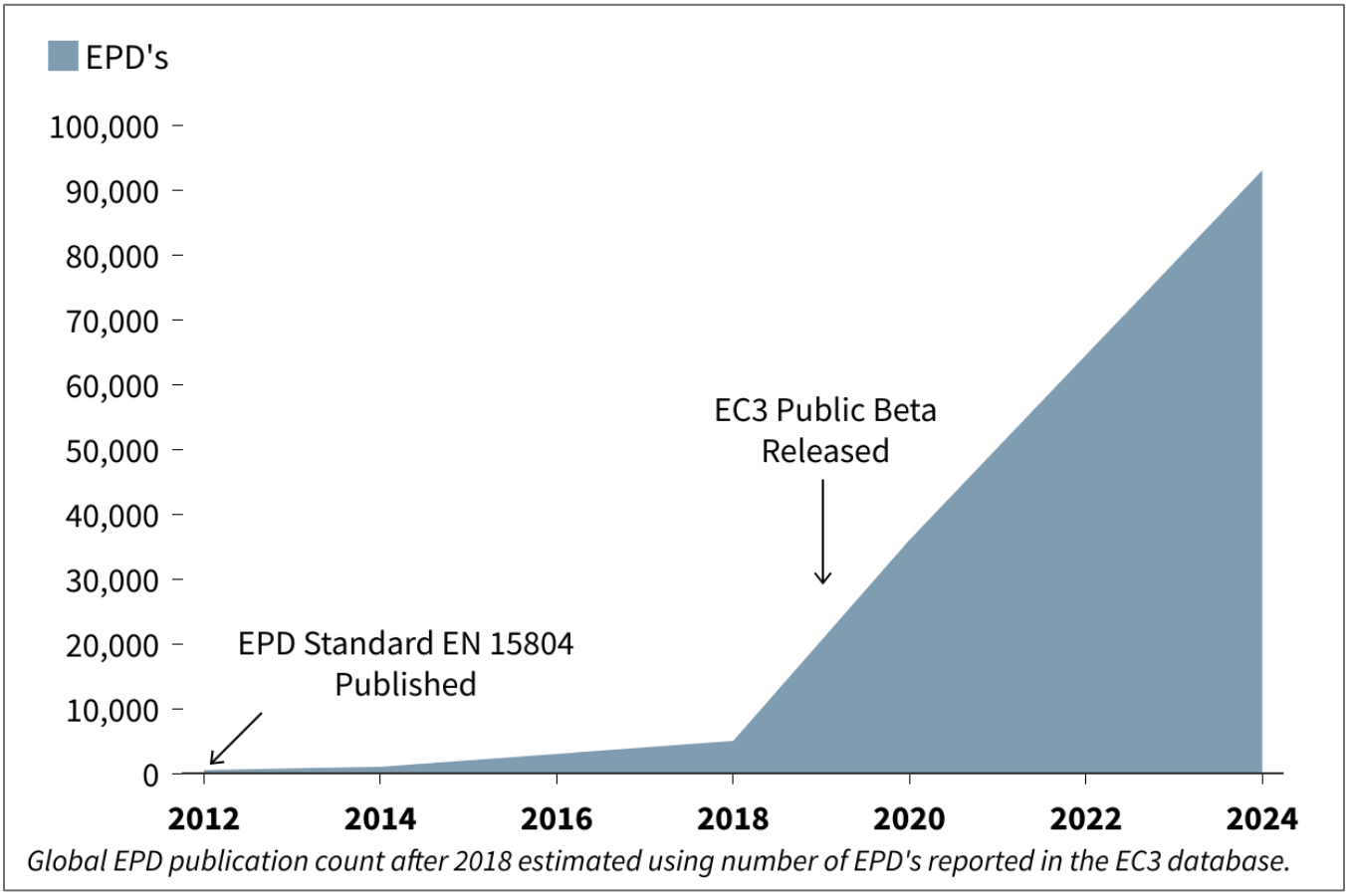

Figure 3: Estimated global growth in number of EPDs between 2012 and 2024.[35]

Oregon is a leader in EPD creation. Table 2 lists the number of product-specific EPDs available in EC3 from Oregon-based manufacturers compared to what is available in EC3 from manufactures in the US.

Product	No. of product-specific EPDs from Oregon based manufacturers available in EC3	No. of product-specific EPDs from US based manufacturers available in EC3
Ready-mix concrete	7,508	72,364
Steel	6	240
Glass	0	26
Wood products	7	17
Insulation	8	251

[35] See page 40 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

Table 2: Number of product-specific EPDs available in EC3 from Oregon and from the US.[36]

Paths to reduce embodied emissions in buildings

This section of the report presents paths for Oregon to reduce embodied emissions that result from materials used in building construction. The paths consider policy options, whether through codes or other regulatory means. Feasibility was a key component in considering what paths to include in this report. These are the implementation approaches that seem most viable and effective, though further review and market transformation may be needed to operationalize them in the short term.

Recommended Paths

BCD has identified three distinct paths for Oregon to address embodied carbon and realize embodied emissions reductions in buildings:

Building reuse
Retain the maximum amount of a building's existing structure when being repaired, added to, or altered. Explore Oregon's building reuse project data.

Environmental product declaration reporting
Through EPDs, analyze GWP data of Oregon's building materials to develop material-level embodied emissions limits and reduction targets.

Whole building life cycle assessment reporting
Through WBLCAs, analyze GWP data to develop Oregon's building-level embodied emissions limits and reduction targets.

Building reuse

Overview

Building reuse, or adaptive reuse, refers to the process of retaining the structure, enclosure, or other portions of an existing building for continued use. Through retaining existing structures, the high embodied emissions associated with new construction are avoided. In plain language, the building that emits the fewest embodied emissions is the one that is already built.

As communities face increasing pressures from urbanization and climate change, the emphasis on repurposing existing structures becomes not just an option, but a necessity. Building reuse can have significant challenges depending on the age of the building, the ability of a building to meet modern energy and safety standards, and the ease of changing a building from one use to another. Collecting data on the number and location of projects in Oregon that retain portions of an existing building would reveal geographic trends and feasibility insights.

[36] See page 40 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

Analysis in the Companion Technical Report by RMI/NBI was completed with the lens of applying as mandatory code provisions for building reuse in Oregon, and shows that as the percentage of a structure reused in commercial and multifamily buildings increases, the projected reduction rises in a relatively linear fashion. Even a moderate increase in building reuse can realize a substantial reduction in embodied emissions by nature of the amount of new construction that is avoided.[37] In the listed results of building reuse scenarios, Scenario 2 represented the middle scenario value. In Scenario 2, set against a "take-no-action" baseline scenario, 25-27% reduction of embodied emissions is anticipated by 2050 where 40 percent, by area, of a commercial and multifamily existing structure in Oregon is reused.[38]

BCD defines regulatory guidelines and provides technical assistance on alterations, additions, and repairs that represent significant opportunities for embodied emissions reductions relative to the impacts from demolition or replacement of the structure. The Oregon Structural Specialty Code (OSSC) Section 3404, which recognizes Section 401.2 of the International Existing Building Code (IEBC) for existing building compliance, includes provisions intended to facilitate adaptive reuse of existing buildings[39] and gives clear direction on allowable materials for reuse and flexible compliance for repairs to existing buildings.[40]

Building reuse path

Oregon Structural Specialty Code currently recognizes the reuse of existing buildings and provides site-specific compliance flexibility for users of the code.[41] Further empowerment of this could broaden the application of building reuse across Oregon and inform state policy to be able to track GHG reduction targets. Building reuse is a current code-recognized path, and could further comprise:

1. Building reuse education and outreach to local jurisdictions and industry stakeholders to use their authority to facilitate broader building reuse in their communities.
2. Exploration of commercial construction projects in Oregon intended for building reuse of at least 20,000 gross floor area (GSA). Reuse of this building size would provide an alternative for up to 56 percent of Oregon's estimated new construction through 2050.[42] Identify:
    a. site location and gross floor area of the original existing structure and enclosure
    b. newly constructed area of the primary structural frame and exterior wall envelope
3. Legislatively-provided financial or regulatory incentives that encourage building reuse. This can come in the form of direct or indirect funding for building reuse projects to help make more reuse projects financially viable, specifically targeting:
    a. creation of housing and utilization of space conversions to create more housing

[37] See page 107 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[38] See page 108 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[39] Oregon Building Codes Division, (2022), *Adaptive Reuse – Existing Buildings.* Oregon Building Codes Division
[40] Oregon Building Codes Division, (2020), *Technical Bulletin – Tenant Improvement Repair, Alteration, Change of Occupancy.* Oregon Building Codes Division
[41] Oregon Building Codes Division | Memorandum: Adaptive Reuse – Existing Buildings
[42] See page 90 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

b. alternate energy efficiency standards in recognition of the intrinsic embodied emissions savings of building reuse

Feasibility of building reuse in Oregon

Encouraging building reuse aligns with Oregon's climate goals and reinforces Oregon's commitment to innovation and resilience in building construction. BCD is positioned to support the additional legislatively-directed incentives or other regulatory changes to facilitate safe compliant building reuse, in compliance with statewide building code, in lieu of new construction. However, it is not within the authority of the building code to mandate building reuse.

Agencies, including BCD, could prioritize support for building reuse projects that both reduce embodied emissions and increase housing production. State agencies and local jurisdictions could further coordinate on work that could lead to GHG reductions through financial and permitting assistance and incentives that promote reutilization of existing buildings. In Oregon, BCD could provide code expertise and consultation to local jurisdictions to develop and implement enforcement strategies for building reuse.

Building reuse policy can also include waste diversion and material circulation strategies, including but not limited to: deconstruction best practices, construction waste recycling; salvage and reuse of interior products; building with less (known as design efficiency); and manufacturer take back programs (known as extended producer responsibility). Globally, an estimated third of the world's overall waste can be attributed to construction.[43] Because of this, a local jurisdiction could consider the impending waste impacts to new/replacement construction and could instead realize the GHG savings opportunity through the pathway of building reuse.[44] Deconstruction, demolition, and required building material reuse are not under the authority of the state building code; however, there are local opportunities for construction and demolition waste diversion.

Importantly, absent an enforcement structure for any building reuse approach, Oregon is unlikely to realize significant emissions reduction benefits. This is a significant consideration for legislative policy makers. However, legislative action to incentivize and encourage building reuse or otherwise holding local jurisdictions accountable for building reuse and waste impacts to new/replacement construction could help ready the market more ready for a future that includes building reuse enforcement.

There are several existing local, regional, and national initiatives and policies demonstrate building reuse as an achievable and successful framework for embodied emissions reductions.[45]

Environmental product declaration reporting

Overview

EPD reporting could be a valuable tool going forward to collect GWP data needed to set realistic embodied emissions reduction targets for building materials in Oregon. EPD reporting involves generating and submitting EPD documentation that discloses actual GWP data of building products and

[43] Miller, N, (2021). *The Industry Creating a Third of the World's Waste.* British Broadcasting Corporation
[44] See page 34 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[45] See pages 33-36 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

materials; actions which do not necessitate a building code requirement. As material-level embodied emissions impacts are quantified, then policy makers could set reduction targets to encourage lower carbon material choices. EPD reporting also reveals the number of EPDs on the market and which manufacturers are producing EPDs, which informs where low carbon materials are being produced. Establishing embodied carbon requirements and GWP limits for specific building materials in code is commonly referred to as a prescriptive method. At this point in time, prescriptive policies tend to target the materials that tend to have the highest climate impact: particularly, concrete and cement, steel, asphalt, glass, wood, and insulation.[46]

The structure and enclosure products of a building, particularly concrete and cement, steel, flat glass, engineered wood, and rigid insulation, represent the majority of the volume and mass of materials used in a building. These materials are also among the highest-ranking embodied emissions products of a building. Therefore, EPD reporting of these high-emitting building products could be an effective mechanism to develop impactful embodied emissions reduction targets. Over time, EPD reporting could expand to include analysis of the market readiness and feasibility of low carbon materials not included in a building's structure and enclosure, such as interior finishes and other assemblies. Ultimately, where a construction project team wants to procure low carbon materials, EPD reporting could be encouraged for any building material.

The Companion Technical Report by RMI/NBI evaluated concrete, steel, and engineered wood for various prescriptive-based code approach scenarios in Oregon and provided results showing embodied emissions that could be avoided through the year 2050.[47] In the listed results of prescriptive approach scenarios, Scenario 2 represented the middle scenario value for concrete, steel, and engineered wood. To represent the middle scenario across all of the materials, the Scenario 2 values for each material were added. Set against a "take-no-action" baseline scenario, 17%-25% reduction of embodied emissions is anticipated by 2050 where GWP limits are set 30 percent below industry average and assuming incorporation of mandatory provisions in code when applied to commercial and multifamily development in Oregon.[48] Following the same Scenario 2, the cumulative embodied emissions savings equate to roughly 800,000 mtCO2e for concrete; 95,000 mtCO2e for steel, and 90,000 mtCO2e for engineered wood over the 2025-2050 period.[49]

EPD reporting path

EPD reporting is a straightforward, prescriptive approach and could inform state policy makers to be able to track GHG reduction targets and help ready the industry for broader use of EPDs. The EPD reporting path could comprise:

1. EPD documentation submission requirement for each permanently installed high-emitting product where a Type III EPD is available, and which is used on commercial construction projects of at least 50,000 GFA. Reuse of buildings at this size threshold would provide an

[46] See page 29 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[47] See pages 107-108 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[48] Any selected scenario or range represented for EPD reporting does not account for all of the reduction potential as it doesn't provide possible reductions for the product categories flat glass and rigid insulation, which are considered in the EPD reporting path.
[49] See page 103 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

alternative for up to 56 percent of Oregon's estimated new construction through 2050. Require EPD reporting for the following product categories:[50] [51] [52]

a. ready-mix concrete
b. structural steel (including reinforcement bar)
c. engineered wood
d. flat glass
e. rigid insulation

2. Staffing within an administering agency for EPD documentation collection and data analysis.
3. Document repository management of the collected EPDs.

Feasibility of EPD reporting in Oregon

Considering that the built environment is a major contributor to Oregon's emissions, EPD reporting implementation as an embodied emissions reduction strategy for high-emitting building materials is appropriate for Oregon. Best practices for implementation of EPD reporting include the creation of a statewide governance system with authority to collect, monitor, and enforce compliance of EPD reporting. This would require a significant policy directive from the legislature, and would likely require significant changes to statute and funding. However, Oregon could benefit from this investment. Low carbon materials are increasingly in-demand, and effective EPD reporting could give Oregon manufacturers and producers an advantage in their operations to meet this increasing demand for low carbon materials, both locally in Oregon and beyond.[53] [54] Alignment with DEQ's Materials Management Program EPD gathering efforts[55] could lead to broader construction stakeholder readiness and secure opportunities to expand the benefits in procuring and installing low carbon building materials.

Adjustments to applying EPD reporting to different building sizes over time would give the state and the market the ability to ramp up to the learning curve of adhering to and complying with EPD reporting. An initial 50,000 GFA threshold would include approximately 30 percent of Oregon's estimated new construction through 2050; and having the intent to reduce the size threshold to at least 20,000 GFA would account for 56 percent of Oregon's estimated new construction through 2050.[56] The appropriate way to implement and enforce EPD reporting that does not disrupt construction or limit product

[50] In the Companion Technical Report by RMI/NBI, concrete, steel, and engineered wood were analyzed as prescriptive-based scenarios for embodied emissions reductions. EPDs are being collected in major prescriptive codes and policies for flat glass and rigid insulation, but these product categories were not analyzed in the report by RMI/NBI. The product category asphalt, which is analyzed in the report by RMI/NBI, is not within the scope of BCD's relevant specialty code programs.

[51] See Table 6-1, page 62 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

[52] See pages 102-103 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

[53] Jones Lang LaSalle Inc., (2024). *The Green Tipping Point*. Jones Lang LaSalle, Inc.

[54] Dougherty, C, et al., (2024). *Structuring Demand for Lower-Carbon Materials: An Initial Assessment of Book and Claim for the Steel and Concrete Sectors.* RMI

[55] Macdonald, C, et al. (2023). *Biennial Report to the Oregon Legislature 2023*. Oregon Global Warming Commission

[56] See page 70 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

availability and choice will have to be determined, and would require a balanced approach and support from the relevant boards.

Enforcement of EPD reporting exists at some local, state, and national levels,[57] but to get to the place where Oregon is going, enforcement of EPD reporting is not in the space of this reports' recommendations. However, importantly, absent an enforcement structure for any EPD reporting directive, Oregon is unlikely to realize significant carbon reduction benefits. This is a significant consideration for legislative policy makers. Steps to incentivize and encourage the use of EPDs could help ready the market for a future that includes requirements.

There are several existing Oregon, regional, and national initiatives and policies that demonstrate EPD reporting as an achievable and successful framework for embodied emissions reductions.[58]

WBLCA reporting

Overview

WBLCA reporting could be a valuable tool going forward to collect GWP data needed to establish Oregon's building-level embodied emissions baseline values and set realistic reduction targets. Completing a WBLCA involves tools and software that are available to practitioners, and incorporates GWP data of construction materials on the project, via EPDs, to quantify embodied emissions on a whole-building level for the complete life cycle of a building. Furthermore, a WBLCA report can include demonstration of a certain level of GWP reduction, reported either as a percent-decrease from a building-level baseline value or as falling under an absolute value that acts as a building-level GWP cap.[59]

Like EPD reporting, an administering agency to analyze WBLCA report documentation as well as an appropriate location and tool for WBLCA guidance is necessary. BCD and local jurisdiction partners are not equipped to perform the necessary data aggregation needed to inform baseline values and set future reduction targets.

The Companion Technical Report by RMI/NBI evaluated various performance-based approach scenarios in Oregon that would incorporate into code a WBLCA requirement with an associated reduction. The evaluation provided results showing embodied emissions that could be avoided through the year 2050.[60] Scenario 3 of RMI/NBI's analysis, set against a "take-no-action" baseline scenario, shows 30% reduction of embodied emissions is anticipated by 2050 where there is a 30 percent building-level reduction target, measured from a reference building assuming industry average GWP values and assuming incorporation of mandatory provisions in code when applied to commercial and multifamily development in Oregon.

[57] See page 92-96 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[58] See pages 29-33 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[59] See page 71 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[60] See page 106 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

WBLCA reporting path

WBLCA reporting is an integrated, performance-based approach and could inform state policy makers to be able to track embodied emissions reduction targets and help ready the industry for broader use of WBLCA. The WBLCA reporting path could comprise:

1. An informative, optional WBLCA reporting appendix to building code.
    a. could apply to commercial and multifamily construction projects of at least 50,000 GFA with an intent to reduce building size threshold over time
    b. could report the environmental impacts of a building's structure and enclosure for the production, construction, and use life cycle stages
2. Development of technical guides on WBLCA reporting.
    a. could include training materials and reporting templates to provide standardization of WBLCA reporting methodologies across Oregon
3. Staffing within an administering agency for WBLCA report collection and analysis.

Feasibility of WBLCA reporting in Oregon

Because WBLCA reporting incorporates GWP data, via EPDs, to quantify embodied emissions on a building-level, the feasibility of WBLCA reporting is dependent on successful and robust advancement of EPD reporting. Ultimately, with expanded EPD reporting that includes interior finishes and other assemblies different from the structure and enclosure, a building-level baseline GWP value for Oregon would be determined and achievable reduction targets and limits could be set.

Adjustments to applying WBLCA reporting to different building typologies and sizes over time will give the state and the market the ability to ramp up to the learning curve of adhering to and complying with WBLCA reporting. An initial 50,000 GFA threshold would include approximately 30 percent of Oregon's estimated new construction through 2050; and having the intent to reduce the size threshold to at least 20,000 GFA would account for 56 percent of Oregon's estimated new construction through 2050.[61] The appropriate way to implement WBLCA reporting that does not disrupt construction or limit product availability and choice will have to be determined, and would require a balanced approach and support from the relevant boards.

Enforcement of WBLCA reporting exists at some local, state, and national levels,[62] but to get to the place where Oregon is going, enforcement of WBLCA reporting is not in the space of this reports' recommendations. However, importantly, absent an enforcement structure for any WBLCA reporting directive, Oregon is unlikely to realize significant carbon reduction benefits. This is a significant consideration for legislative policy makers. Finally, there are several existing Oregon, regional, and

[61] See page 70 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[62] See pages 92-96 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)

national initiatives and policies that demonstrate WBLCA reporting as an achievable and successful framework for embodied emissions reductions.[63]

Ongoing opportunities to reduce embodied emissions

BCD recognizes that the policy landscape of embodied emissions reductions from construction and building materials is rapidly maturing. Having this awareness, BCD identified other actionable opportunities to create more sustainable, resilient, and equitable construction, including:

1. The Sustainability Policy Analyst position at BCD will respond to future legislation through continued participation of Oregon's interagency engagement with stakeholders on this topic.
2. BCD will work to assure consistent messaging and program alignment for embodied emissions reduction policies and programs, refining current relationships with state agencies.
3. BCD will continue to identify where it can complement programs for embodied emissions reduction best practices, including training opportunities, support of the workforce, incentive programs, stakeholder engagement, and state agency and regional ally alignment.
4. BCD will continue to review and consult on leading local, regional, and national updates regarding existing and emerging embodied emissions reduction policies in building codes, as well as many non-code policies. Particularly, the recommendations for Washington State embodied carbon code language (a study commissioned by the State of Washington 68th Legislature for potential adoption by Washington State building code council)[64]; the California Green Building Standards Code[65] (known as CALGreen), the Vancouver Building Bylaw[66], the Denver Green Code, International Green Construction Code for high-performance buildings (ASHRAE Standard 189.1), Quantification of Life-Cycle Greenhouse Gas Emissions of Buildings (ASHRAE Standard 240P), the ECHO Project[67], and the Carbon Leadership Forum's WBLCA benchmark studies[68].

Environmental equity, community outreach, and building codes

This report is specific to environmental impacts of buildings and building materials in Oregon. It is valuable to consider how this report's presented paths to reduce embodied emissions that result from materials used in building construction fit into Oregon's larger policy and governmental systems.

---

[63] See page 31-33 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[64] Jensen, A, et al., (2024). Recommendations for Washington State Embodied Carbon Code Language. Carbon Leadership Forum.
[65] See pages 30, 31, 83 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[66] City of Vancouver, Washington, (2023). *Guidelines: Embodied Carbon Guidelines.* City of Vancouver, Washington
[67] Echo Project, (2024). *Embodied Carbon Harmonization and Optimization.* Echo Project
[68] Carbon Leadership Forum, (2024). *CLF WBLCA Benchmark Study V2*. Carbon Leadership Forum

Climate change caused by GHG emissions affect everyone. However, Oregonians that experience inequity based on gender, race, or any other immutable characteristics likewise experience the negative impacts of climate change more acutely. These individuals are typically less prepared for the expense of climate change adaptation, including disaster impacts, implementation of mitigation strategies for weather events, or other climate change impacts.

Furthermore, addressing emissions reductions through construction and building materials impacts housing policy. Housing policy seeks to address multiple persistent challenges, including affordability. Adding the additional challenge of equitable environmental climate response in this already complex system may leave policymakers overwhelmed.[69]

The work of the RJC[70], specifically the categories in the vision, can be a useful tool to understand what policies are useful and impactful. A landscape analysis of different climate action policies enacted by jurisdictions across North America was created to show fulfillment into the six vision categories of the RJC[71]. While it is possible for anyone to disagree with the actual analysis in this table, the technique of aligning policy choices for building materials with the RJC represents a potentially powerful policy tool.

Another potential tool to consider is social cost of carbon (SCC) calculation. SCC puts a cost on the potential emissions of a process (operational emissions) or a product (embodied emissions) when determining embodied emissions limits or reduction targets. The social cost of carbon has been used to develop operational efficiency and electrification goals in jurisdictions including NY State. A 2020 report by Oregon Department of Energy (ODOE) lists a high-end estimate for the SCC in 2025 at $175 per ton of CO2. This has context for the equity impacts of carbon, and represents a methodology that could broadly be used to inform and set embodied emissions limits or reduction goals that reflect Oregon's societal health goals.[72]

Beyond these tools, there are other implementation considerations that the state could adopt to address inequity, including:

- Adoption of an engagement model, or similar best practices for engaging communities and Oregonians. Addressing systemic inequity requires building relationships with disadvantaged communities and people. There are known techniques for community engagement that can make engagement and relationship building more successful and authentic. For example, the need to meet people in the community spaces they attend, the special emphasis on time and timelines, or the progression over time from informing to engaging to collaboration and shared problem-solving. An engagement model of deliberate engagement that is meaningful to all parties is a powerful tool that could be applied to reduce inequity statewide, including at the intersection of the built environment and people.
- Incorporation of the presented paths in this report into other policy actions. Currently, in Oregon, we are in the midst of a public policy goal for the construction of 36,000 homes a year.[73] Building in

[69] Martín, C. (2022). *Exploring Climate Change in U.S. Housing Policy. Housing Policy Debate*, *32*(1), 1–13.
[70] Oregon Racial Justice Council | Overview
[71] Appendix C – Landscape analysis of existing climate policies and fulfillment of Oregon's Racial Justice Council equity pillars
[72] See page 82 of the Companion Technical Report by RMI/NBI (Ariel Brenner, Rebecca Esau, et al.)
[73] Office of Governor Tina Kotek, (2024), *Housing Priorities*. State of Oregon

incentives for the prioritization of building reuse, EPD and WBLCA reporting, and use of low carbon materials, etc. into policy choices for housing construction could be an effective way to address housing inequity and environmental inequity simultaneously.

Finally, it must be acknowledged that systemic equity goals, including environmental impacts of building materials, likely fall at least partially outside of the scope of Oregon's building codes and code language. Historically, building codes are created for fire and life safety of the occupants of a structure. The inclusion of embodied emissions considerations in code is a step beyond those traditional safety concerns.

Conclusions

This report explores three primary paths of embodied emissions reductions for Oregon: retain the maximum amount of a building's existing structure through building reuse, develop material-level embodied emissions limits and reduction targets through EPD reporting, and develop building-level embodied emissions limits and reduction targets via WBLCA.

While still being developed, policy approaches by regional accelerators, national standards, and public agencies represent robust embodied emissions reduction pathways and programs. The pacific northwest region has strong leadership in the conversation on this topic and BCD is available to continue initiatives deemed feasible through incremental progress and steady, predictable policy application.

Given Oregon's ambitious push towards a zero-carbon future in 2050, regulating embodied emissions from new and existing buildings is a critical component to achieving this outcome. BCD is excited to be a part of Oregon's leadership on reduction of embodied emissions. BCD and its boards take pride in Oregon's place as a national leader in energy efficiency, and intend to continue that leadership with cutting edge, cost effective updates to the codes. BCD recognizes that we cannot get there alone. It is only with our expert board member volunteers, government partners, and public participation that we are going to achieve the ambitious goals laid out in HB 3409. We are well on our way, and we are up to the challenges we will face going forward. Oregon can be proud of its 50 years of national leadership in providing safe, efficient buildings and BCD will continue with a balanced approach to these exciting emerging opportunities to reduce the carbon impact of buildings.

Glossary of terms

Term	Definition
The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	An American professional association seeking to advance heating, ventilation, air conditioning and refrigeration (HVAC&R) systems design and construction. ASHRAE has over 50,000 members in more than 130 countries worldwide.
ASHRAE Standard 189.1	The International Green Construction Code, also known as ASHRAE Standard 189.1, is an overlay to other ICC model codes and provides minimum requirements for the siting, design, construction, and operation of high-performance green buildings. Chapter 9, which addresses materials and resources, houses most of the standard's provisions around embodied emissions.
ASHRAE Standard 240P	Quantification of Life Cycle Greenhouse Gas Emissions of Buildings. Standard 240P will provide a methodology to quantify the embodied and operational GHG emissions associated with buildings and their sites. The standard will also provide minimum requirements for documentation of life cycle GHG emissions.
Building Codes Division (BCD)	The division responsible for adoption and administration of the Oregon Building Codes
Carbon Dioxide (CO_2e)	A measure used to compare the impact of various greenhouse gasses based on their global warming potential (GWP). CO2e approximates the time-integrated warming effect of a unit mass of a given GHG relative to that of carbon dioxide (CO2). The following GWP values are used based on a 100-year time horizon: 1 for CO2, 25 for methane, and 298 for nitrous oxide.
Carbon Footprint	The total amount of greenhouse gas emissions associated directly and indirectly with a product, building, individual, organization, or event. Carbon footprint is measured in the units of kg or tons of carbon dioxide equivalent, commonly expressed as GWP.
Carbon Leadership Forum (CLF)	The Carbon Leadership Forum accelerates the transformation of the building sector to radically reduce the greenhouse gas emissions attributed to materials used in buildings and infrastructure.
Department of Consumer & Business Services (DCBS)	The state department that oversees the work completed by BCD.
Diversity, Equity, and Inclusion (DEI)	Diversity is the quality of being different or unique at the individual or group level. This includes age; ethnicity; gender; gender identity; military status; language differences; nationality; parental status; physical, mental, and developmental abilities; race; religion; sexual orientation; skin color; socio-economic status; work and behavioral styles; and the perspectives of each person shaped by that individual's nation, experiences, and culture. Even when people appear the same on the outside, they are different. Equity is giving everyone what they need to be successful. Equality aims to promote fairness, but it can work only if everyone starts from the same place and needs the same thing. Equality is treating everyone the same. We must first ensure equity

	before we can enjoy equality. Inclusion is a state of being valued, respected, and supported. Inclusion should be reflected within DCBS' culture, practices, and relationships by supporting a diverse workforce for all people to achieve their full potential. We build a culture of belonging by actively inviting the contribution and participation of all employees.
Department of Environmental Quality (DEQ)	The state agency listed in HB 3409 (7) to consult with DCBS on reducing GHG emissions attributable to building materials. DEQ's mission to be a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.
Embodied Carbon Harmonization and Optimization (ECHO) Project	A collaborative initiative of industry groups and movement leaders to tackle the challenge to rapidly reduce embodied carbon in built environments by ensuring that all embodied carbon reporting at the whole building and whole project scale (including landscapes and infrastructure) in the US follow the same clear definitions and scopes of included impacts.
Embodied Carbon	Also known as embodied emissions, embodied carbon is the GHG emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of products and materials..
Environmental Justice Council (EJC)	Established within the State of Oregon Office of the Governor, the EJC is a 13-member statewide council responsible to advise the Governor and state natural resource agencies on environmental justice issues
Environmental Product Declaration (EPD)	Quantification of the environmental impacts of a product, throughout the product's life cycle, such as global warming potential, smog creation, ozone depletion and water pollution, in a single, comprehensive report that is a transparency document used to assess and communicate the environmental impact of construction products.
Greenhouse Gas (GHG)	Any gas that contributes to anthropogenic global warming including, but not limited to, carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.
Global Warming Potential (GWP)	An index for estimating the relative global warming contributions of GHG emissions, commonly referred to as a carbon footprint.
Gross Floor Area (GSA)	Gross floor area is generally defined as the total area of all floors inside a building measured from the outside face of the perimeter walls, excluding buttresses and other exterior protrusions.
International Existing Building Code (IEBC)	The International Existing Building Code (IEBC) establishes minimum requirements for existing building using prescriptive and performance-related provisions. It is founded on broad-based principles intended to encourage the use and reuse of existing buildings while requiring reasonable upgrades and improvements.
International Green Construction Code (IgCC)	The IgCC, also known as ASHRAE Standard 189.1, is an overlay to other ICC model codes and provides minimum requirements for the siting, design, construction, and operation of high-performance green buildings. Chapter 9, which addresses materials and resources, houses most of the standard's provisions around embodied carbon.

Intergovernmental Panel on Climate Change (IPCC)	The Intergovernmental Panel on Climate Change is the United Nations body for assessing the science related to climate change.
International Organization for Standardization (ISO)	ISO is an independent, non-governmental international organization that develops and publishes global standards for various sectors and topics.
Kilograms of carbon dioxide equivalent (Kg CO_2e)	Typical units for reporting GWP are as kilogram CO2 equivalent units (kg CO_2e). This is a measurement of what is commonly called the "carbon footprint" of a building.
Life Cycle Analysis (LCA)	A compilation and evaluation of the inputs, outputs, and the potential environmental impacts of a product system or whole building throughout its life cycle. This is consistent with the definition found in ISO 14044:2006.
Metric tons of carbon dioxide equivalent (MT CO_2e)	A unit for reporting GWP is metric tons CO2 equivalent units (Metric tCO2e). This is a measurement of what is commonly called the "carbon footprint" of a building.
Oregon Administration Rule (OAR)	Oregon Administrative Rules are created by most agencies and some boards and commissions to implement and interpret their statutory authority.
Operational Carbon	Includes the GHG emissions associated with the operational use of the building. This includes all carbon from energy required to heat and power the building, including but not limited to lighting, plug loads, heating and cooling, and cooking.
Oregon Revised Statute (ORS)	The Oregon Revised Statutes are the codified laws of the State of Oregon.
Oregon Structural Specialty Code (OSSC)	The Oregon Structural Specialty Code (OSSC) establishes the minimum requirements for the construction, reconstruction, alteration and repair of buildings and other structures, as well as the installation of mechanical devices and equipment. It is a fully integrated custom code based on the 2021 International Building Code®.
Product Category Rule (PCR)	Defines the rules and requirements for developing Type III EPDs for a group of products that fulfill an equivalent function.
Racial Justice Council (RJC)	The Racial Justice Council and its committee members advise the Governor across an array of areas, including housing and homelessness, education, health equity, economic opportunity, criminal justice reform, environmental equity, and on legislative actions, executive orders, and state government policies, budgets, programs, and implementation.
Social Cost of Carbon	The dollar-value of climate change damages imposed by an additional ton of CO2 emissions or its equivalent.
Type III Environmental Product Declaration (Type III EPD)	Third-party verified product information based on life cycle impacts; governed by ISO 14025.

Whole-Building Life Cycle Assessment (WBLCA)	An analysis of an entire building system and components, including inputs, outputs, and potential environmental impacts of a product or system over its lifetime, from initial extraction of raw materials through manufacture, distribution, use, and final disposal.

References

Anavitor. (2024). *A Journey Through Life Cycle Assessment (LCA)*. Retrieved December 19, 2024, from https://anavitor.ai/en/sustainable-construction-lca-challenges-trends-anavitor-lca

Ariel Brenner, Rebecca Esau, et al. (2024). *Findings and Recommendations on the Use of Lower Carbon Materials in the Statewide Building Code and Other Means for Reducing Greenhouse Gas Emissions Attributable to building materials.* NBI and RMI. https://www.oregon.gov/bcd/codes-stand/Documents/2024-techreport-nbi-rmi.pdf

BuildingTransparency. (2024). *Embodied Carbon in Construction Calculator (EC3)*. Retrieved December 19, 2024, from https://www.buildingtransparency.org/wp-content/uploads/2024/08/ec3_product_brief_pdf.pdf

Carbon Leadership Forum. (2024). *CLF WBLCA Benchmark Study v2*. Retrieved from Carbonleadershipforum.org: https://carbonleadershipforum.org/clf-wblca-v2/

City of Vancouver, Washington. (2023). *Guidelines: Emobided Carbon Guidelines.* Vancouver: City of Vancouver, Washington. Retrieved from https://vancouver.ca/files/cov/embodied-carbon-guidelines.pdf

Dougherty, C. e. (2024). *Structuring Demand for Lower-Carbon Materials: An Initial Assessment of Book and Claim for the Steel and Concrete Sectors.* RMI. Retrieved from https://rmi.org/insight/structuring-demand-for-lower-carbon-materials-an-initial-assessment-of-book-and-claim-for-the-steel-and-concrete-sectors/

Echo Project. (2024, October 1). *Embodied Carbon Harmonization and Optimization*. Retrieved from Echo-project.info: https://www.echo-project.info/

Environmental Protection Agency. (2024, October 22). *Sources of Greenhouse Gas Emission*. Retrieved December 18, 2024, from https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

Executive Order No. 20-04 Directing state agencies to take actions to reduce and regulate greenhouse gas emissions. (2020, March 10). Salem, Oregon, United States of America: Office of the Governor, State of Oregon. Retrieved from https://www.oregon.gov/gov/eo/eo_20-04.pdf

Intergovernmental Panel on Climate Change (IPCC). (2022). *Global Warming of 1.5°C: IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.* Cambridge: Cambridge University Press. Retrieved from https://doi.org/10.1017/9781009157940

Jensen, A., et al., (2024). *Recommendations for Washington State Embodied Carbon Code Language.* Carbon Leadership Forum. Retrieved December 19, 2024, from https://sbcc.wa.gov/sites/default/files/2024-11/2024-11-08%20-

%20CLF%20NBI%20RMI%20UW%20-%20Recommendations%20for%20Washington%20State%20Embodied%20Carbon%20Code%20Language%20-%20FINAL.pdf

Jones Lang LaSalle. (2024). *The Green Tipping Point*. Retrieved December 19, 2024, from https://www.us.jll.com/en/trends-and-insights/research/the-green-tipping-point

Lang, W. L. (2020, February 12). *John Beeson (1803-1889)*. Retrieved December 5, 2024, from https://www.oregonencyclopedia.org/articles/beeson_john_1803_1889_/

Macdonald, C. (2024). *Biennial Report to the Oregon Legislature*. Oregon Climate Action Commission. Retrieved from https://static1.squarespace.com/static/59c554e0f09ca40655ea6eb0/t/6737aca0fd0bf62d47d86c76/1731701924603/2024-OCAC-Biennial-Legislative-Report.pdf

Martin, C. (2022). Exploring Climate Change in U.S. Housing Policy. *Housing Policy Debate Volume 32*, 1-13. Retrieved from https://doi.org/10.1080/10511482.2022.2012030

Miller, Norman, British Broadcasting Corporation. (2021, December 15). *The Industry Creating a Third of the World's Waste*. Retrieved December 15, 2024, from https://www.bbc.com/future/article/20211215-the-buildings-made-from-rubbish

Nokes, G. (2024, May 17). *Black Exclusion Laws in Oregon*. Retrieved December 5, 2024, from https://www.oregonencyclopedia.org/articles/exclusion_laws/

Office of Oregon Governor Tina Kotek. (n.d.). *Housing and Homelessness*. Retrieved December 19, 2024, from https://www.oregon.gov/gov/priorities/pages/housing-and-homelessness.aspx

Office of the Governor, Kate Brown. (2021, February). HB 2167 - Codifying the RJC. Salem. Retrieved December 19, 2024, from https://olis.oregonlegislature.gov/liz/2021R1/Downloads/PublicTestimonyDocument/8075

Oregon Building Codes Division. (2020, July). *BCD Technical Bulletin | Tenant Improvement, repair, alteration, change of occupancy - Oregon Structural Specialty Code.* Retrieved November 12, 2024, from Oregon Building Codes Division: https://www.oregon.gov/bcd/codes-stand/Documents/st-existing-buildings-techb.pdf

Oregon Building Codes Division. (2022, May 24). *Memorandum: Adaptive Reuse - Existing Buildings*. Retrieved December 19, 2024, from https://www.oregon.gov/bcd/Documents/adaptive-reuse-memo.pdf

Oregon DCBS. (2024). *Diversity, equity, and inclusion*. Retrieved December 6, 2024, from https://www.oregon.gov/dcbs/dei/Pages/index.aspx

Oregon Department of Environmental Quality. (2024). *Oregon's Consumption Based Greenhouse Gas Emissions 1990-2021*. Salem: Oregon Department of Environmental Quality. Retrieved from https://www.oregon.gov/deq/mm/Documents/mm-Reporton2021CBEI.pdf

Oregon Health & Science University. (2024, August 23). *Resources on Race, Racism and Health Disparities*. Retrieved December 5, 2024, from https://libguides.ohsu.edu/race-racism-health/oregon-history

Oregon Legislature. (2021). *House Bill 2167*. Retrieved December 18, 2024, from https://olis.oregonlegislature.gov/liz/2021R1/Measures/Overview/HB2167

Oregon Legislature. (2023, June 13). *House Bill 3409*. Retrieved December 19, 2024, from https://olis.oregonlegislature.gov/liz/2023R1/Measures/Overview/HB3409

Oregon Legislature. (2023). *Oregon Revised Statute 184 - Administrative Services and Transportation Departments*. Retrieved December 19, 2024, from https://www.oregonlegislature.gov/bills_laws/ors/ors184.html

Oregon Legislature. (2023). *Oregon Revised Statute 455 - Building Code*. Retrieved December 18, 2024, from https://www.oregonlegislature.gov/bills_laws/ors/ors455.html

Oregon Legislature. (2023). *Oregon Revised Statute 468A - Air Quality*. Retrieved December 19, 2024, from https://www.oregonlegislature.gov/bills_laws/ors/ors468a.html

Oregon Legislature. (2023). *Oregon Revised Statute 469A - Renewable Portfolio Standards; Nonemitting Electricity Targets*. Retrieved December 19, 2024, from https://www.oregonlegislature.gov/bills_laws/ors/ors469a.html

Oregon Racial Justice Council. (2021). *Oregon Racial Justice Council*. Retrieved December 18, 2024, from https://www.oregonracialjusticecouncil.org/

State of Oregon. (2023). *2023 Racial Justice Council Report.* Salem: State of Oregon. Retrieved from https://www.oregon.gov/gov/Documents/RJC-2023-Annual-Report.pdf

Throckmorton, J., & al., e. (2024). *Opportunities to Reduce Greenhouse Gas Emissions Caused by Oregon's Consumption.* Salem: Oregon Department of Environmental Quality. Retrieved December 20, 2024, from https://www.oregon.gov/deq/mm/Documents/HB3409Sec52CBEReport.pdf

World Green Building Council. (2019). *Bringing Embodied Carbon Upfront*. Retrieved November 12, 2024, from https://worldgbc.org/advancing-net-zero/embodied-carbon

Acknowledgements

The production of this report was a collaborative effort supported by multiple staff within the Oregon Department of Consumer and Business Services Building Codes Division Policy and Technical Services.

Cover Images by Travis White and City of Salem, Oregon, Historic Photograph Collections

BCD wishes to acknowledge the following individuals and organizations for their assistance in coordination as well as contributions to this report:

- Oregon Department of Consumer and Business Services: Bryant Campbell and Theresa Vanwinkle
- Oregon Department of Environmental Quality Materials Management Program: Amanda Ingmire, David Allaway, Martin Brown, Peter Canepa, and Rita Haberman
- RMI: Aurimas Bukauskas, Rebecca Esau, Satyam Maharaj, and Victor Olgyay
- NBI: Ariel Brenner, Grant Sheely, Jodi Smits Anderson, and Jess Meylor

This document was prepared by Building Codes Division Policy and Technical Services

P.O. Box 14470
Salem, OR 97309-0404
503-378-4133 (main)
800-442-7457 (toll-free)
https://www.oregon.gov/bcd/codes-stand/Pages/energy-efficiency.aspx

Contact:

Todd R. Smith
Policy and Technical Services Manager | Building Codes Division
Oregon Department of Consumer & Business Services
Todd.R.Smith@dcbs.oregon.gov
503-856-6819

Appendix A

BCD Principles for Code Adoption

BCD has developed several principles to make sure the building code achieves our mission, which is to work with Oregonians to ensure safe building construction while supporting a positive business climate. Here are some of the principles that guide our work when considering revisions to the building code:

Take a long view. A long-term strategy ensures predictability in the code. Code cycles generally vary from 3-6 years, and different states can be at different stages in the code cycle at a given time. It takes significant time to develop revisions to the code, and it is important to ensure stakeholders, boards, labor, and industry have the time and space to develop the best possible standards.

Coordinated approach. Oregon relies on builders, labor, contractors, and stakeholders to participate in policy work by leading the discussion through the seven advisory boards that assist in directing code adoption. Their expertise results in a better building code. Adopting the building code is not enough, labor and industry have to be trained to follow the code, and inspectors have to be trained to ensure compliance with the code. Rigorous training for labor, industry and inspectors mean that from the beginning of a project to its completion, all parties involved have the tools necessary to ensure the standards that are carefully developed through the code process are followed. BCD doesn't just set policy goals, it achieves them.

Focus on performance and choice. It is important in the building code not to create narrow paths that benefit particular companies or industries, but to instead ensure construction practices are the safest and most efficient for all buildings in Oregon. Proponents of proprietary products, testing, and inspection techniques may have incentives beyond what is safest, most efficient, and most cost effective. BCD's duty to all Oregonians, including labor, industry, and other stakeholder groups is to focus on creating choices to achieve technically feasible, safe, efficient, and cost-effective buildings.

Evidence based. BCD collects evidence and best practices from across the nation and the world to develop codes that best suit Oregonians. Our goal is always to rely on good research to make evidence-based decisions.

Independent verification. BCD uses an independent review process to verify that Oregon is achieving its efficiency goals. First through the University of Idaho, and now through the University of Oregon, BCD submits the commercial and residential energy codes for review to ensure Oregon is on pace to remain a national leader and that BCD is making data driven decisions about efficiency standards.

Consistency across the state. Any building in this state, whether urban, rural, affordable or extravagant, has the benefit of the same minimum efficiency standards. All Oregonians should have the benefit of a safe, affordable, and efficient home. This advantage of consistent, predictable codes, creates extremely high compliance rates and is part of what makes the Oregon model unique. Other states may say they have adopted a particular cutting-edge code, but if local jurisdictions never adopt it, state or local inspectors never enforce it, and labor is not trained to it, it is only as good as the paper it's written on. That's not the case in Oregon.

Appendix B

Board composition

Oregon Building Codes Division

State Plumbing Board ORS 693.115 Seven members	A journeyman plumber with 10 or more years of experience in the trade
	A licensed plumbing contractor
	A local plumbing inspector who is also a journeyman plumber
	A registered professional mechanical engineer
	An officer or employee of the Oregon Health Authority
	A plumbing equipment supplier who otherwise qualifies to sit on the board by industry experience OR a building official
	A member of the general public
Construction Industry Energy Board **(CIEB)** ORS 455.492 Eleven members	Two members of the Electrical and Elevator Board who have electrical experience, to be selected by the Electrical and Elevator Board
	Two members of the RMSB who have practical experience in either the residential structure industry or the manufactured structure industry, to be selected by the RMSB
	Two members of the BCSB with practical experience in construction, to be selected by the BCSB
	Two members of the Plumbing Board with practical experience in construction, to be selected by the Plumbing Board
	Two members of the Mechanical Board with practical experience in construction, to be selected by the Mechanical Board
	An employee or officer of ODOE appointed by the director of the ODOE
Mechanical Board ORS 455.140 Ten members	A representative of the plumbing industry
	A sheet metal and air conditioner installer
	A municipal mechanical inspector with the highest level of certification issued by DCBS
	A heating ventilation and air conditioning contractor
	A heating ventilation and air conditioning installer
	A sheet metal and air conditioner installer
	An insulation craftsperson with experience with heat and frost insulation
	A representative of a natural gas company or other utility
	A member of the general public not receiving a compensation from any interest represented by one of the other represented stakeholders
	At least one member of the board must be an owner or operator of a contracting business with 10 or fewer employees at the time of their appointment

Electrical and Elevator Board ORS 455.138 Fifteen members	A fire and casual underwriter
	A representative of industrial plants regularly employing licensed electricians
	A representative of the power and light industry
	An electrical equipment supplier who otherwise qualifies by experience and training in the industry
	Two journeyman electricians
	An electrical inspector
	Two electrical contractors
	A municipal building official
	A journeyman elevator installer
	An owner or manager of a commercial office building
	A member of the general public not receiving a compensation from any interest represented by one of the other represented stakeholders
Residential and Manufactured Structures Board (RMSB) ORS 455.135 Eleven members	A contractor specializing in the construction of residential structures
	A contractor specializing in remodeling of residential structures
	A contractor specializing in multifamily structures three stories or fewer above grade
	A home designer or architect
	A building official
	A representative of residential building trade subcontractors
	A structural engineer
	A representative of a utility or energy supplier
	A manufacturer of manufactured dwellings
	A seller or distributor of manufactured dwellings
	A member of the general public not receiving a compensation from any interest represented by one of the other represented stakeholders
Building Codes Structures Board (BCSB) ORS 455.132 Nine members	An architect or engineer
	A general contractor specializing in buildings more than three stories above grade
	A contractor specializing in heavy industry construction
	A representative of the building trade
	A representative of a utility or energy provider
	A representative of a fire protection agency
	A building official
	An owner or manager of a commercial office building
	A representative selected from a list of individuals recommended by the Oregon Disabilities Commission

Appendix C

Landscape analysis of existing climate policies and fulfillment of Oregon's Racial Justice Council equity pillars

New Buildings Institute

Legend

CJ Criminal Justice | **HH** Housing and Homelessness | **EO** Economic Opportunity | **HE** Health Equity | **EE** Environmental Equity | **ER** Education Recovery

Policy	CJ	HH	EO	HE	EE	ER	Key Strategies
40% by 2030-35 w/EC targets							
Vancouver Climate Emergency Action Plan	■		■	■	■		By 2030, 2/3 of all trips on foot, bike, or transit, using improved bus speeds, remote and flexible work hours, res parking permits, create parking maximums
		■		■	■		OC from buildings cut in half by 2030 from 2007 levels
			■	■		■	EC reduced 40% from 2018 - EC limits, support of low-carbon materials w/ easier access and better pricing
California AB 2446	■	■	■				EC and OC tied to housing goals, rising material costs, and evolving market
		■					LCA of new res > than 5 units or non-res 10,000 sf A1-A3
			■				Products available in region of project, and at cost of < 5% increase
Boulder Climate Action Plan	■		■		■	■	Allow time and resources to address climate change equitably
	■	■		■	■		Work WITH communities and strengthen community capacity to thrive
		■		■			Count all emissions (creation and purchase of goods and foods)
				■	■		Land use policies
			■				Financial systems

Austin Climate Equity Action Plan							Maintain community inclusivity
							Just transition, cultural preservation, accessibility, affordability, health
							Business focus on BIPOC owned to support improved sustainability
							EC reduction of 40% by 2030
							Equitable water use at community scale, access to local food
							Anti-displacement, and focus on land-use, equitable tree cover, resilience
							50% of trips not in SOV (single occupancy vehicles)
50% 2030-33 w/EC targets							
Los Angeles Clean Construction Declaration							EC reduction of 50% by 2050 and 30% by 2025 (new construction)
							Working groups to create roadmap inc tenants
							Training in EC3 tools
							Market signals and drive reductions through procurement
							Construction equipment electrification through focus groups and swap-out incentives, also preference points in contracting
							Prioritize building reuse w/ incentives tied to metro proximity (since 1999)
Mexico City Clean Construction Declaration							Recycled material use and improved/increased recycling processes
							Support of teleworking
							EPDs for proof EC and Circular economy w/multidisciplinary work groups
							Incentives for cool roofs and more
							Metropolitan-scale efforts

New York City PlaNYC							Max summer indoor temp policy, reform home energy assistance
							30% tree canopy goal, connected network of green spaces, training, incentives.
							Install cool roofs, invest in pools, city-wide
							EC and performance standards for materials by 2025
							Financing tools to support LL97
							Climate education, green training, and entrepreneurship incentives/support
							Water systems, transportation, food, and circular economy goals
net zero by 2050 no EC targets							
Portland Climate Emergency Workplan							Climate and health standards for existing buildings (EJ focus)
							City focus on green building
							EC policies to reduce through adaptive reuse, WBLCA, and material choices
							Clean industry - circular, clean, decarb…
							Compact and mixed use development
							Anti-displacement by working with existing communities
							Internal cost of carbon (for operational) to inform all city decisions
New York State Scoping Plan							40% investment under Climate Law for disadvantaged communities
							Co-design programs, seek meaningful public input, focus on intersectionality
							Just Transitions (culture, jobs, training, collaborative planning, resilience +)
							Community scale solutions
							Market transparency on building costs
Toronto Green Standard Version 4							Reused materials exempted from BEAM calcs. in res. 250kgCO2e/m3
							CaGBC methodology for carbon calcs. <350 kgCO2e/M2 or extra low at 250
							Voluntary system w /refund program increases for participation

Phoenix Climate Action Plan							Circular economy incentives
							Air quality focus and inclusivity/ equity charge
							Living building challenge net-positive goals for all in-city construction by 2050
							Walkable complete streets, cool corridors, local food, reduce SOV trips 60%
							Low-carbon refrigerant transition
							EC calculator development, incentives, and standards for private sector work
Evanston, Illinois Climate Action and Resilience Plan							Outreach and behavior change focus on mitigation
							Vulnerable populations focus on resilience
							Zero waste by 2030
							Building projects focused on mobility connections
King County 2020 Strategic Climate Action Plan							Partnering with Cities for GHG reductions (larger systems approach)
							Cost of carbon (operational) included in planning
							Transit, city center development, and vehicle usage equitable pricing
							Equitable implementations of WA state clean energy transformation act
							Social justice and equity integrated into all capital projects
							Low-embodied materials in construction projects
							Zero waste food systems
							Forestry focus supporting immigrant and refugee farmers
							Obtain 25 equity open space opportunity sites for urban green space

Miscellaneous							
Oregon Executive Order 20-04							45% below 1990 by 2035 (operational carbon), energy use and utility transitions
							Consult with Environmental Justice Council
							Focus on impacted communities, working w/ all agencies
							Landfill emissions in combinations with neighboring states
							Food Waste reduction goal of 50% by 2030 (industry, retailers, jurisdictions)
							Public process w/ Housing and Community re: affordability and EJ issues
							Carbon sequestration and storage planning (also re:building projects)
San Francisco Climate Action Plan							Use of Racial and Social Equity Assessment tool
							Affordability, education, financial incentives, diversity of workforce, etc.
							Reducing life-cycle impacts on buildings and materials is a key strategy.
Oakland 2030 Equitable Climate Action Plan							Community workshops
							Use of Racial Equity Impact Assessment throughout the process.
							Prevent displacement (in Transportation and Land use)
							Car-free access
							All electric buildings by 2040
							Reduce life-cycle emissions of buildings
							Food, repair, deconstruction
							Tree canopy, carbon farming, open space

Legend:

CJ Criminal Justice **HH** Housing and Homelessness **EO** Economic Opportunity **HE** Health Equity **EE** Environmental Equity **ER** Education Recovery