West Coast Climate & Materials Management Forum

June 6, 2023

Built Environment Workgroup Presents -

Including Embodied Carbon in Climate Action Plans

Zoom Logistics and Technical Orientation

- For closed captioning of today's discussion, please select the closed captioning icon at the bottom of your screen.
- All participants are in listen-only mode now. Please email julia.keane@erg.com if you experience any technical difficulties with Zoom.
- Please submit questions for discussion into the Q&A feature.
- Today's session will be recorded and shared at a later date through the Forum website at www.westcoastclimateforum.com

West Coast Climate Forum Webinar Series Disclaimer

This webinar is being provided as part of the West Coast Climate and Materials Management Forum Webinar Series. The Forum is a collaboration of state, local, and tribal governments. We invite guest speakers to share their views on climate change topics to get participants thinking and talking about new strategies for achieving our environmental goals. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Please note the opinions, ideas, or data presented by speakers in this series do not represent West Coast Climate and Materials Management Forum members policy or constitute endorsement by the forum.

www.westcoastclimateforum.com

West Coast Climate
& Materials Management Forum

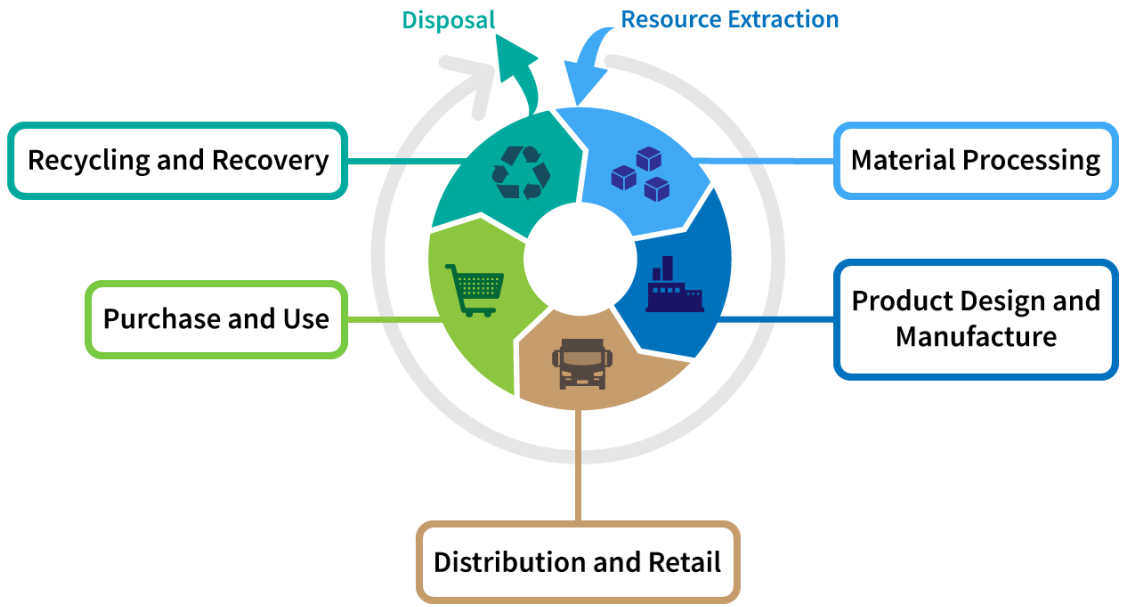
Today's Agenda

- Introduction
- Importance of embodied carbon
- Examples of estimating embodied carbon
- Resources for potential embodied carbon reduction strategies
- Q&A Conversation
- Next Steps

West Coast Climate & Materials Management Forum

A collaboration of state, local, and tribal governments with the mission to:

- Develop ways to institutionalize sustainable materials management practices.
- Develop tools to help jurisdictions reduce the greenhouse gas emissions associated with materials



West Coast Climate & Materials Management Forum

Check out the Forum's Resources

- Original Report Connecting Materials/Climate
- Research Summaries
- Turn-key Materials Management Presentation
- Climate Action Toolkit
- Climate-Friendly Purchasing Toolkit
- Food: Too Good to Waste Toolkit
- Webinar Series

www.westcoastclimateforum.com

West Coast Climate
& Materials Management Forum

Forum Areas of Focus

- Justice, Equity, Diversity and Inclusion (JEDI)
- Built Environment
- Reducing Consumption
- Extended Producer Responsibility (EPR) for Packaging

- Stay tuned and join us!

West Coast Climate & Materials Management Forum

IRA Embodied Carbon Funding

Section	Agency	Funding	Summary	Expiration Date
60112	EPA	$250M	**EPD Assistance** to support the development and standardization of EPDs for construction materials with grants and technical assistance to manufacturers.	9/30/2031
60116	EPA	$100M	**Low-Embodied Carbon Labeling for Construction Materials** to identify and label low-carbon materials and products based on data available via EPDs	9/30/2026
60503	GSA	$2.15B	**Specify and install low-embodied carbon materials** and products for use in General Services Administration-owned buildings	9/30/2026
60506	FHWA	$2B	**Low-Carbon Transportation Grants** that reimburse and incentivize the use of low-carbon materials and products for Federal Highway Administration projects.	9/30/2026

EPA Reducing Embodied Carbon in Construction Materials & Products

- Inflation Reduction Act provides **$350 million** for **Grants, Technical Assistance & Labeling to Substantially Reduce Embodied Carbon**
  - Focus on production, use and disposal of **steel, concrete, asphalt and glass**
  - Also supports **minimally-processed salvaged and reused materials**
- **Programs are currently under development -** Public comments on program development
  https://www.regulations.gov/docket/EPA-HQ-OPPT-2022-0924/comments
- **NEW: GSA Embodied Carbon Requirements and FAQ**
  https://www.gsa.gov/cdnstatic/Interim%20IRA%20LEC%20Material%20Requirements%20-%20used%20in%20Pilot%20May%202023%2005162023.pdf
  https://www.gsa.gov/cdnstatic/FAQs-on-GSAs-IRA-LEC-Material-Requirements.pdf

EPA Climate Pollution Reduction Grants (CPRG)

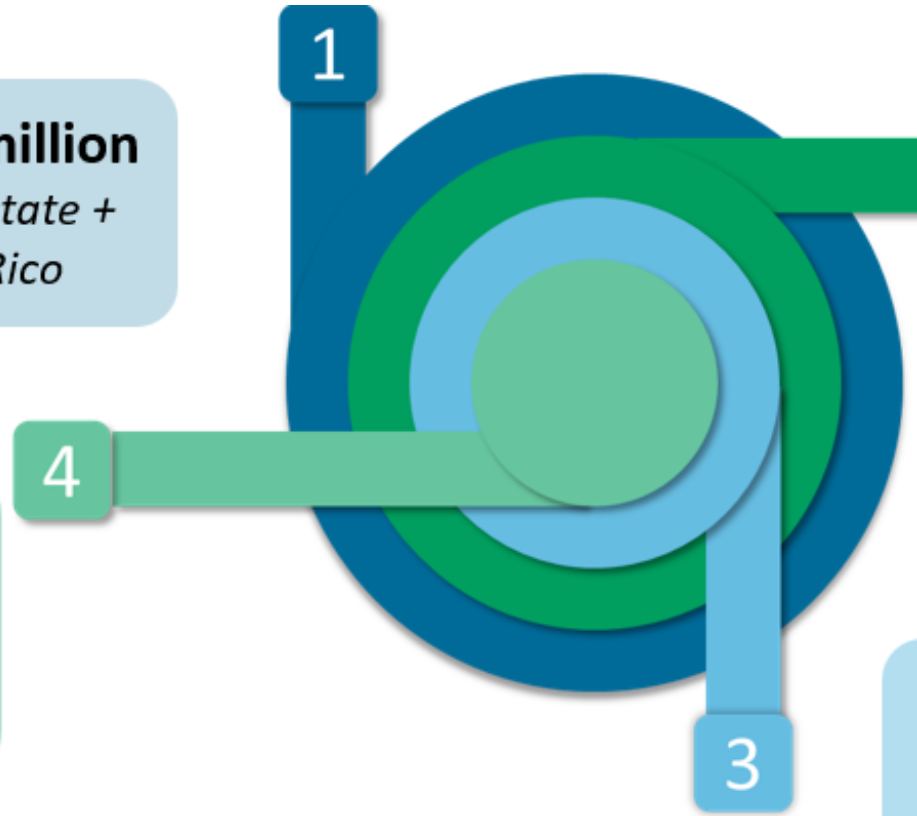
1. Planning grants to develop strong climate pollution reduction strategies ($250 million)

- Non-competitive grants, awarding FY23
- 46 states, DC and Puerto Rico and 79 Major Metro Areas participating
- **Develop or expand Priority Climate Action Plans through a collaborative process by March 2024**
- Comprehensive Climate Action Plans due 2025

2. Competitive implementation grants to help put plans into action ($4.6 billion)

- Not open, guidance under development
- Anticipated later in 2023
- **Implementation grants must support Priority Climate Action Plan activities**

CPRG Planning Grant Funding



States: $156 million
Up to $3M per state + DC + Puerto Rico

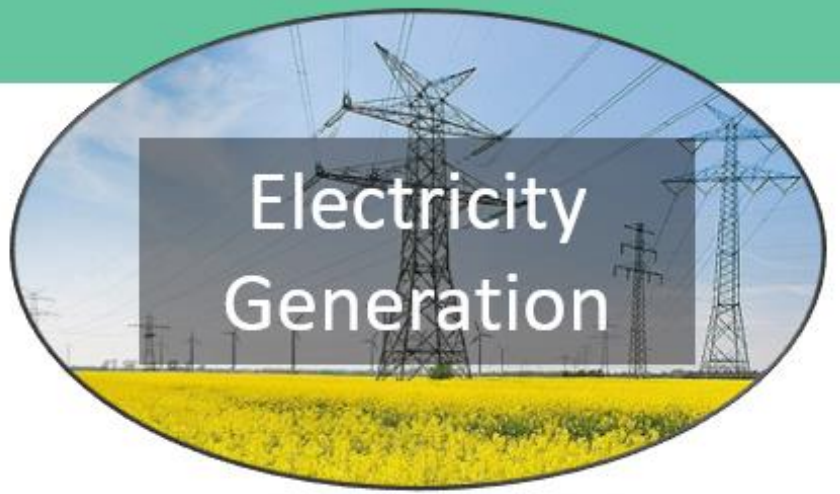
Locals: $79 million
Up to $1M each for the 79 most populous metropolitan areas

Territories: $2 million
Up to $500K each for US Virgin Islands, Guam, American Samoa, Northern Mariana Islands

Tribes: $25 million
Up to $500K per tribe or $1M for groups of 2 or more

KEY SECTORS


Waste & Materials Management


Electricity Generation


Transportation


Agriculture/Natural and Working Lands


Industry


Commercial & Residential Buildings

Climate Action Planning Process for EPA CPRG

1. Inventory sector emissions (estimate baseline)
2. Define strategies, policies, programs
3. Estimate impact of strategies (on GHG, cost, benefits)
4. Implementation

Today's Guests

Jordan Palmeri
Carbon Leadership Forum

Rebecca Esau
RMI

Megan Kalsman
Carbon Leadership Forum

Webly Bowles
New Buildings Institute

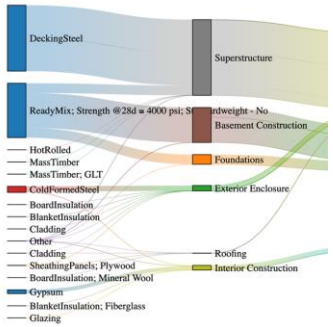
West Coast Climate
& Materials Management Forum

Carbon Leadership Forum

COLLEGE OF BUILT ENVIRONMENTS
UNIVERSITY of WASHINGTON

Mission

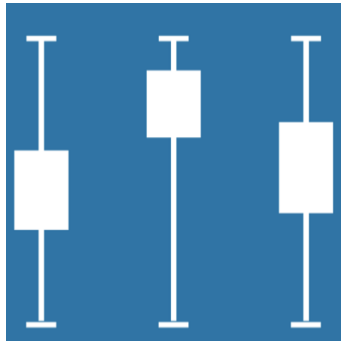
Our mission is to eliminate embodied carbon of buildings, materials, and infrastructure to create a just and thriving future.



MATERIAL BASELINE PUBLICATIONS

LEADERSHIP IN STANDARDS COMMITTEES

GLOBAL CLF HUBS



WHOLE BUILDING BENCHMARKS

NOVEL MATERIAL RESEARCH

GUIDANCE FOR EFFECTIVE POLICY MAKING

Carbon Leadership Forum

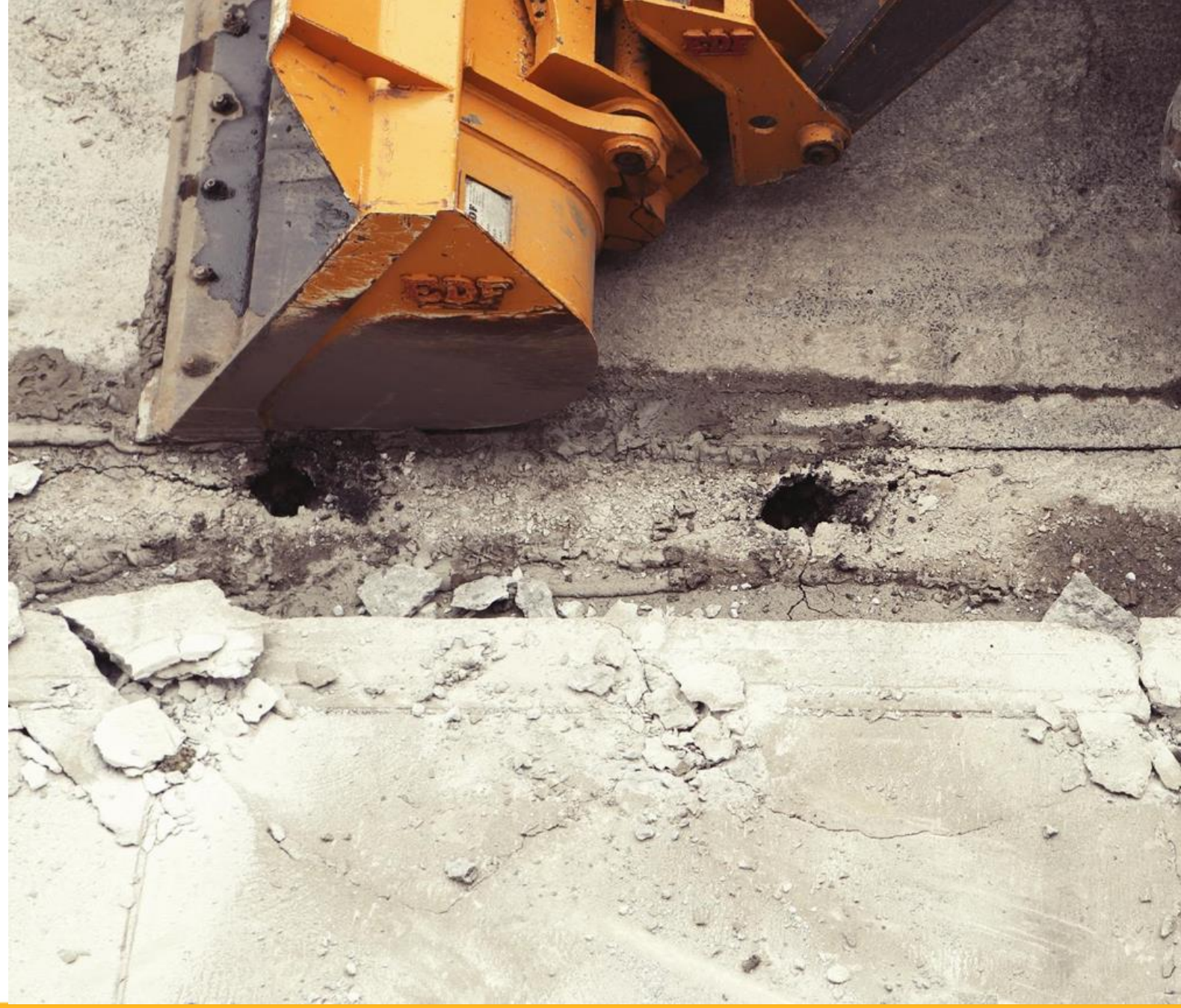
Including Embodied Carbon in Climate Action Plans

Jordan Palmeri, Senior Researcher

June 6, 2023

Overview

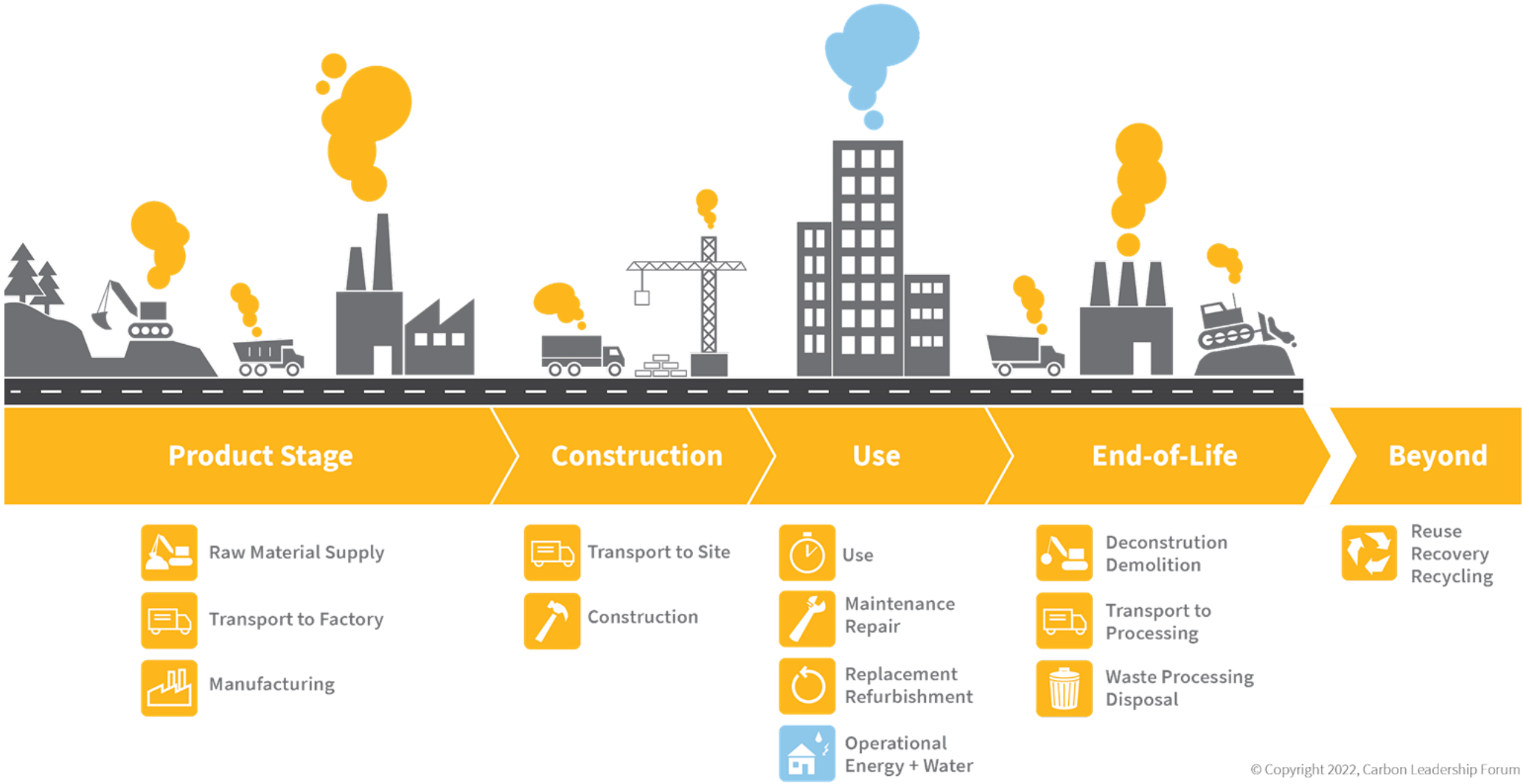
1. What is embodied carbon?
2. Estimating embodied carbon
3. Identify reduction strategies
4. Quantify GHG reduction potential
5. Implementation



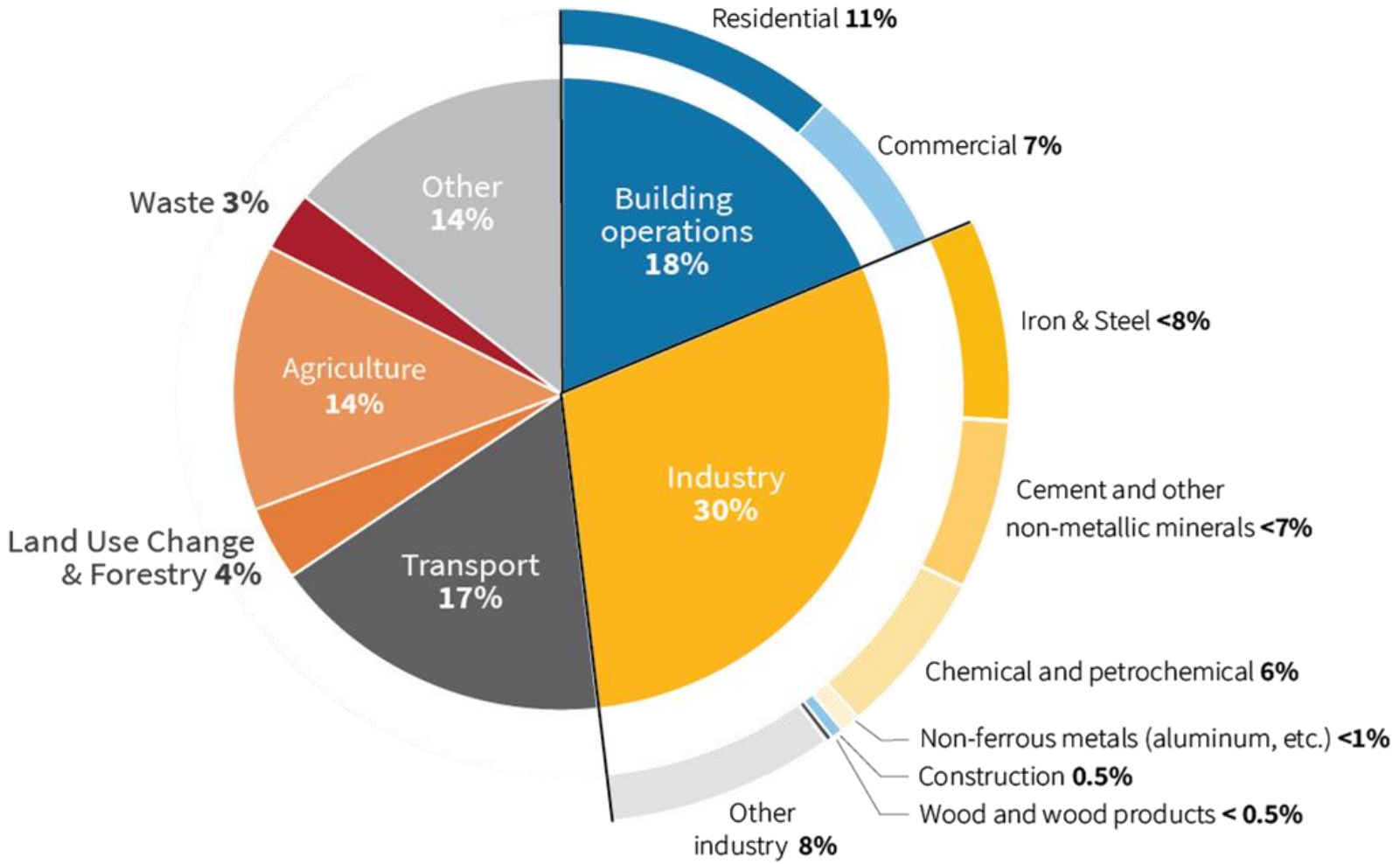
What is embodied carbon?

Embodied carbon *refers to the greenhouse gas (GHG) emissions from the manufacture, transport, installation, maintenance, and disposal/recovery of construction materials*

What is embodied carbon?

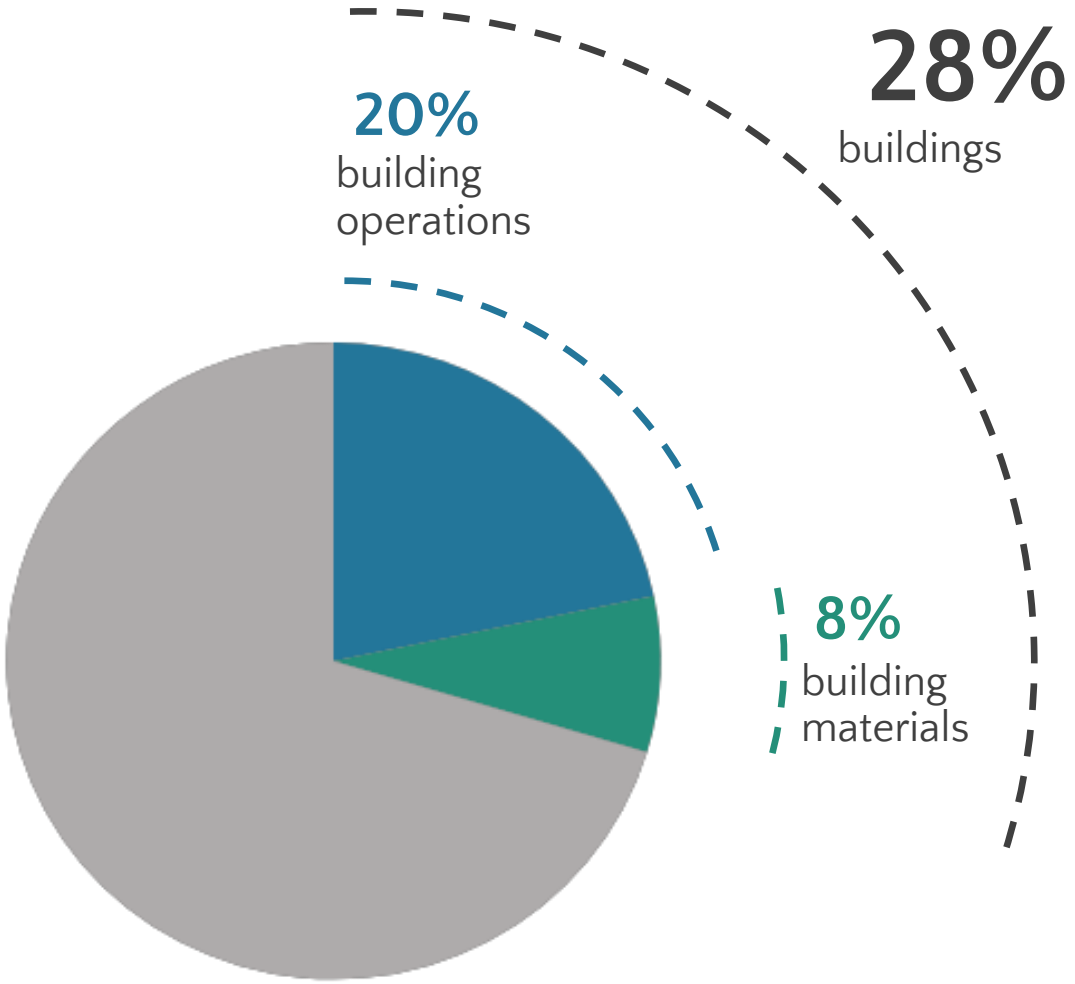


Global GHG emissions by end use



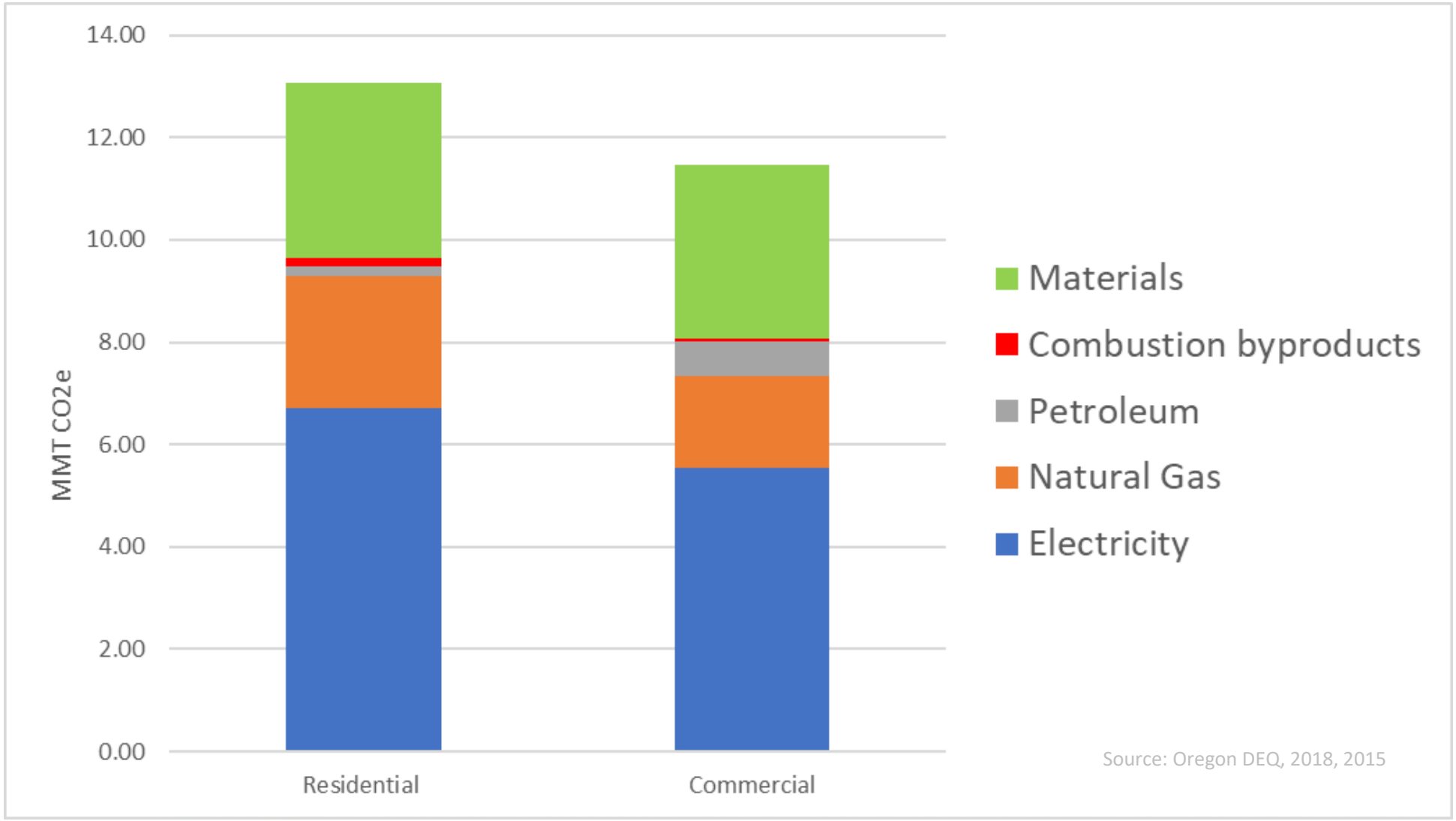
Data sources: WRI Climate Watch (2016); IEA World Energy Balances (2019).

Oregon's consumption-based GHG emissions

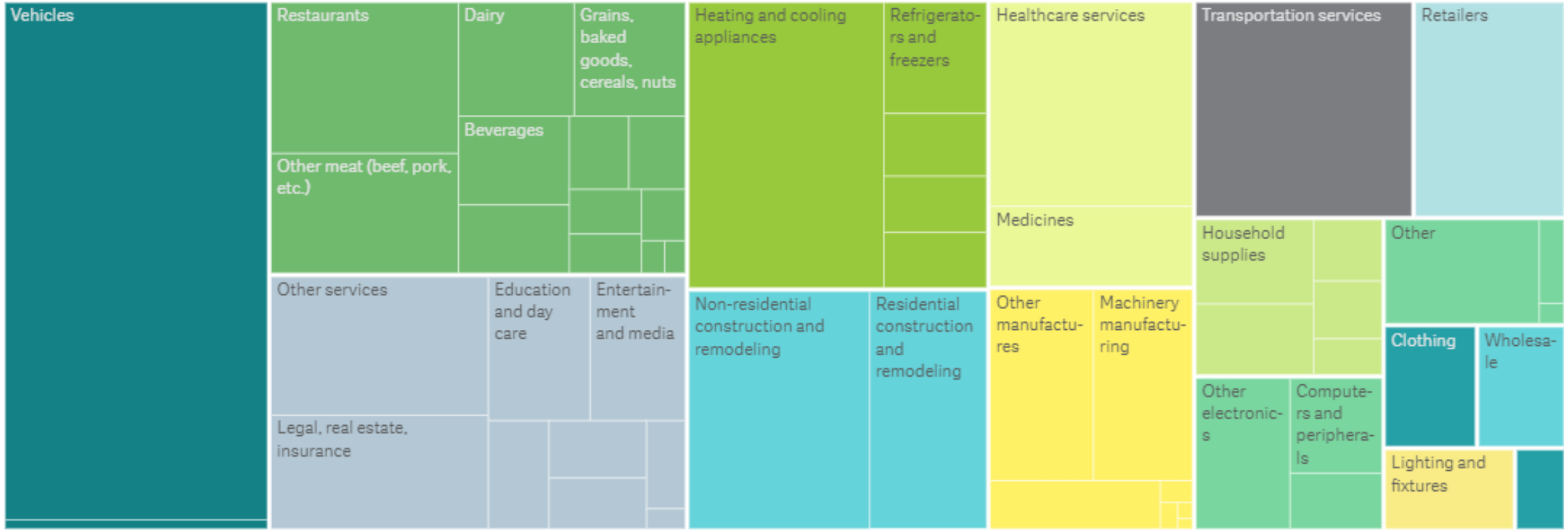


Source: Oregon DEQ, 2018, 2015

Consumption Based GHG Emission from Oregon's Building Sector (2018 + 2015 data)



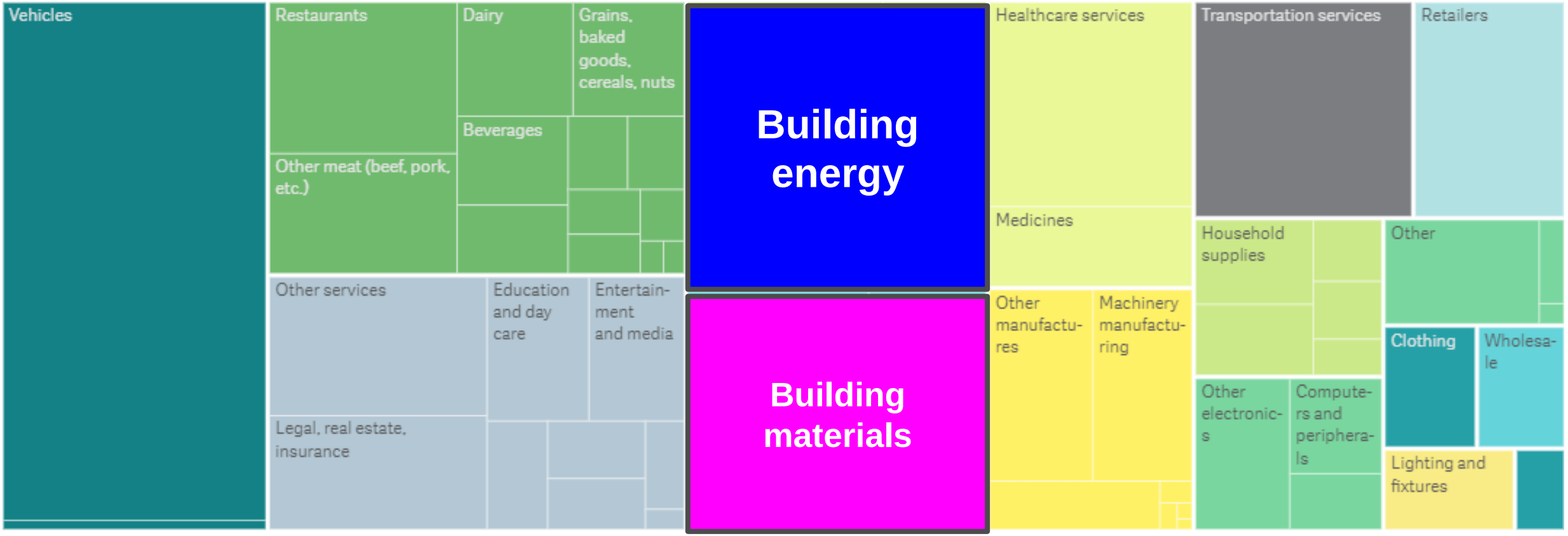
City of Portland - GHG emissions by sub category (2015)



Carbon Leadership Forum

Source: https://www.c40knowledgehub.org/s/article/Data-story-what-Portland-learnt-from-their-consumption-based-emissions-inventory?language=en_US

City of Portland - GHG emissions by sub category (2015)



Source: https://www.c40knowledgehub.org/s/article/Data-story-what-Portland-learnt-from-their-consumption-based-emissions-inventory?language=en_US

GHG Emissions Inventories: Production vs. Consumption based

PRODUCTION-BASED INVENTORY

Quantifies emissions **produced within a regional boundary**

(power plants, factories, cars, cattle, forestry, etc.)

CONSUMPTION-BASED INVENTORY

Quantify emissions **consumed within a regional boundary**

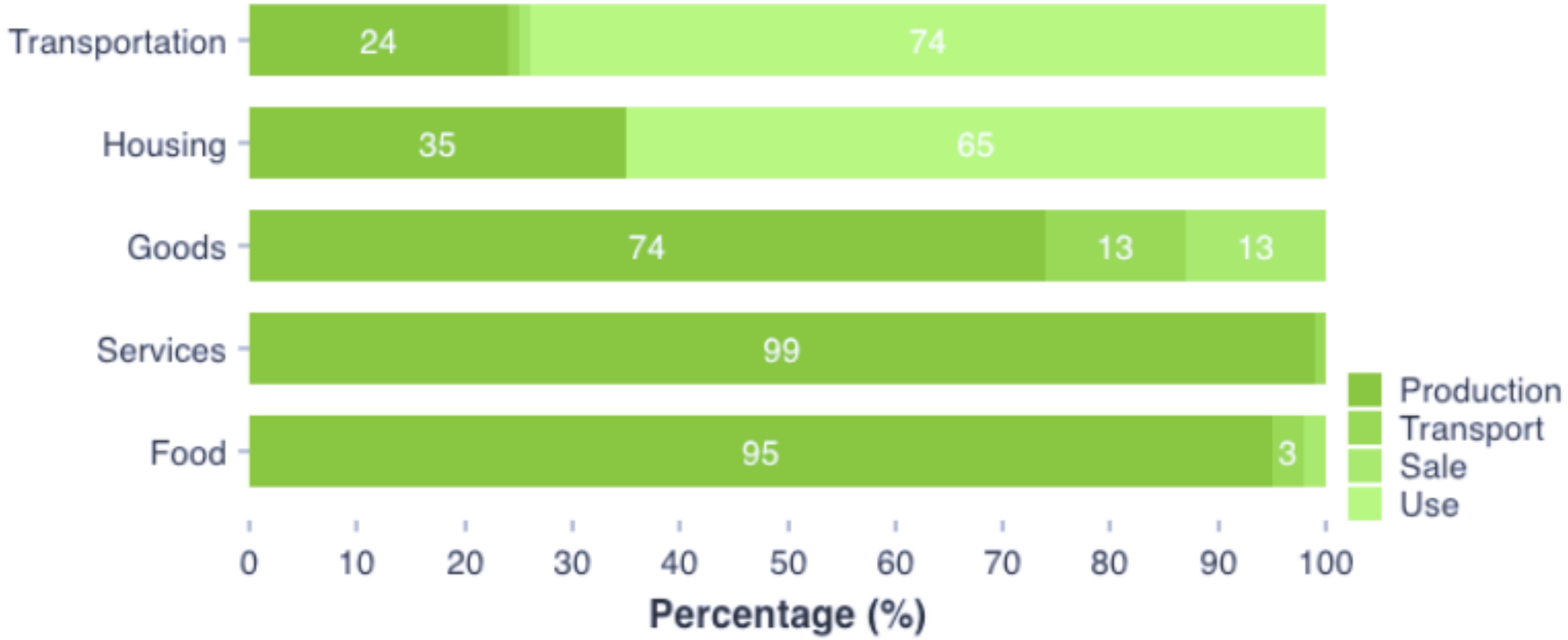
(electricity, food, construction goods, etc.)

Methodology fairly standardized - guidelines include IPCC (national), US EPA (state), and CDP-ICLEI (city)

Methodology **not** yet standardized; state approach published by US EPA

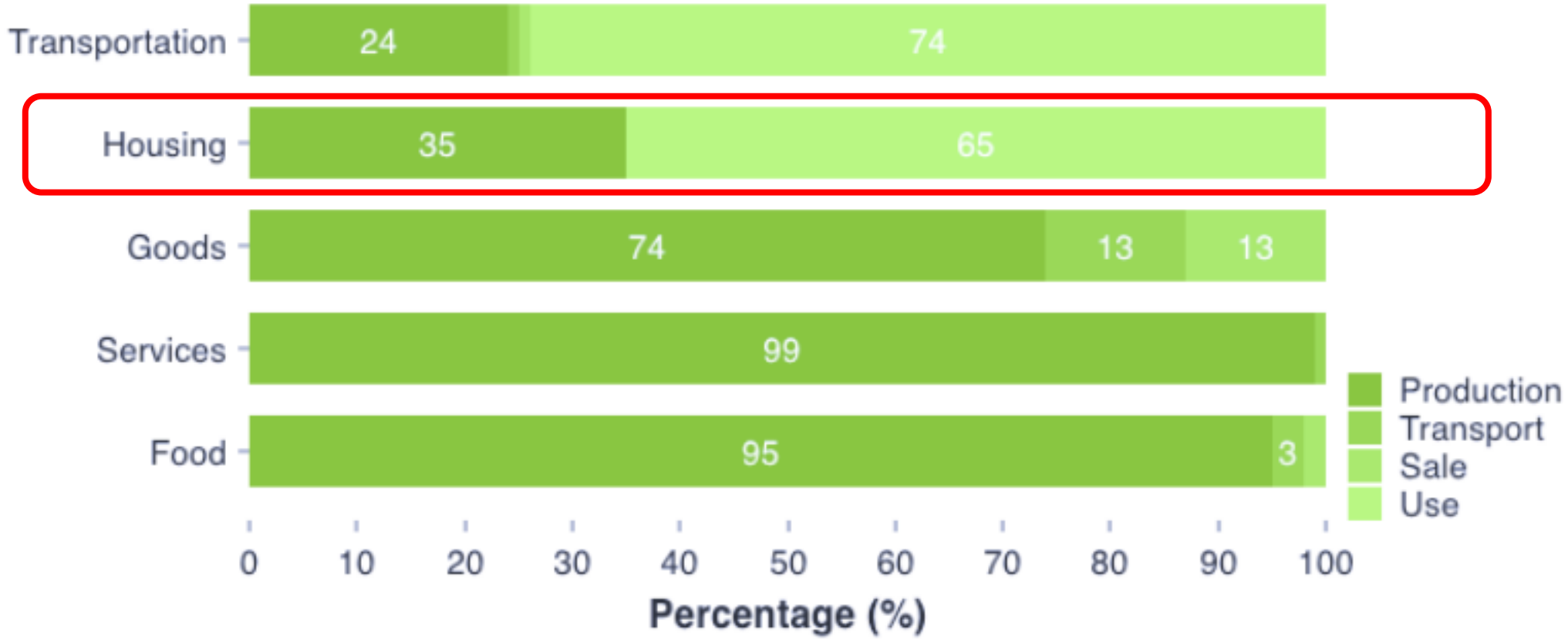
https://westcoastclimateforum.com/files/video/FINAL-WCCMMF-CBEI-Meeting_04-27-2023.mp4

Household Emissions Breakdown by Supply Chain Stage - US Average



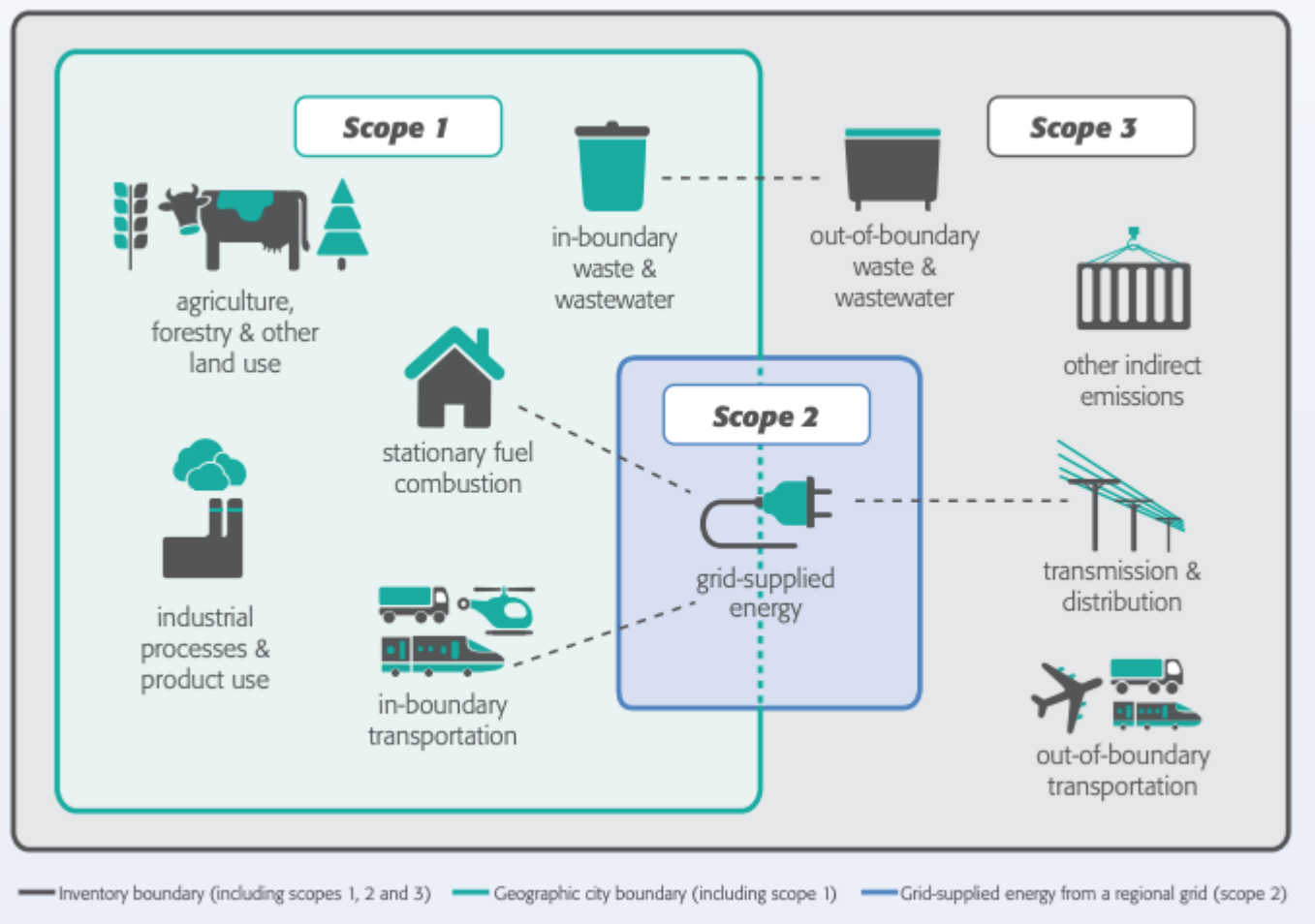
Source: https://your.kingcounty.gov/dnrp/climate/documents/2022/king-county-consumption-ghg-emissions-inventory-and-wedge-report-09-2022.pdf

Household Emissions Breakdown by Supply Chain Stage - US Average



Source: https://your.kingcounty.gov/dnrp/climate/documents/2022/king-county-consumption-ghg-emissions-inventory-and-wedge-report-09-2022.pdf

Corporate/Organizational GHG Reporting: Scopes 1, 2, and 3

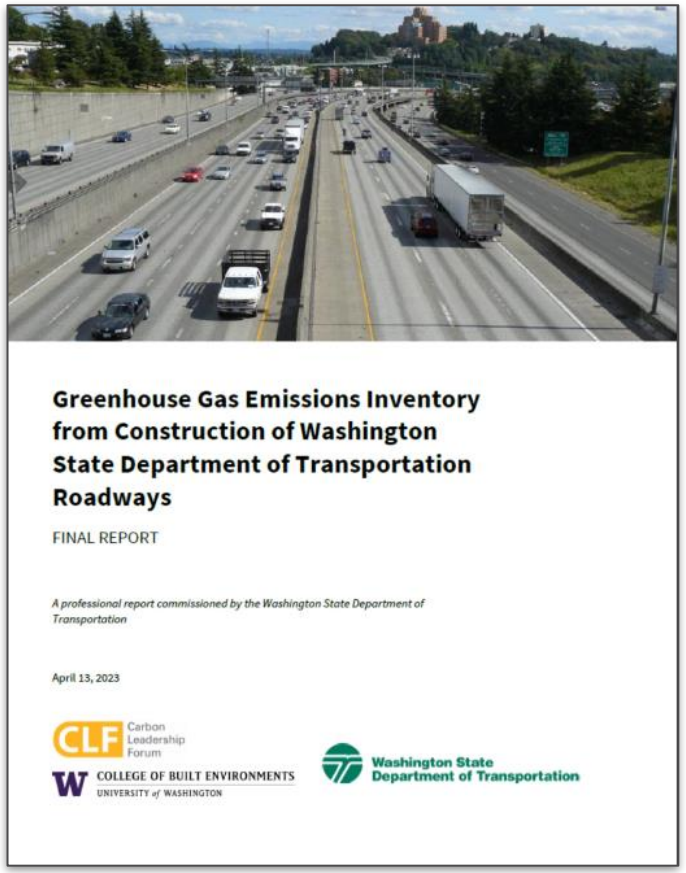


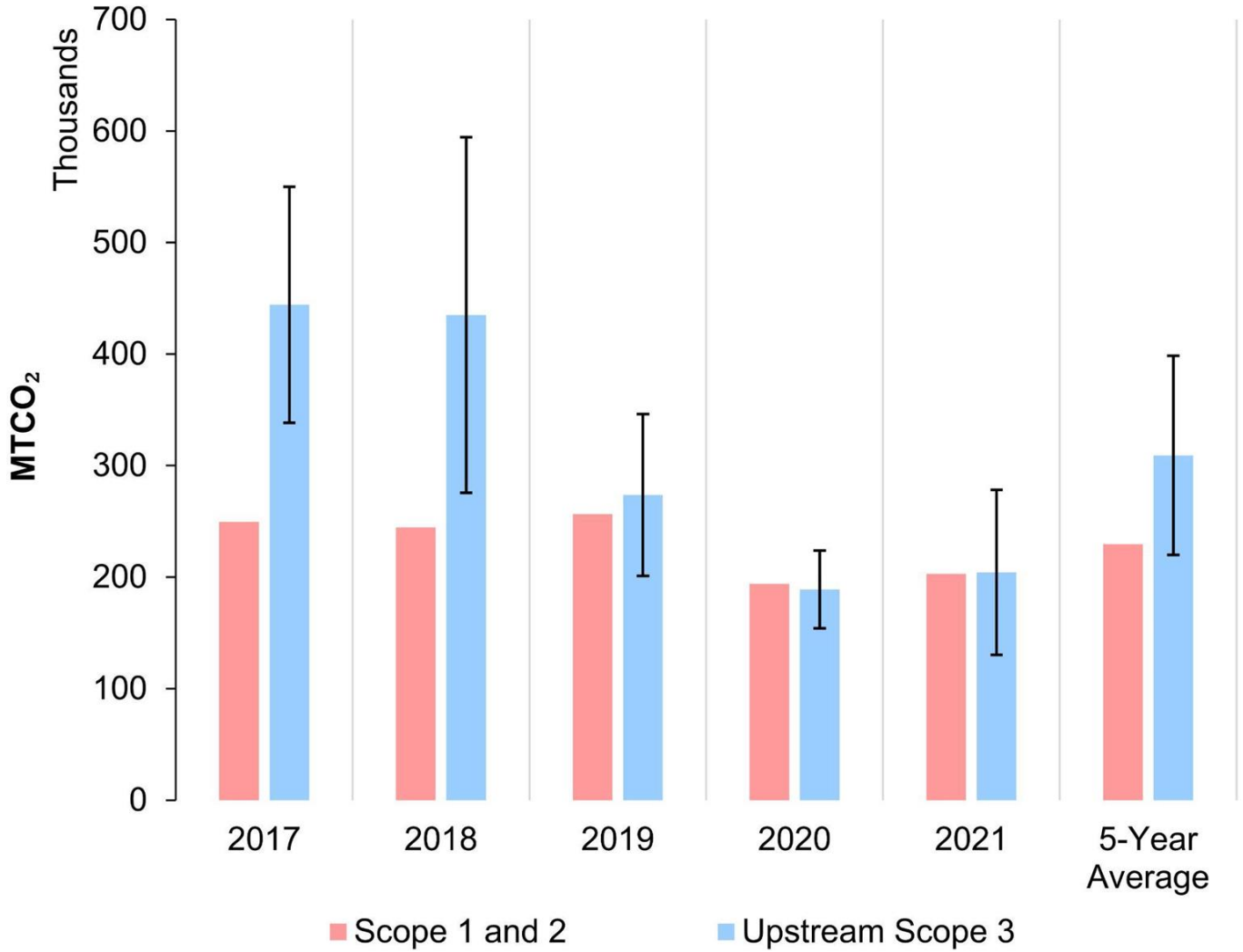
The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard splits GHG emissions into three scopes:

- **Scope 1 emissions** are from a company's operations that are under a facility's direct control, e.g., on-site fuel combustion;
- **Scope 2 emissions** are from usage of electricity, steam, heat and/or cooling purchased from third parties; and
- **Scope 3 emissions** are upstream and downstream value chain emissions, **including upstream supply chain emissions from purchased products,** transport emissions, and business travel and downstream emissions from transport of products, usage of sold products and product disposal.

GREENHOUSE GAS PROTOCOL

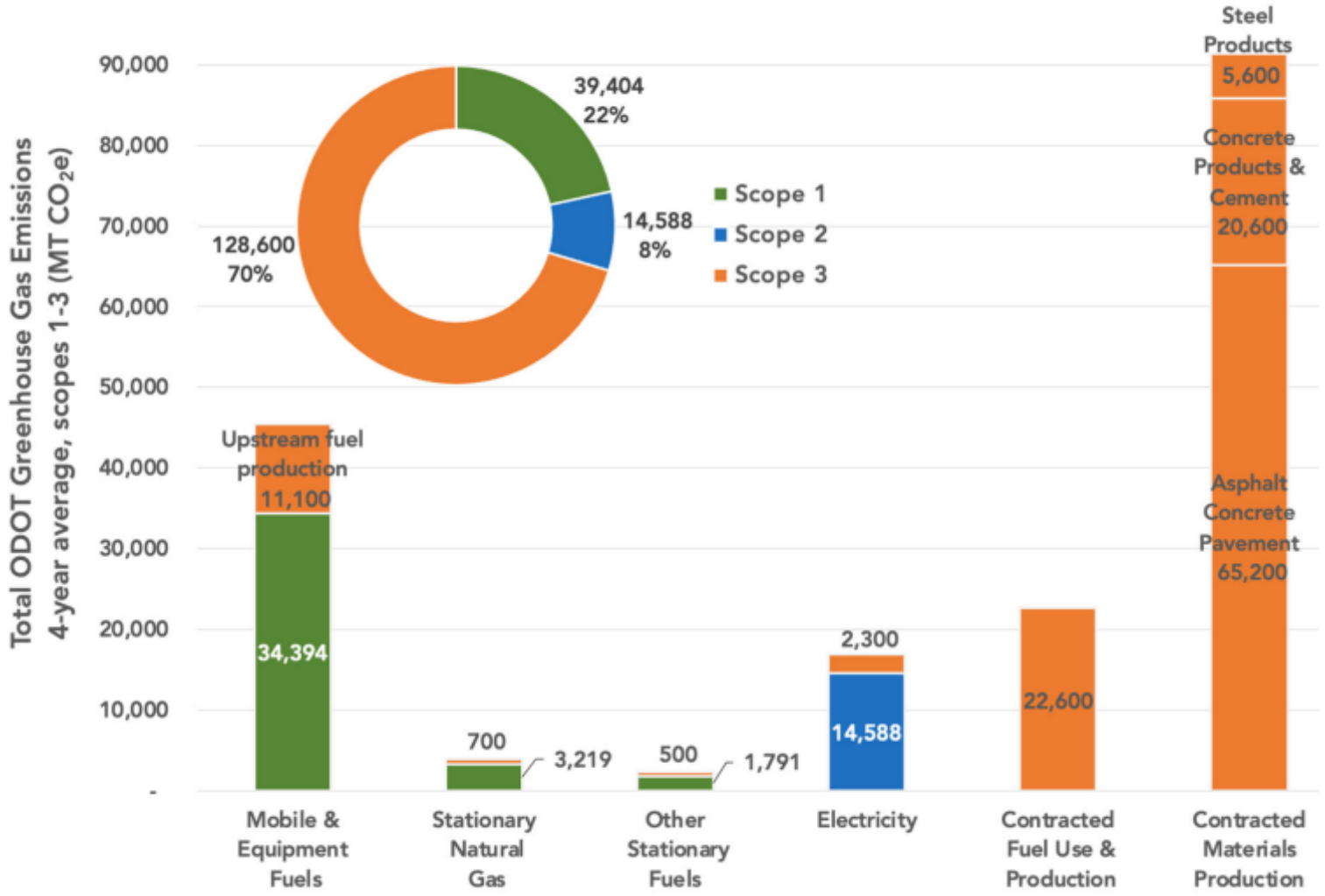
Washington State Dept of Transportation GHG inventory





Source: https://carbonleadershipforum.org/ghg-emissions-inventory-washington-roadways/

Oregon Dept of Transportation GHG inventory



Source: https://www.oregon.gov/odot/climate/Documents/GHG_Report_FINAL.pdf

Integrating Embodied Carbon into Climate Action Plans

Rebecca Esau resau@rmi.org

RMI Embodied Carbon Initiative

Federal Policy

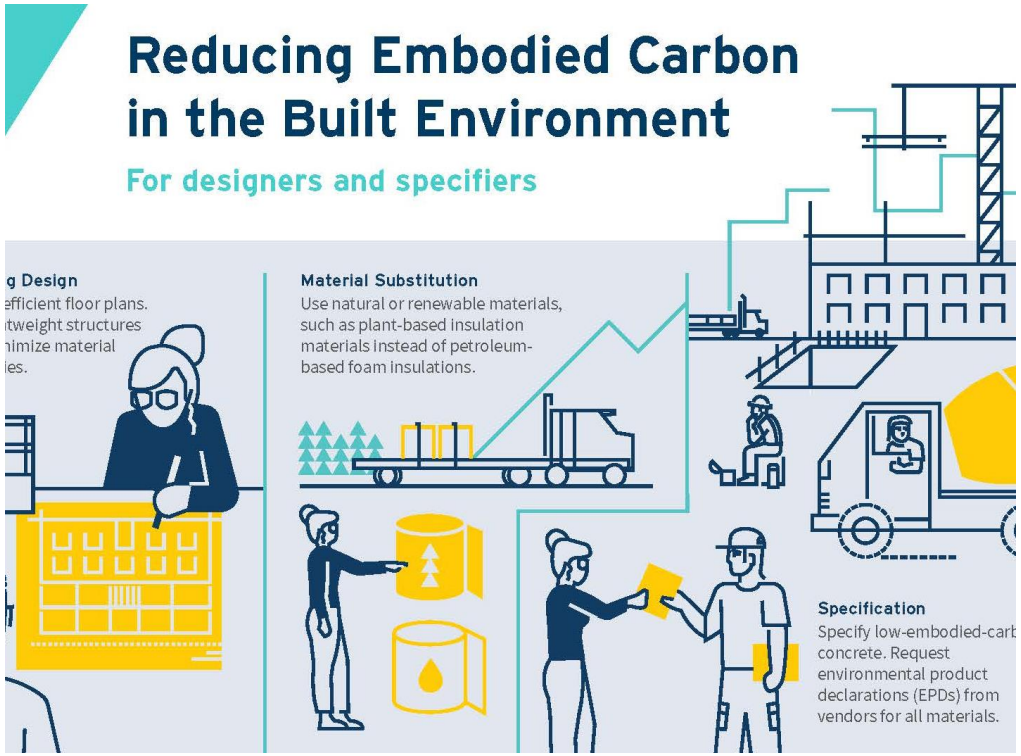
- Roadmap to Zero Embodied Carbon
- 2021 GSA Buy Clean Guidelines / 2022 IRA program engagement

State Policy

- Buy Clean Colorado policy development & implementation
- Technical advisory group for NYS low carbon concrete procurement
- Research for NY & MA on Buy Clean and low-carbon concrete bills
- Work on low-carbon concrete with State DOTs
- California green building code

Local Policy

- Embodied Carbon in Climate Action Plans Workshops – Policy Toolkit!
- Policy brief on material circularity



Integrating embodied carbon into CAPs

Embodied carbon typically falls into the following CAP areas:

1. Local Production / Industry
2. Buildings / Construction
3. Waste / Material Recovery
4. Consumption Emissions

City	Strategy Areas
Austin	• Sustainable Buildings
Eugene	• Consumption Emissions
King County	• Green building • Consumption & Materials
Los Angeles	• Industrial Emissions & Air Quality Monitoring • Lead by Example (Municipal Buildings)
Phoenix	• Stationary Energy Sector Goals (Net-Zero Buildings)
San Francisco	• Responsible Production and Consumption (RPC)
Vancouver B.C.	• How We Build and Renovate

Embodied carbon targets in CAPs

C40 Clean Construction Declaration Targets (Buildings and infrastructure)

- 30% by 2025
- 50% by 2030

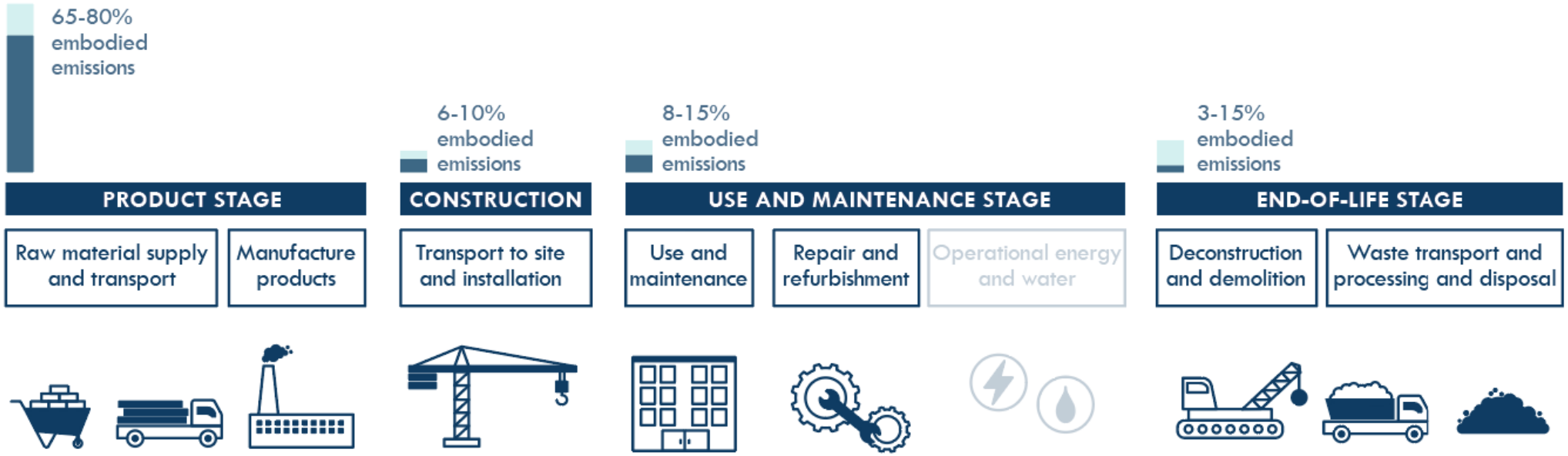
Architecture 2030 Embodied Carbon Targets

- 45% or better in 2025
- 65% or better in 2030
- **Zero** global warming potential (GWP) by 2040

City	Strategy Areas
Austin	• 40% reduction by 2030 from a 2020 baseline
Los Angeles	• 50% by 2030
Phoenix	• Net-Positive Design by 2050
Vancouver B.C.	• 40% reduction by 2030 from a 2018 baseline

Embodied carbon strategies across the lifecycle

Embodied carbon emissions distribution
(NOT including emissions from building operations):



Lifecycle stage:

strategies:

PRODUCT STAGE	CONSTRUCTION	USE AND MAINTENANCE STAGE	END-OF-LIFE STAGE
Building materials	**Transportation**	**Existing building preservation and adaptation**	**Deconstruction**
Material efficiency	**Construction emissions**		**Material reuse/ recycling**
			Waste diversion

RMI
ENERGY. TRANSFORMED.

Carbon-Free Buildings
Low-Embodied Carbon Program

Embodied carbon strategies in CAPs

Strategies identified by climate action plans that incorporate embodied carbon goals and targets

Buildings	Material Recovery & Reuse	Low Carbon Materials
Municipal buildings (lead by example)	Support local reuse markets	Municipal procurement
Base codes & building regulations	Deconstruction reqs	Support local low carbon material producers
Voluntary codes/reporting	Waste separation/diversion reqs	

Education

Incentive programs

Policy alignment

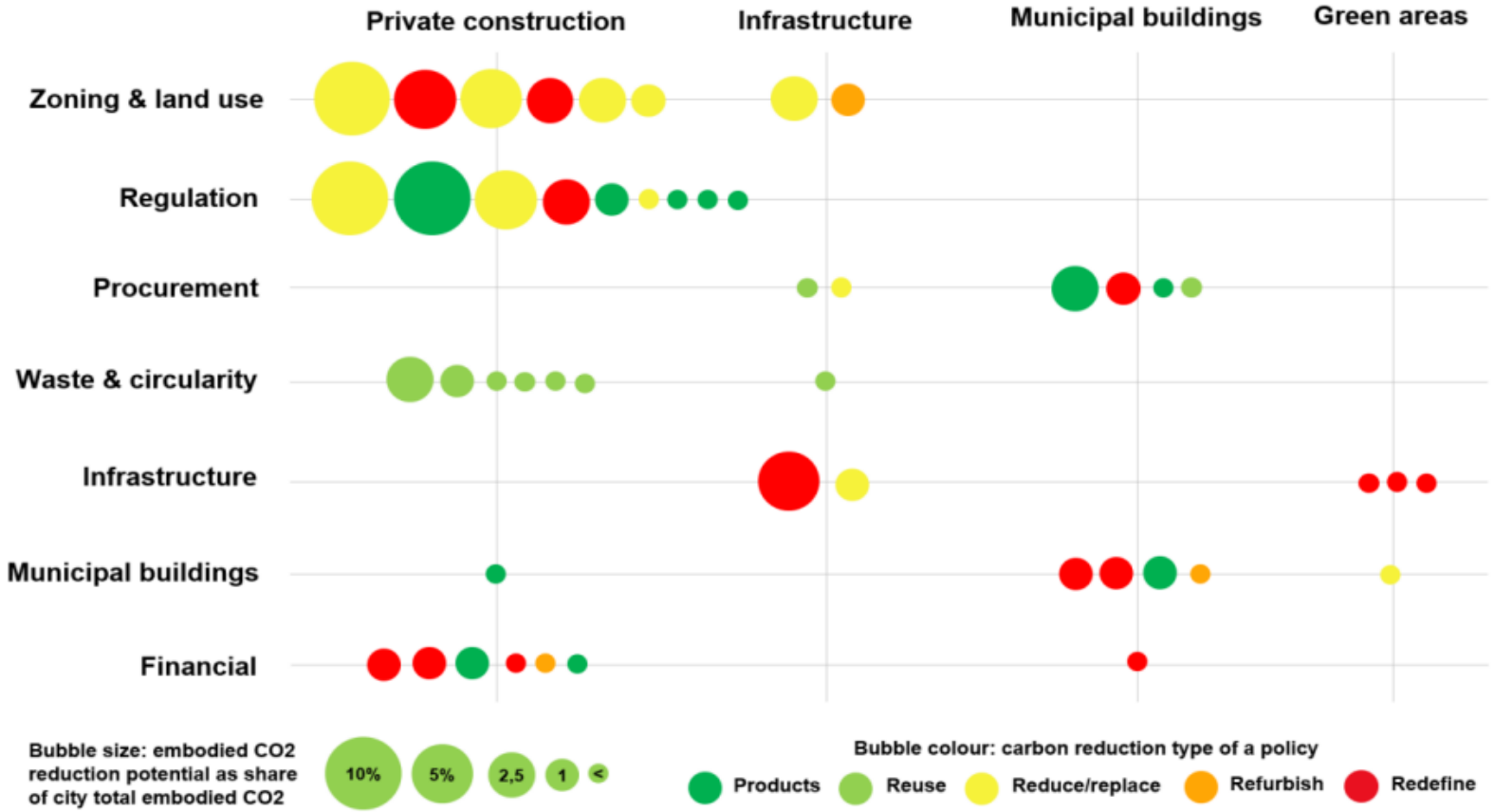
RMI ENERGY. TRANSFORMED.

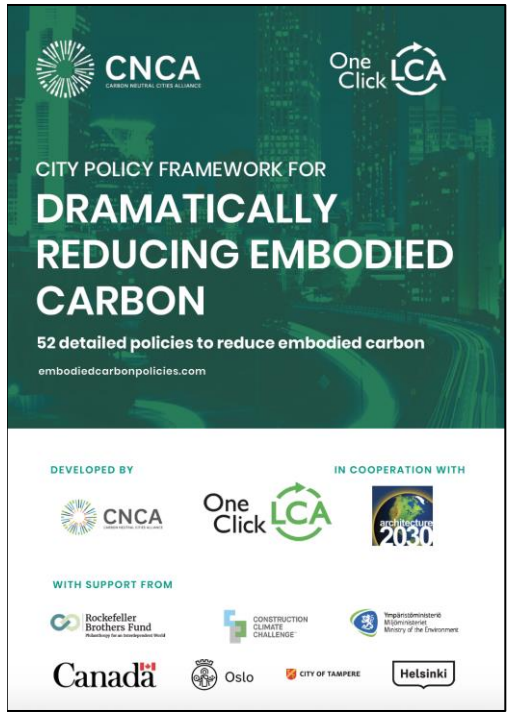
CLF Carbon Leadership Forum

Carbon-Free Buildings
Low-Embodied Carbon Program

Policy resource: 52 policies by CNCA

Figure 3 Embodied carbon policies in this report visualized per carbon reduction impact





[CNCA Report]

RMI
ENERGY. TRANSFORMED.

Carbon-Free Buildings
Low-Embodied Carbon Program

CAP example: City of Austin, TX

Reduction Target: **By 2030, reduce embodied carbon footprint of building materials used in local construction by 40% from a 2020 baseline.**

Strategies:

Lead by example: Develop City of Austin **design and construction specifications** and **purchasing agreements** to result in low carbon, healthful buildings. For example, encourage lower-carbon building materials, whole building life cycle analysis, healthy building certifications, building reuse and deconstruction **in City-funded projects**.

Incentivize: Enhance and integrate lower-carbon building materials and deconstruction practices into incentive programs including points structure for the **expedited permit process**, PUD guidelines or Austin Energy Green Building program, with the intent to transition voluntary design guidance into **planning and development agreements** over time.

Educate: Create a **performance framework** and **educational programming** for industry professionals and the general public, with a focus on low income communities and communities of color, to reduce the lifecycle and negative health impact of building materials and construction practices. **Provide resources** that address and help mitigate health impact considerations of materials from point of extraction to operation, including availability of Environmental and Health Product Declarations.

Partnerships: Prioritize partnerships within **local materials markets** to decarbonize high-impact materials, specifically: glass, steel, aluminum, concrete, drywall, carpet. Leverage existing local and align with national efforts to **create equitable outcomes** in materials decarbonization and look for **incubation and co-location opportunities**.

RMI
ENERGY. TRANSFORMED.

Thank You

resau@rmi.org

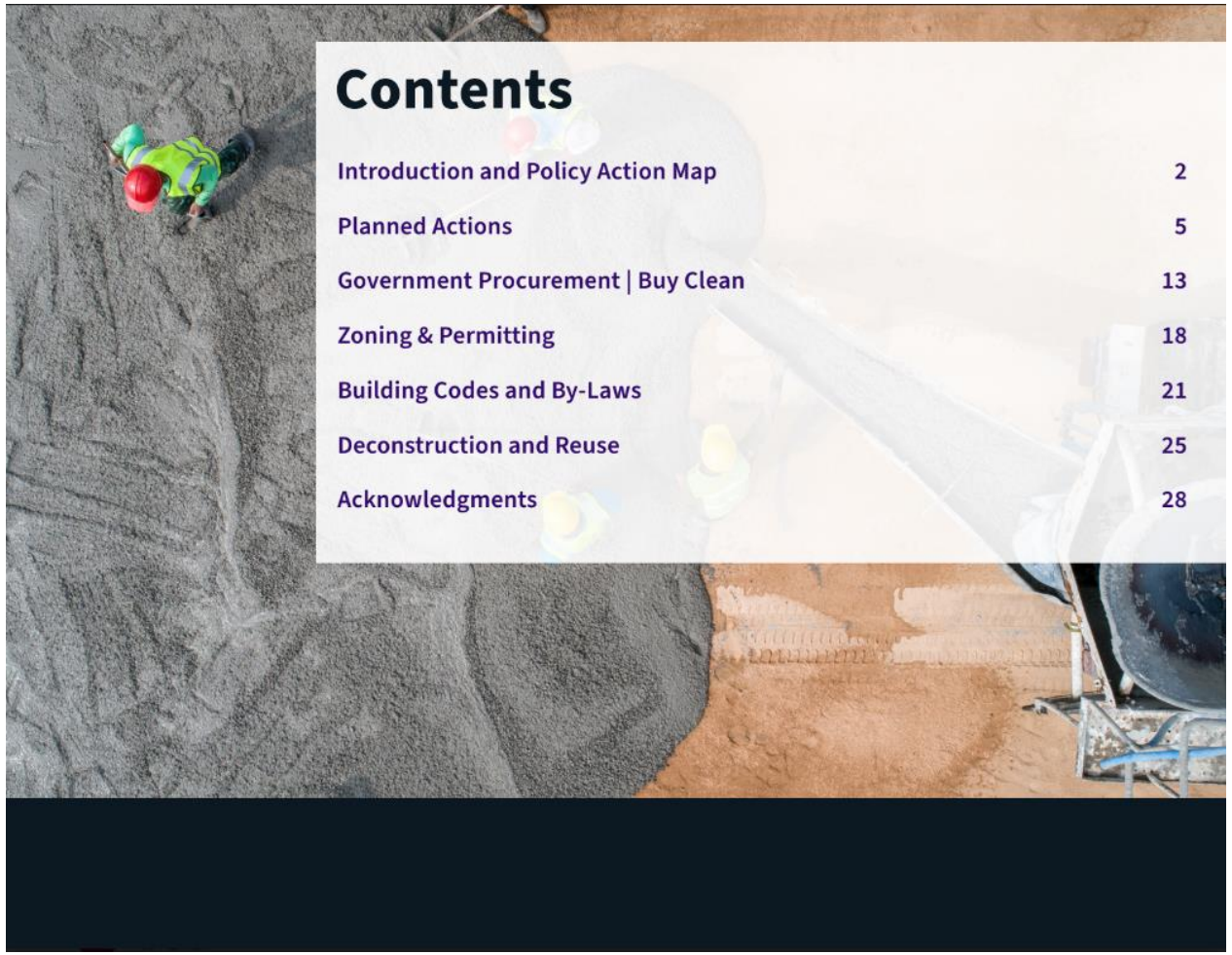
Introduction

Pacific Coast COLLABORATIVE

Initiatives:

- Transforming Transportation
- Transitioning to Clean Energy
- Reducing Wasted Food
- Protecting Coastal Communities
- Decarbonizing Buildings
- Creating a Resilient Low-Carbon Economy
- Putting a Price on Carbon
- **Low Carbon Construction**

Case Studies



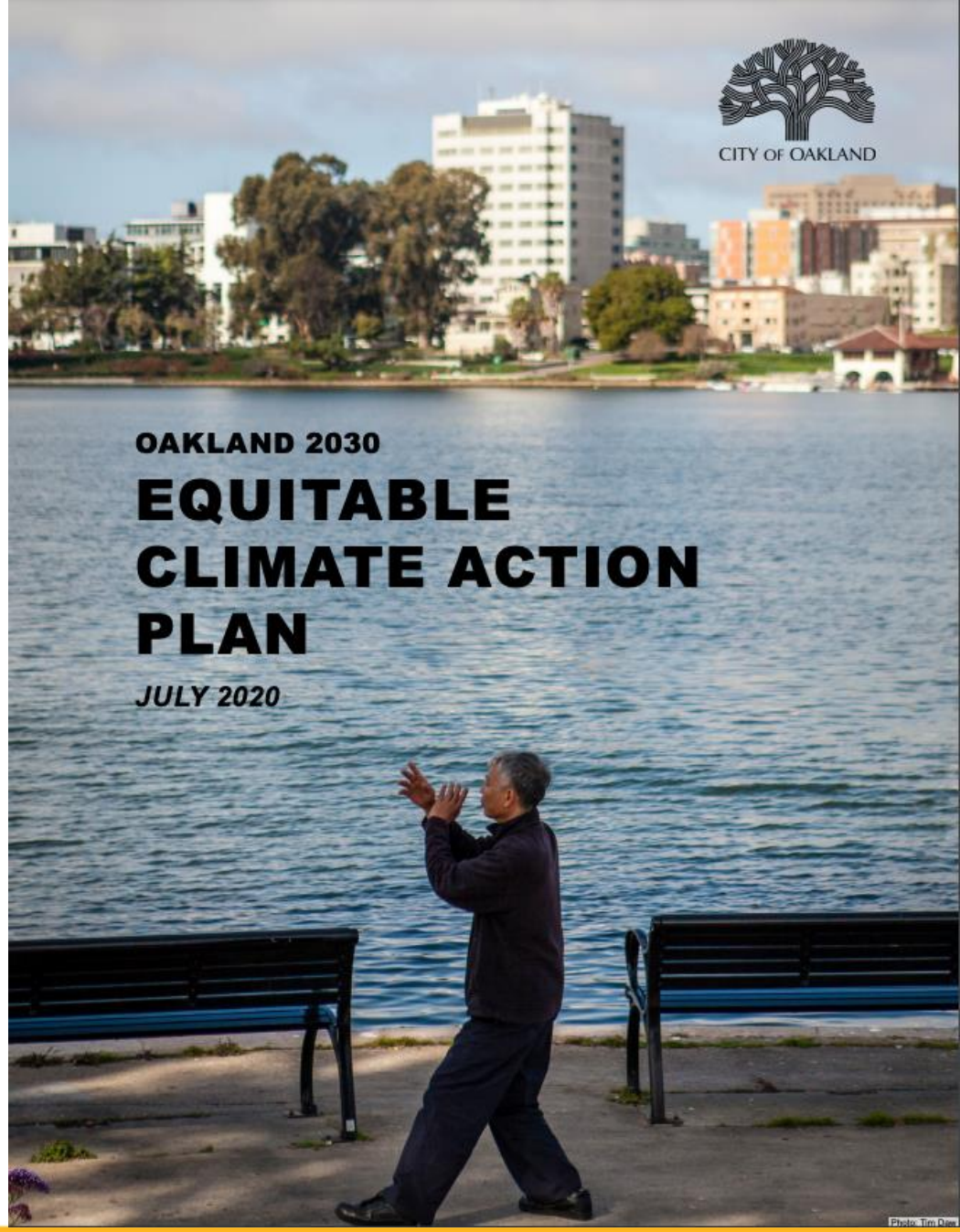
Case Studies

1. **Planned Actions**
   a. Oakland 2030 Equitable Climate Action Plan
   b. San Francisco Climate Action Plan
   c. Portland Climate Emergency Work Plan
   d. British Columbia's Mass Timber Action Plan
2. **Government Procurement**
   a. Buy Clean California
   b. Buy Clean Oregon
   c. Buy Clean Buy Fair Washington Pilot Study and Reporting Database
3. **Zoning & Permitting**
   a. Seattle Green Building Incentive Program
4. **Building Codes & ByLaws**
   a. Vancouver Building By-Law Amendment
5. **Reuse & Deconstruction**
   a. Portland's Residential Deconstruction Law

Oakland 2030 Equitable Climate Action Plan

Goals:

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



Oakland 2030 Equitable Climate Action Plan

Category	Strategy
Base codes and regulations	Reduce lifecycle emissions: Adopt a concrete code for new construction that limits embodied carbon emissions. Performance standards for existing buildings.
Education	Support the Reuse, Repair, Recovery, and Refurbishment Economy.
Education	Expand Community Repair Resources.
Materials + Waste	Establish a deconstruction requirement.
City Procurement	Track annual embodied GHG emissions related to City expenditures for construction, building maintenance, travel, and food. Establish maximum GHG performance thresholds.

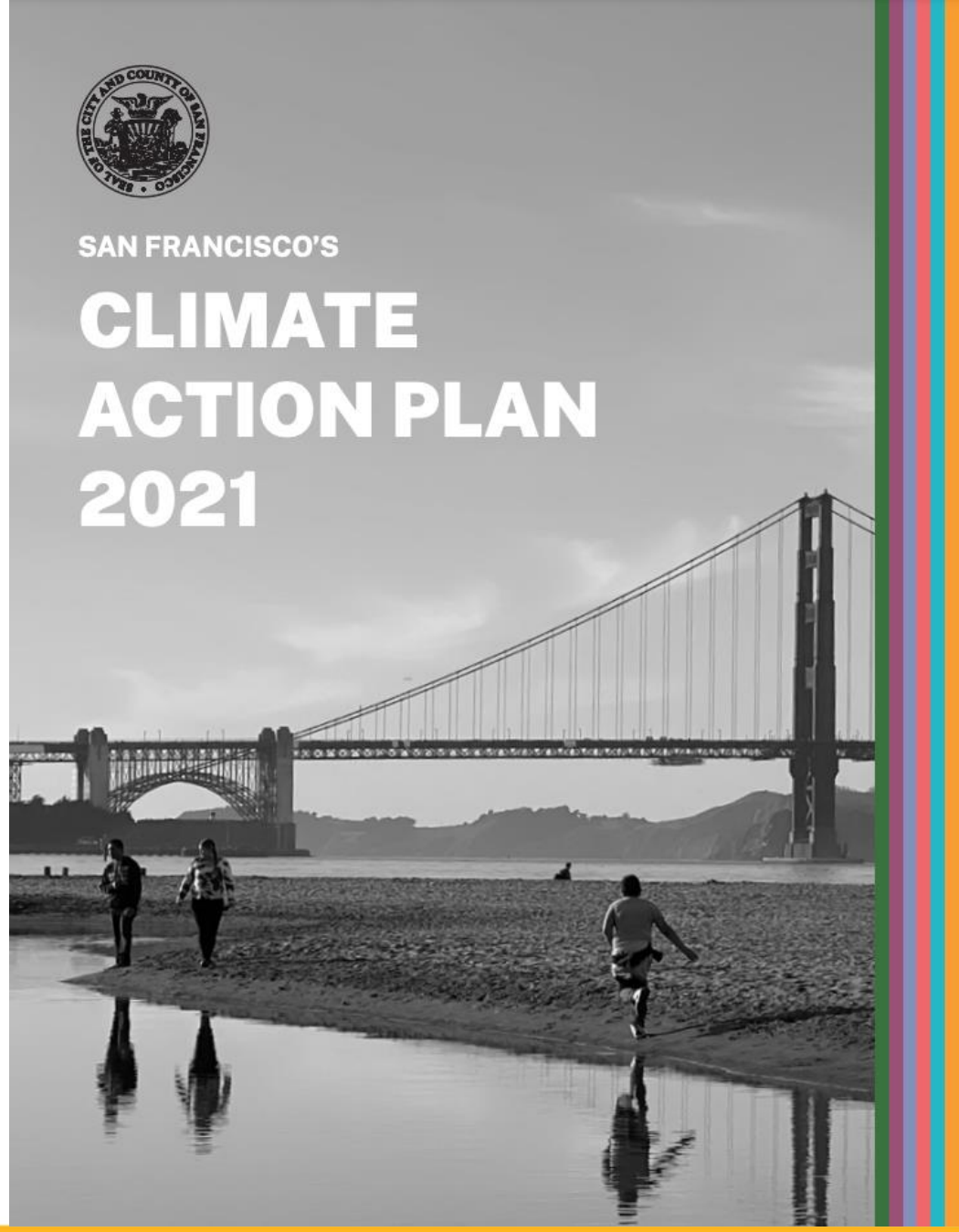
Keys to Success

- Pairing the embodied carbon planned actions with broader economic and workforce development, climate mitigation, and health actions
- Collaboration with other local governments was important in developing a healthy regional economy of low-carbon building material providers and a workforce ready to use these materials.
- The focus on low-carbon concrete (and embodied carbon generally) in the ECAP builds on years of existing work and awareness in Oakland.
  - Bay Area Low-Carbon Concrete Code

San Francisco Climate Action Plan 2021

Target:

- Achieve total carbon balance across the buildings and infrastructure sectors.
- By 2030, buildings constructed will have a 40% reduction in embodied carbon.



San Francisco Climate Action Plan 2021

Category	Strategy
Policy Instruments	Develop a suite of incentives, policies, and/or guidelines for adaptive reuse of existing buildings, as well as the design and procurement of low carbon structural materials for new construction.
Materials	Amend existing policies to require deconstruction of buildings and increase the source separation of specific materials.
Incentives	Policy framework to expand and cultivate regional building material reuse markets that support workforce development, small business enterprises, and entrepreneurial innovation.
Education	Advance best practices for “Design for Disassembly” and “Buildings As Material Banks” by creating implementation resources in partnership with global cities, and pilot at least one municipal project to maximize the value of carbon already invested in buildings.

City of San Francisco

Responsible Production and Consumption (RPC) 1: Achieve total carbon balance across the buildings and infrastructure sectors.

Supporting actions

1. Between 2021-2025, phase-in policies to **reduce embodied carbon more than 10% per project** by addressing at least three product categories or building assembly types.
2. By 2023, **develop a suite of incentives, policies, and/or guidelines for adaptive reuse of existing buildings**, as well as the **design and procurement of low carbon structural materials for new construction.**
3. By 2025, **establish a maximum allowance** for embodied carbon of buildings, to be adjusted in regular intervals.
4. By 2025, amend existing policies to **require deconstruction of buildings** and increase the source separation of specific materials.
5. By 2025, engage with designers, landlords, and lessees to **develop guidelines for tenant improvement and space turnover projects** that reduce excess material purchases and support reuse distribution channels.
6. By 2025, create a policy framework to **expand and cultivate regional building material reuse markets** that support workforce development, small business enterprises, and entrepreneurial innovation.
7. By 2030, advance best practices for “Design for Disassembly” and “Buildings As Material Banks” by **creating implementation resources** in partnership with global cities, and pilot at least one municipal project to maximize the value of carbon already invested in buildings.

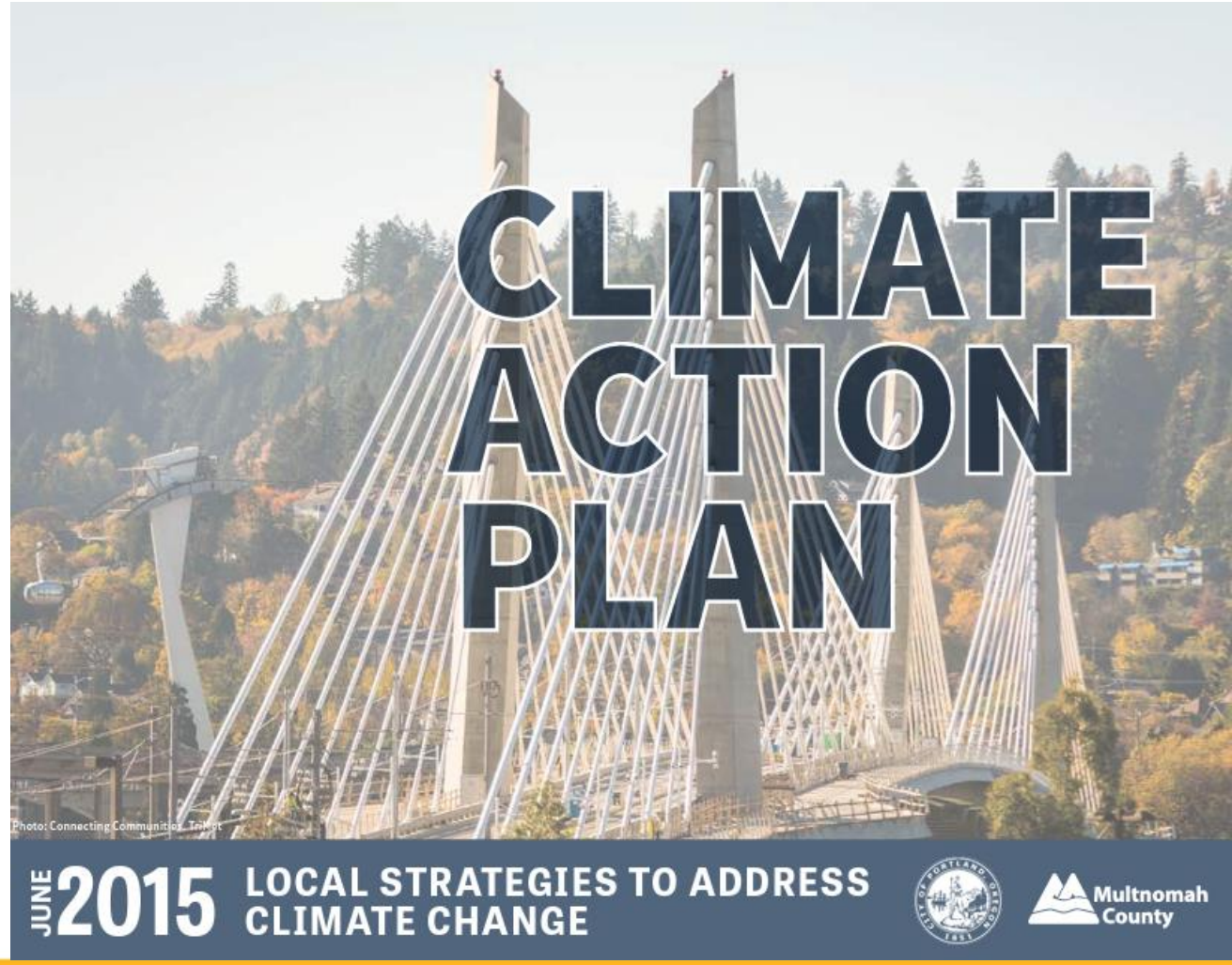
Keys to Success

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

Portland, OR Climate Action Plan (2015)

Target:

- 80 percent carbon-reduction goal by 2050



Portland, OR Climate Action Plan (2015)

Category	Strategy
Consumption and Solid Waste	Reduce consumption-related emissions by encouraging sustainable consumption and supporting Portland businesses in minimizing the carbon intensity of their supply chains.
Consumption and Solid Waste	Provide technical assistance and resources to contractors to meet Portland's construction and demolition debris requirements, giving priority to salvage and reuse activities.
Consumption and Solid Waste	Promote alternatives to traditional building demolition such as relocation, deconstruction and salvage, including identifying and removing barriers and disincentives.
Rehabilitation and Adaptive Reuse	Promote rehabilitation, adaptive reuse and energy and seismic upgrades of buildings to conserve natural and historic resources, reduce waste and improve public safety.

Portland Deconstruction of Buildings Law

All single-dwelling structures (houses and duplexes) in all zones must be fully deconstructed as opposed to mechanically demolished if:

- The structure was built in 1940 or earlier; or
- The structure is designated as a historic resource

Projects must use a city-published list of Certified Deconstruction Contractors to perform the deconstruction work.

Portland Deconstruction of Buildings Law

All single-dwelling structures (houses and duplexes) in all zones must be fully deconstructed as opposed to mechanically demolished if:

- The structure was built in 1940 or earlier; or
- The structure is designated as a historic resource

Projects must use a city-published list of Certified Deconstruction Contractors to perform the deconstruction work.

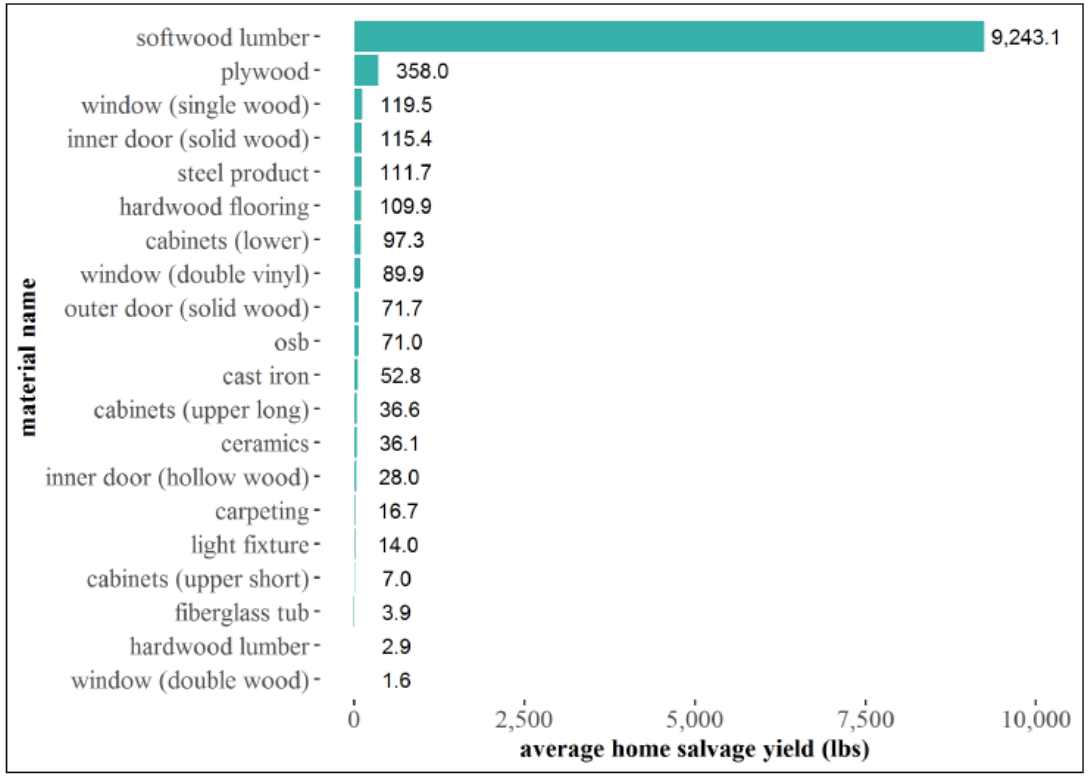


Figure 5: Quantity of materials salvaged from an average home

Source: Oregon DEQ Materials Management, "Deconstruction and Demolition" Study

Case Study: Portland Deconstruction of Buildings Law

Timeline:

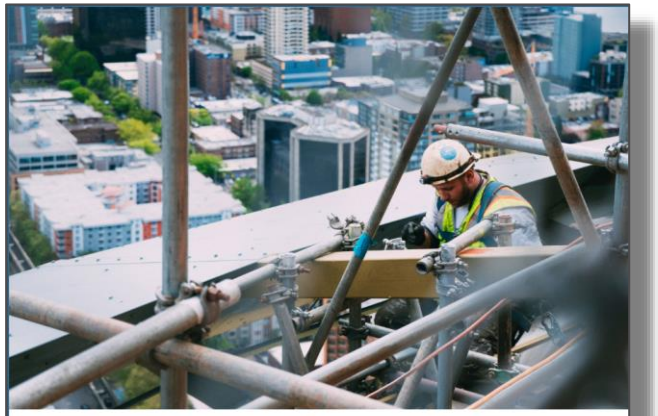
- Work began in 2015
- Deconstruction vs. demolition modeling scenario
- Stakeholder advisory groups
  - Phase in approach
- October 2016, Portland became the first city to require deconstruction and material salvage for its oldest and most historic houses

Stakeholders

- Home builders
- Neighborhood advocates
- Historic preservation advocates
- Hazardous material experts
- Deconstruction firms
- Salvage retailers
- Permitting staff
- Construction and demolition recyclers
- Regional waste authority

Embodied Carbon Policy Reduction Calculator
https://carbonleadershipforum.org/policy-reduction-calculator/

Framework, Case Studies, and Feedback



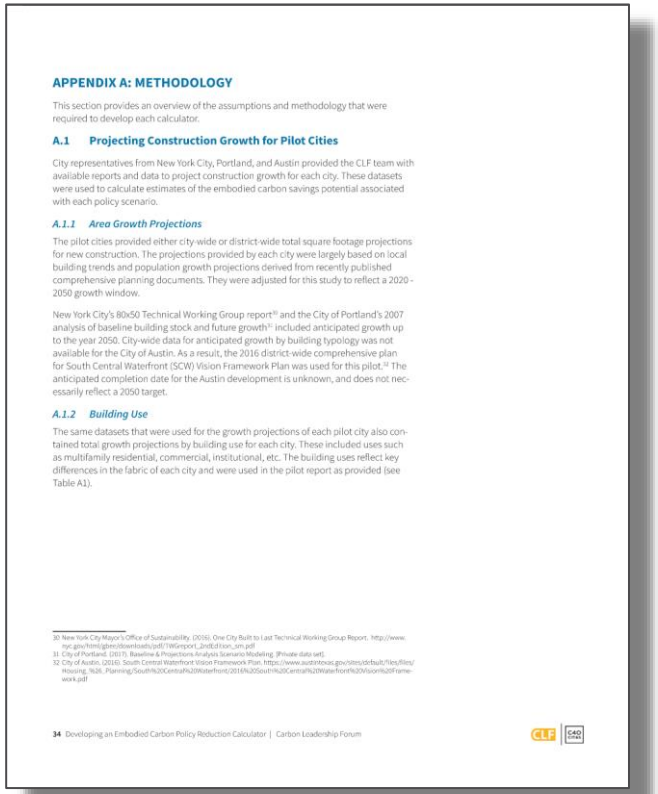
Developing an Embodied Carbon Policy Reduction Calculator

Quantifying the embodied emisions reduction potential of city policies

PROOF OF CONCEPT REPORT | MARCH 2022

CLF Carbon Leadership Forum | C40 CITIES

Detailed Methodology



APPENDIX A: METHODOLOGY

This section provides an overview of the assumptions and methodology that were required to develop each calculator.

A.1 Projecting Construction Growth for Pilot Cities

City representatives from New York City, Portland, and Austin provided the CLF team with available reports and data to project construction growth for each city. These datasets were used to calculate estimates of the embodied carbon savings potential associated with each policy scenario.

A.1.1 Area Growth Projections

The pilot cities provided either city-wide or district-wide total square footage projections for new construction. The projections provided by each city were largely based on local building trends and population growth projections derived from recently published comprehensive planning documents. They were adjusted for this study to reflect a 2020 - 2050 growth window.

New York City's 80x50 Technical Working Group report[30] and the City of Portland's 2007 analysis of baseline building stock and future growth[31] included anticipated growth up to the year 2050. City-wide data for anticipated growth by building typology was not available for the City of Austin. As a result, the 2016 district-wide comprehensive plan for South Central Waterfront (SCW) Vision Framework Plan was used for this pilot.[32] The anticipated completion date for the Austin development is unknown, and does not necessarily reflect a 2050 target.

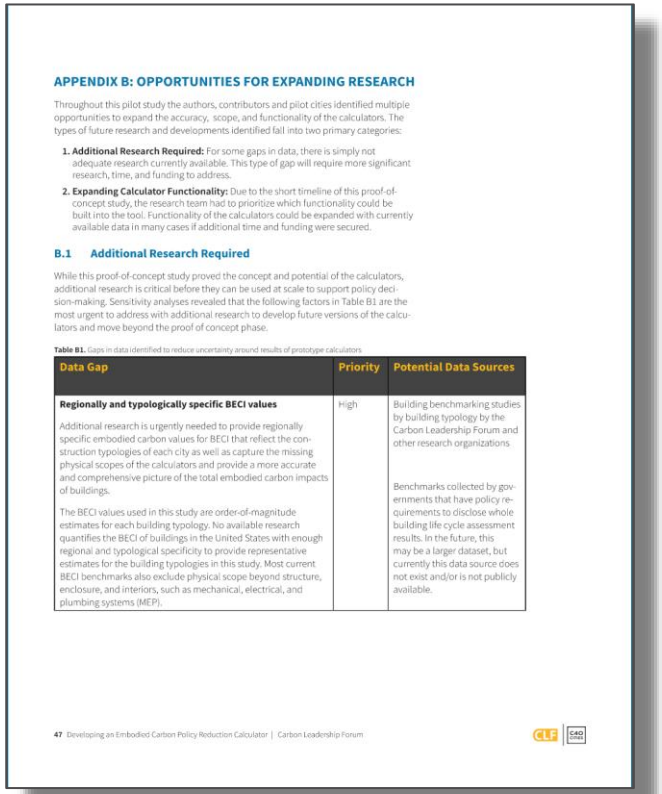
A.1.2 Building Use

The same datasets that were used for the growth projections of each pilot city also contained total growth projections by building use for each city. These included uses such as multifamily residential, commercial, institutional, etc. The building uses reflect key differences in the fabric of each city and were used in the pilot report as provided (see Table A1).

30 New York City Mayor's Office of Sustainability. (2016). One City Built to Last Technical Working Group Report. http://www.nyc.gov/html/gbee/downloads/pdf/TWGreport_2ndEdition_sm.pdf
31 City of Portland. (2017). Baseline & Projections Analysis Scenario Modeling. [Private data set].
32 City of Austin. (2016). South Central Waterfront Vision Framework Plan. https://www.austintexas.gov/sites/default/files/files/Housing,_%26_Planning/South%20Central%20Waterfront/2016%20South%20Central%20Waterfront%20Vision%20Framework.pdf

34 Developing an Embodied Carbon Policy Reduction Calculator | Carbon Leadership Forum

Future Research and Opportunities



APPENDIX B: OPPORTUNITIES FOR EXPANDING RESEARCH

Throughout this pilot study the authors, contributors and pilot cities identified multiple opportunities to expand the accuracy, scope, and functionality of the calculators. The types of future research and developments identified fall into two primary categories:

1. **Additional Research Required:** For some gaps in data, there is simply not adequate research currently available. This type of gap will require more significant research, time, and funding to address.
2. **Expanding Calculator Functionality:** Due to the short timeline of this proof-of-concept study, the research team had to prioritize which functionality could be built into the tool. Functionality of the calculators could be expanded with currently available data in many cases if additional time and funding were secured.

B.1 Additional Research Required

While this proof-of-concept study proved the concept and potential of the calculators, additional research is critical before they can be used at scale to support policy decision-making. Sensitivity analyses revealed that the following factors in Table B1 are the most urgent to address with additional research to develop future versions of the calculators and move beyond the proof of concept phase.

Table B1. Gaps in data identified to reduce uncertainty around results of prototype calculators

Data Gap	Priority	Potential Data Sources
Regionally and typologically specific BECI values Additional research is urgently needed to provide regionally specific embodied carbon values for BECI that reflect the construction typologies of each city as well as capture the missing physical scopes of the calculators and provide a more accurate and comprehensive picture of the total embodied carbon impacts of buildings. The BECI values used in this study are order-of-magnitude estimates for each building typology. No available research quantifies the BECI of buildings in the United States with enough regional and typological specificity to provide representative estimates for the building typologies in this study. Most current BECI benchmarks also exclude physical scope beyond structure, enclosure, and interiors, such as mechanical, electrical, and plumbing systems (MEP).	High	Building benchmarking studies by building typology by the Carbon Leadership Forum and other research organizations Benchmarks collected by governments that have policy requirements to disclose whole building life cycle assessment results. In the future, this may be a larger dataset, but currently this data source does not exist and/or is not publicly available.

47 Developing an Embodied Carbon Policy Reduction Calculator | Carbon Leadership Forum

Project Goals:

- Establish a simple way for planners and policymakers to **model the carbon savings** potential of EC policies for a specific city;
- Allow for **comparison of reduction policies** for EC by key target dates (2030 and 2050) to assess the largest opportunities for impact;
- Provide **customized estimates of carbon savings** associated with each policy to give cities the values they need to make a case for action;
- **Evaluate and prioritize** policies that may be required to meet embodied carbon reduction targets, such as those set by city or regional climate action plans.

Reducing Building Carbon Intensity

↓ $kgCO_2e/ft^2$

If building carbon intensity limits require X% reductions for X building types, how much carbon would be saved by 2050?

- Incentivizes **Designers** to collaborate to design a lower carbon building
- Captures strategies like:
  - Building/material reuse
  - Use of mass timber/bio-based materials
  - Efficient structural design

Reducing Concrete Carbon Intensity

↓ $kgCO_2e/yd^3$ concrete

If concrete carbon intensity limits require X% reductions for X building types, how much carbon would be saved by 2050?

- Incentivizes **Manufacturers** to invest in clean manufacturing and **Contractors** to procure low carbon materials
- Captures strategies like:
  - Concrete mix designs
  - Plant efficiency/fuel choices
  - Sustainable sourcing

Increasing Adaptive Reuse

↓ ft^2 of new construction

If X% of growth for X building types is through adaptive reuse (rather than demolition and N.C.), how much carbon would be saved by 2050?

- Incentivizes **Developers** to reuse existing buildings, rather than demolishing and building new

Evaluating Housing Unit Size

↓ ft^2 of new construction

What is the carbon impact of housing type and unit size on the carbon footprint of growth required to meet 2050 housing needs?

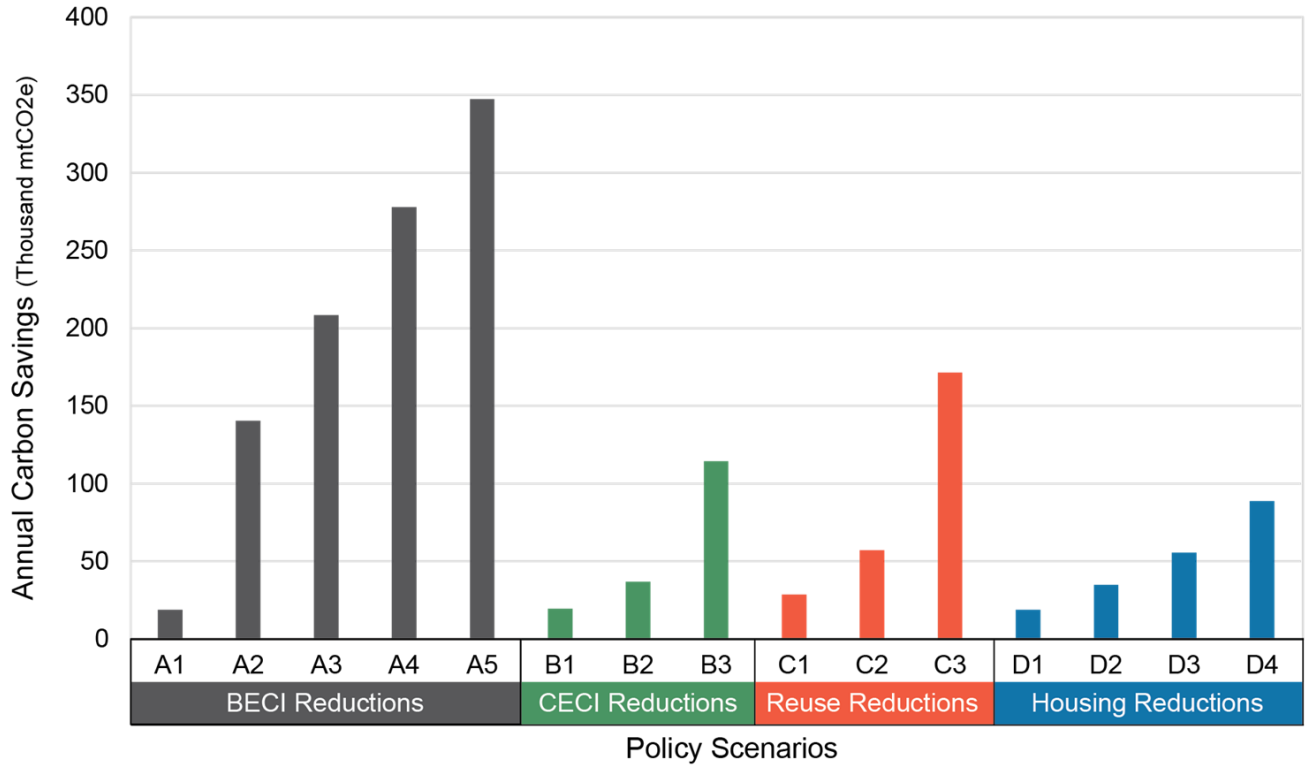
- Allows **Developers** to consider more efficient housing designs

Same program, same ft^2, lower CO_2 ← → *Same program, less new ft^2*

Carbon Leadership Forum

NYC: Key Takeaways from Calculator Results

- **BECI reduction requirements** present the largest opportunity, such as the 50% reduction targets in alignment with the Clean Construction Declaration
- **Incentivizing adaptive reuse** is the second largest opportunity
- **Multifamily residential** should be targeted in EC policies
  - *Ex: requiring a 40% reduction in BECI for multifamily construction alone has about the same impact as requiring 75% reductions in the embodied carbon of concrete for all commercial, multifamily, and institutional buildings.*
- Minimal reduction requirements (e.g. <30%) are not adequate to have a large impact, even at the scale of the entire city.



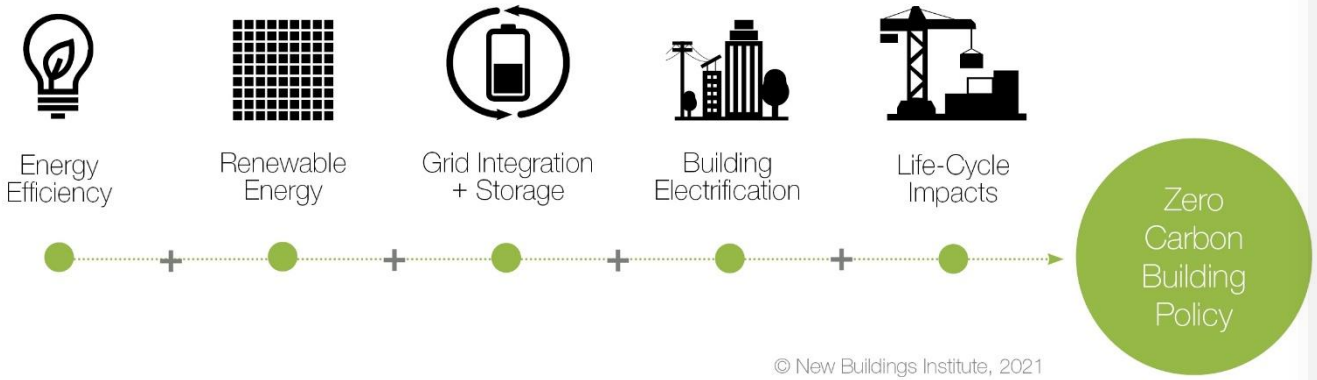
Overview of carbon savings results for City of New York illustrating maximum reduction (e.g. most progressive policy scenario analyzed) from each policy calculator.

nbi new buildings institute

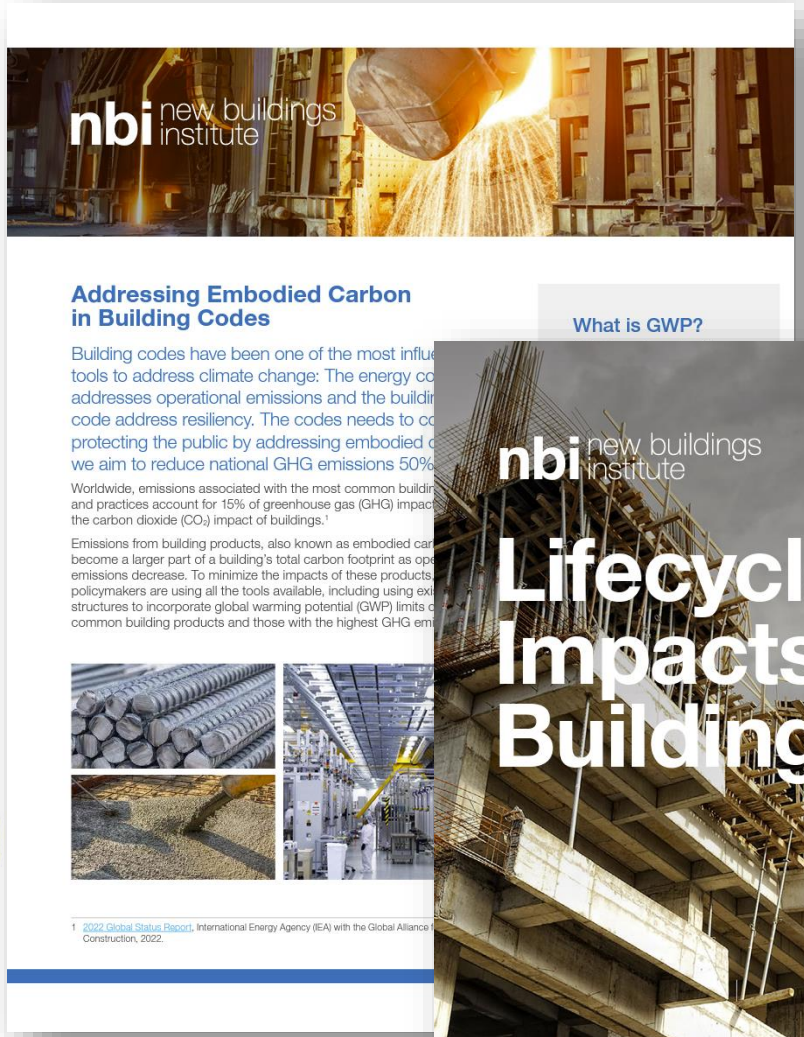
West Coast Material Management Collaboration

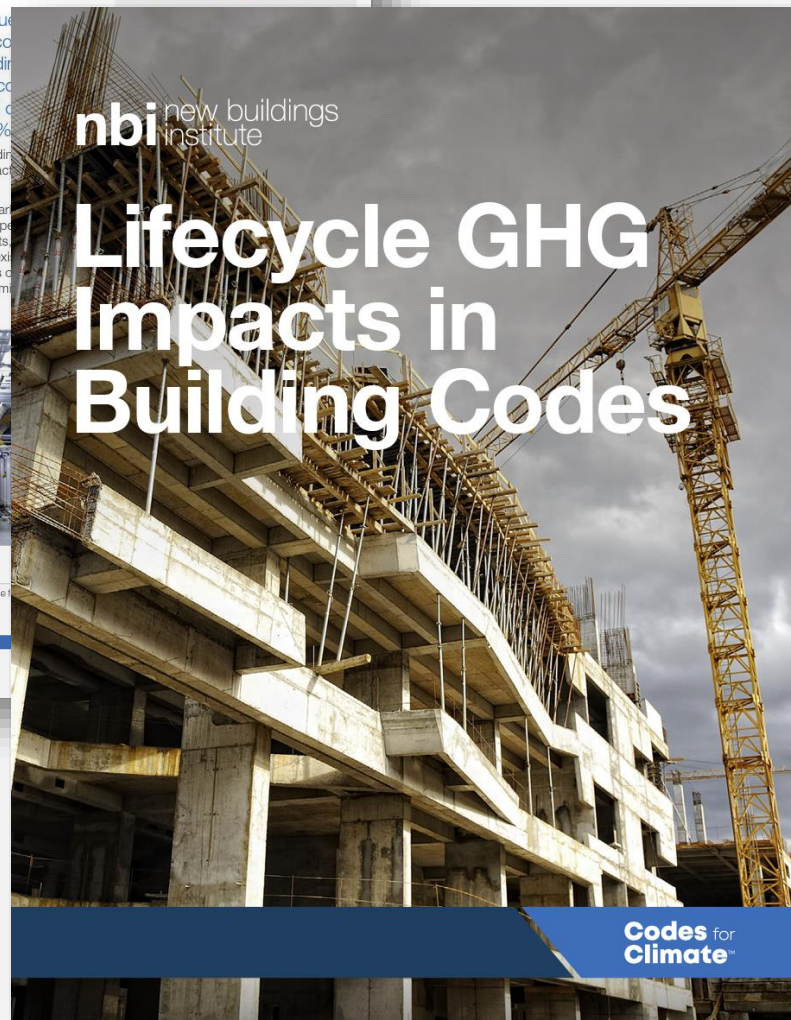
New Buildings Institute: Lifecycle Impacts

The Five Foundations of Zero Carbon Building Policies



newbuildings.org/code_policy/embodied-carbon/





Coordination Among Jurisdictional Embodied Carbon Actions

Climate Action Plan Topic Areas

Local Production / Industry

Buildings / Construction

Waste / Material Recovery

Consumption Emissions

Embodied Carbon Legislation

Template policy language is designed to help jurisdictions reduce embodied carbon emissions from their building stock. It focuses on commercial building and can be combined with a Procurement Policy to address government buildings first.

Statement of Purpose

- The purpose of this policy is to reduce greenhouse gas (GHG) emissions resulting from embodied carbon from new construction and major renovation of buildings in [JURISDICTION] to mitigate the impacts of climate change.

Whereas

Building or Zoning Code

Flat Glass EC Code Example

ADD NEW TEXT AS FOLLOWS:

2403.6 Embodied CO2e of Glazing Products. 50% of all flat glass used in window products used in the building project, based on cost or weight, shall not exceed 150% of IW-EPD's kg-CO2e/metric ton. Products must meet the documentation and reporting requirements of 2403.6.1.

Exceptions:

a. Plastic glazing
b. *Fire-rated glazing*
c. Interior partition walls
d. Skylights
e. *Guards* and railings
f. Glazing in athletic facilities
g. Floor/ceiling walking surfaces
h. Elevator hoistway glazing

2403.6.1 Documentation of Product CO2e. 50% of flat glass products, based on cost or weight must have a product-specific Type III EPD. Confirmation of the product's kg-CO2e/metric ton and EPDs shall be verified by a licensed design professional on the project, and they must make a summary available to the code official prior to the certificate of occupancy.

CALgreen 2022 Proposal

	Description	*Existing Voluntary*	Mandatory 100,000 sf (Schools: 50,000 sf)	Tier 1 100,000 sf (Schools: 50,000 sf)	Tier 2 100,000 sf (Schools: 50,000 sf)
Option 1	**Building Reuse**	75% of the structure and enclosed to be reused	**45% of the structure and enclosed to be reused**	**75% of the structure and enclosed to be reused**	**75% of the structure and enclosed to be reused AND 30% of interior non-structural elements to be reused**
Option 2	**WBLCA**	10% reduction from baseline	**10% reduction from baseline**	**15% reduction from baseline**	**20% reduction from baseline**
Option 3	**Prescriptive Approach**	N/A	**175% of IW-EPD GWP Limits** (weighted average available for concrete)	**150% of IW-EPD GWP Limits** (weighted average available for concrete)	**IW-EPD GWP Limits** (weighted average available for concrete)

Mandatory CALgreen EC Options

WBLCA

- Conduct a cradle-to-grave WB LCA in accordance with ISO 14040 and ISO 14044
  - Building components: enclosure components (glazing assemblies, insulation, and exterior finishes), footings, foundations, structural columns, beams, walls, roofs, and floors.
  - Exclude operating energy
  - Referenced baseline: similar size, function, complexity, type of construction, material specification, and location

Requirements

- Design professional of record to indicate a minimum 10% reduction in global warming potential (GWP) (software report)
- WB LCA software must have a dataset compliant with ISO-14044, and ISO 21930 or EN 15804, and the software shall conform to ISO 21931 and/or EN 15978.
  - The baseline and design WB LCA software tools must be the same.
- Provide the owner: WB LCA summary, maintenance and training information for the operation and maintenance manual

Prescriptive

- Products GWP must not exceed those in the table.
  - A weighted average calculations can demonstrate compliance
  - Design professional of record to confirm GWP values and calculations
  - Provide the owner: Type III EPDs at construction end (and to the enforcement entity upon request.)

Products	GWP value	Unit of Measurement
Hot-rolled structural steel sections	1.77	MT CO_{2e}/MT
Hollow structural sections	3.00	MT CO_{2e}/MT
Steel plate	2.61	MT CO_{2e}/MT
Concrete reinforcing steel	1.56	MT CO_{2e}/MT
Flat glass	2.50	kg CO_{2e}/MT
Light-density mineral wool board insulation	5.83	kg CO_{2e}/1 m^2
Heavy-density mineral wool board insulation	14.28	kg CO_{2e}/1 m^2
Concrete	Various	kg CO2e/m3

TIMELINE FOR CALGREEN ADOPTION: August 1-3: https://www.dgs.ca.gov/BSC/Rulemaking/2022-Intervening-Cycle/Commission-Mtgs-List-v2

Prescriptive CalGreen EC Mandatory Option

Buy Clean California Materials Product Category [1]	Maximum acceptable GWP value (unfabricated) (GWP $_{allowed}$)	Unit of Measurement
Hot-rolled structural steel sections	1.77	MT CO_{2e}/MT
Hollow structural sections	3.00	MT CO_{2e}/MT
Steel plate	2.61	MT CO_{2e}/MT
Concrete reinforcing steel	1.56	MT CO_{2e}/MT
Flat glass	2.50	kg CO_{2e}/MT
Light-density mineral wool board insulation	5.83	kg CO_{2e}/1 m^2
Heavy-density mineral wool board insulation	14.28	kg CO_{2e}/1 m^2

Exception EQUATION 5.409.3.1

Exception EQUATION 5.409.3.1

$GWP_n < GWP_{allowed}$

where

$GWP_n = \Sigma(GWP_n)(v_n)$ *and* $GWP_{allowed} = \Sigma(GWP_{allowed})(v_n)$

and

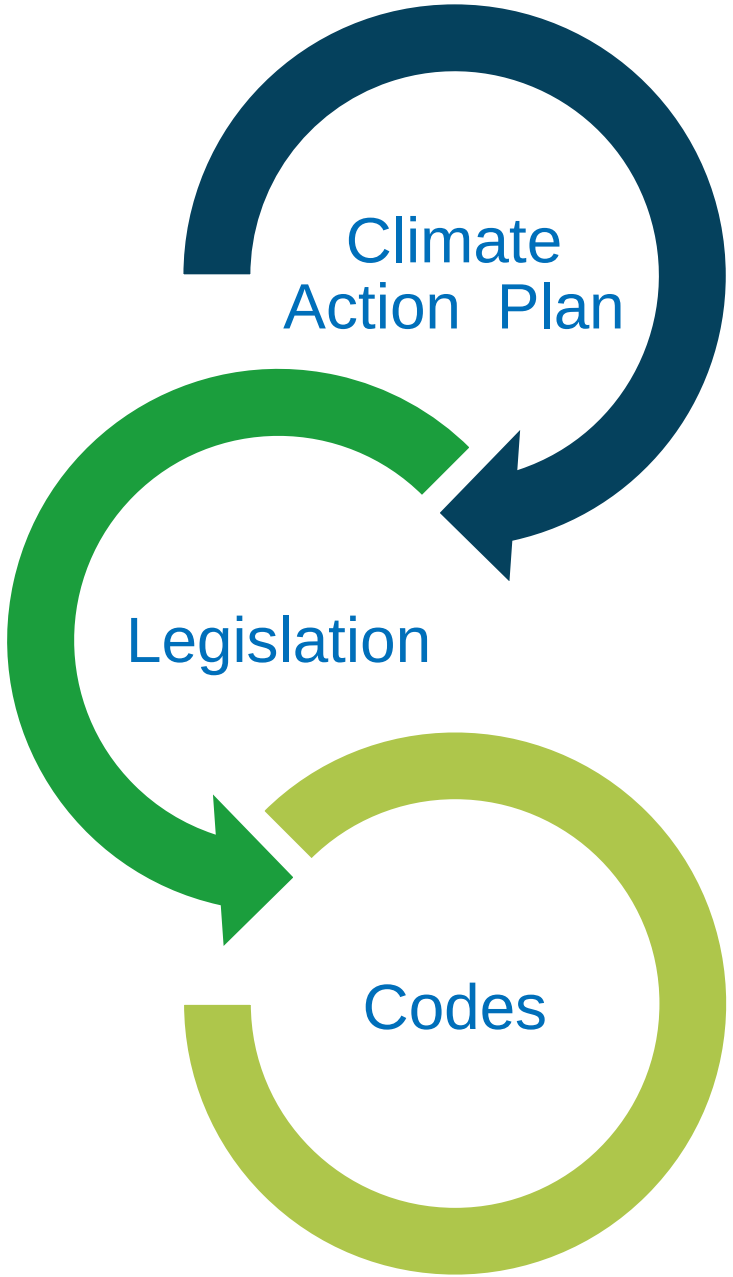
n = each concrete mix installed in the project

GWP_n = the GWP for concrete mix *n* per concrete mix EPD, in kg CO_{2e}/m^3
$GWP_{allowed}$ = the GWP potential allowed for concrete mix *n* per Table 5.409.3
v_n = the volume of concrete mix *n* installed in the project, in m^3

Concrete, Ready Mixed [2, 3]		
Concrete Product Category	Maximum GWP allowed value (GWP $_{allowed}$)	Unit of Measurement
up to 2499 psi	450	kg CO_{2e}/m^3
2500-3499 psi	489	kg CO_{2e}/m^3
3500-4499 psi	566	kg CO_{2e}/m^3
4500-5499 psi	661	kg CO_{2e}/m^3
5500-6499 psi	701	kg CO_{2e}/m^3
6500 psi and greater	799	kg CO_{2e}/m^3

Concrete, Lightweight Ready Mixed [2]		
Concrete Product Category	Maximum GWP allowed value (GWP $_{allowed}$)	Unit of Measurement
up to 2499 psi	875	kg CO_{2e}/m^3
2500-3499 psi	956	kg CO_{2e}/m^3
3500-4499 psi	1,039	kg CO_{2e}/m^3

California



- **San Francisco:** By 2030 new buildings will have a 40% reduction in embodied carbon.

- **Buy Clean California:** GWP limits for select products in state construction.

- **CALGreen:** Mandatory measures.

Thank you!

Webly Bowles, AIA

Associate Director of Codes and Policy
webly@newbuildings.org

nbi new buildings institute

West Berkeley Public Library, Berkeley, CA

Review: Climate Action Planning Process for EPA CPRG

1. Inventory sector emissions (estimate baseline)
2. Define strategies, policies, programs
3. Estimate impact of strategies (on GHG, cost, benefits)
4. Implementation

EPA Climate Pollution Reduction State Planning Grantees (EPA Regions 9 & 10)

- Alaska Dept. of Environmental Conservation
- Washington State Governor's Office
- Oregon Dept. of Environmental Quality
- Idaho Dept. of Environmental Quality
- California Air Resources Board
- Nevada Division of Environmental Protection
- Arizona Governor's Office of Resiliency
- Hawai'i Climate Change Mitigation & Adaptation Commission, Dept. of Land and Natural Resource

CPRG Major Metro Area Planning Grants (EPA Region 9 & 10)

Arizona

- **Maricopa Association of Governments:** Phoenix-Mesa-Chandler, AZ Metro Area
- **Pima County Department of Environmental Quality:** Tucson, AZ Metro Area

Hawai'i - City and County of Honolulu Office of Climate Change, Sustainability and Resiliency: Urban Honolulu, HI Metro Area

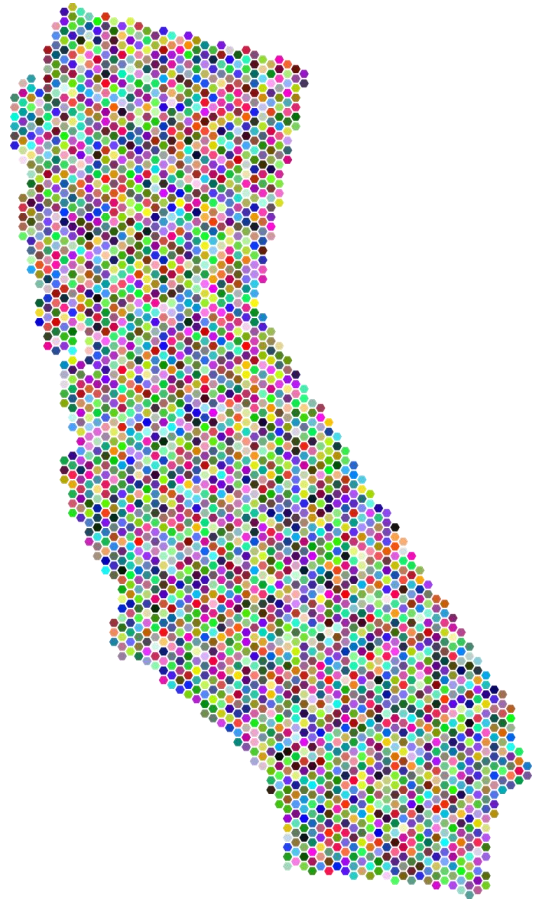
Nevada - Clark County Department of Environment and Sustainability: Las Vegas-Henderson-Paradise, NV Metro Area

Oregon/Washington - Oregon Metro: Portland-Vancouver-Hillsboro, OR-WA Metro Area

Washington - Puget Sound Clean Air Agency: Seattle-Tacoma-Bellevue, WA Metro Area

CPRG - California Agencies and Major Metropolitan Areas Receiving Planning Grants

- **Los Angeles County:** Los Angeles-Long Beach-Anaheim Metro Area
- **Bay Area Air Quality Management District:** San Francisco-Oakland-Berkeley Metro Area
- **San Bernardino County Transportation Authority:** Riverside-San Bernardino-Ontario, CA Metro Area
- **San Diego Association of Governments:** San Diego-Chula Vista-Carlsbad, Metro Area
- **Sacramento Metropolitan Air Quality Management District:** Sacramento-Roseville-Folsom Metro Area
- **County of Santa Clara:** San Jose-Sunnyvale-Santa Clara Metro Area
- **Fresno Council of Governments:** Fresno Metro Area
- **City of Bakersfield:** Bakersfield Metro Area
- **County of Ventura County Executive Office Sustainability Division:** Oxnard-Thousand Oaks-Ventura Metro Area



Full National List: https://www.epa.gov/system/files/documents/2023-04/NOIP%20Status%20Lists.pdf

EPA Funding Links

- **Search for and apply for federal grants**
  - **Grants.gov:** Clearinghouse for all federal grant opportunities, includes training and resources: https://www.grants.gov
  - **EPA Grants Office:** Training and resources on applying for grants: www.epa.gov/grants
- **Climate Pollution Reduction Grants**
  https://www.epa.gov/inflation-reduction-act/climate-pollution-reduction-grants
  - **Sign up for updates:** www.epa.gov/inflation-reduction-act/forms/stay-connected-climate-pollution-reduction-grants
- **Reducing Embodied Greenhouse Gas Emissions of Construction Materials and Products**
  https://www.epa.gov/inflation-reduction-act/inflation-reduction-act-programs-fight-climate-change-reducing-embodied
- **OPEN - Pollution Prevention Grants** https://www.epa.gov/p2/grant-programs-pollution-prevention
- **OPEN - Environmental Justice Grants, Funding and Technical Assistance**
  https://www.epa.gov/environmentaljustice/environmental-justice-grants-funding-and-technical-assistance
- **OPEN - Small Business Innovative Research – Includes Topic Area:** Innovative material reduction and reuse solutions to lower embodied carbon in the built environment https://www.epa.gov/SBIR

- What questions do you have?
- Are you interested in exploring embodied carbon CAP measures?
- What kind of resources would help your exploration?

Next Steps

The Built Environment Workgroup hopes to continue the conversation!

Please reach out if you would like to be part of our Workgroup

Email: joy.onasch@erg.com

West Coast Climate & Materials Management Forum

THANK YOU!

For more information, visit www.westcoastclimateforum.com

West Coast Climate
& Materials Management Forum