Embodied Carbon of Building Materials

Opportunities for carbon reduction

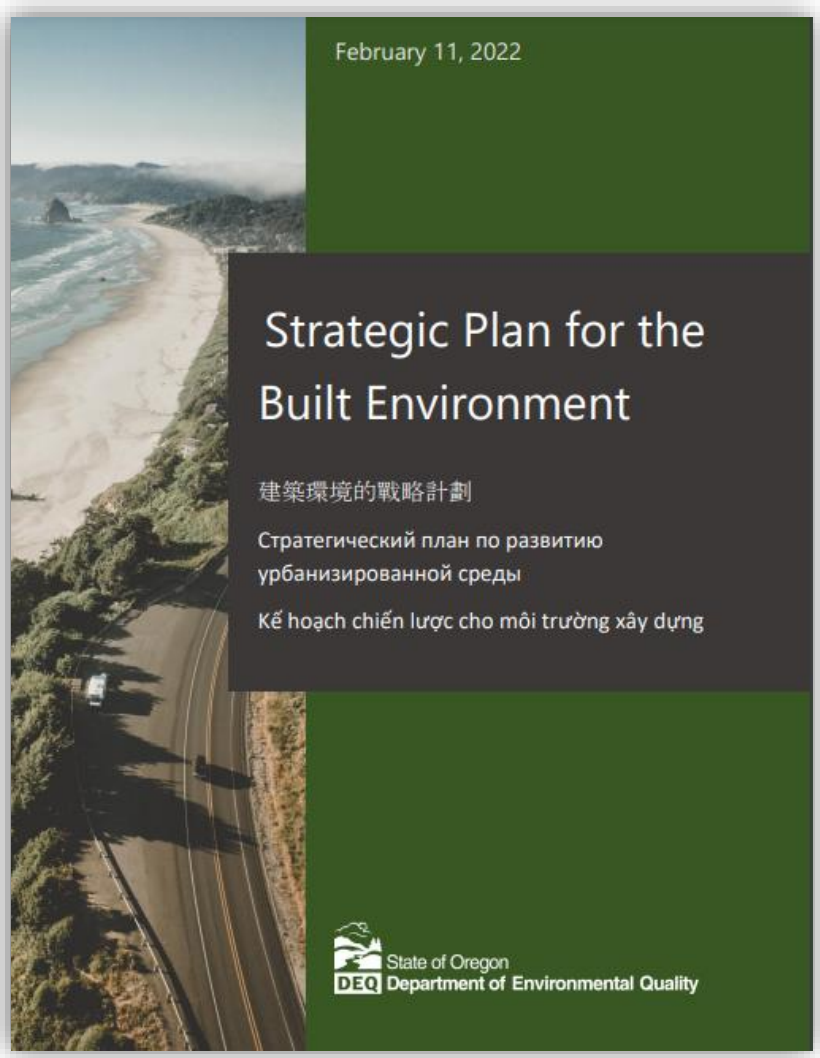
Resilient Efficient Buildings Task Force (SB 1518)

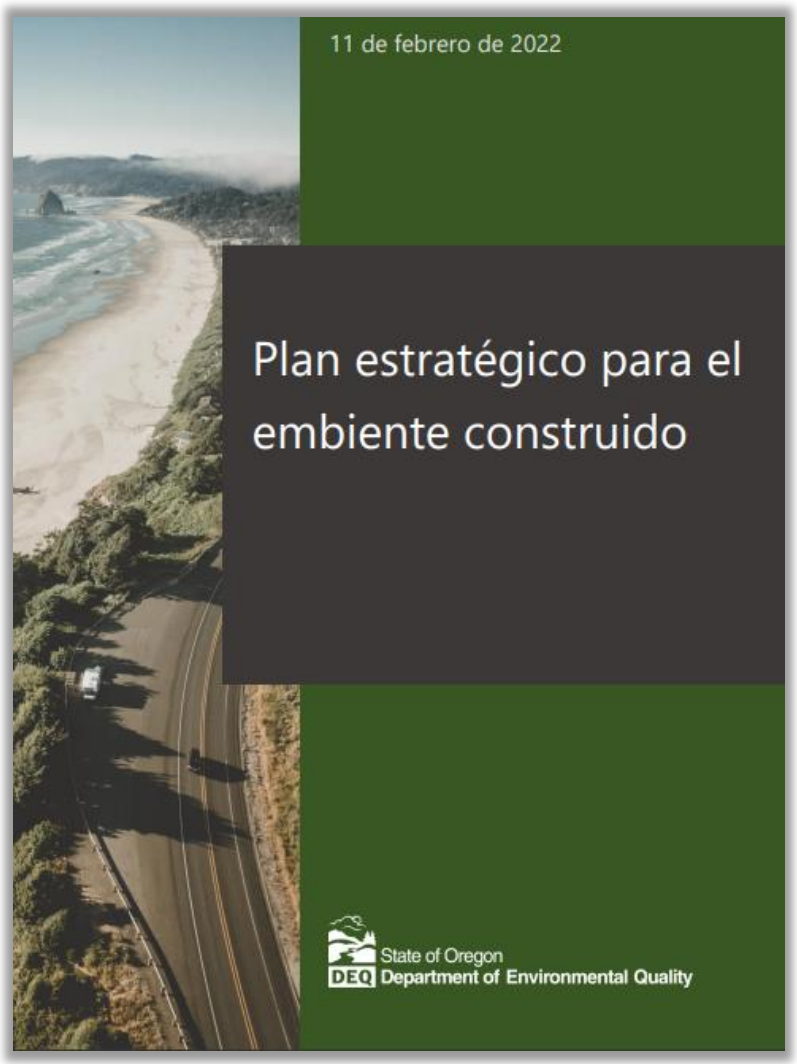
Amanda Ingmire + Jordan Palmeri

Oregon Department of Environmental Quality

4/19/22

DEQ's built environment program





Source: https://www.oregon.gov/deq/mm/production/Pages/Strategic-Plan.aspx

Overview

- What is embodied Carbon and why is it important?
- Opportunities for carbon reduction

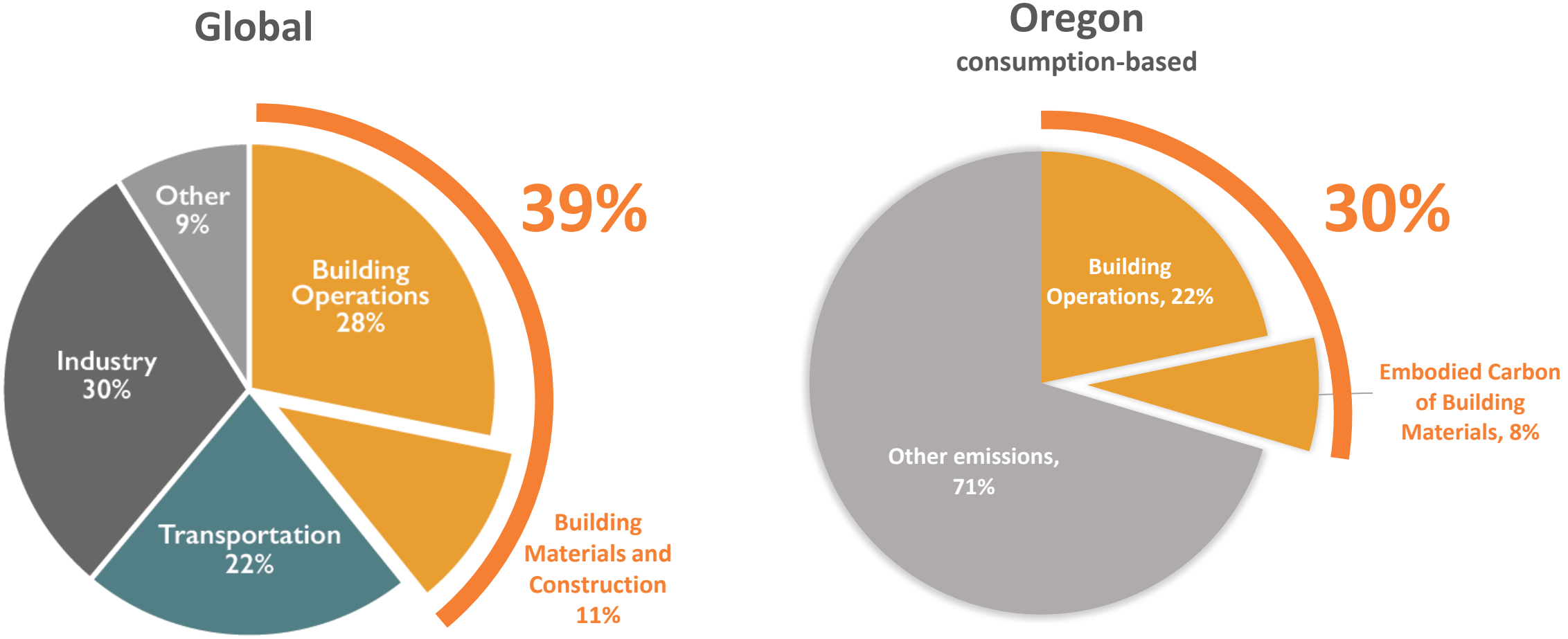
What is embodied carbon?

Greenhouse gas emissions from the manufacture, transport, installation, and disposal/recovery of construction materials

What is embodied carbon?

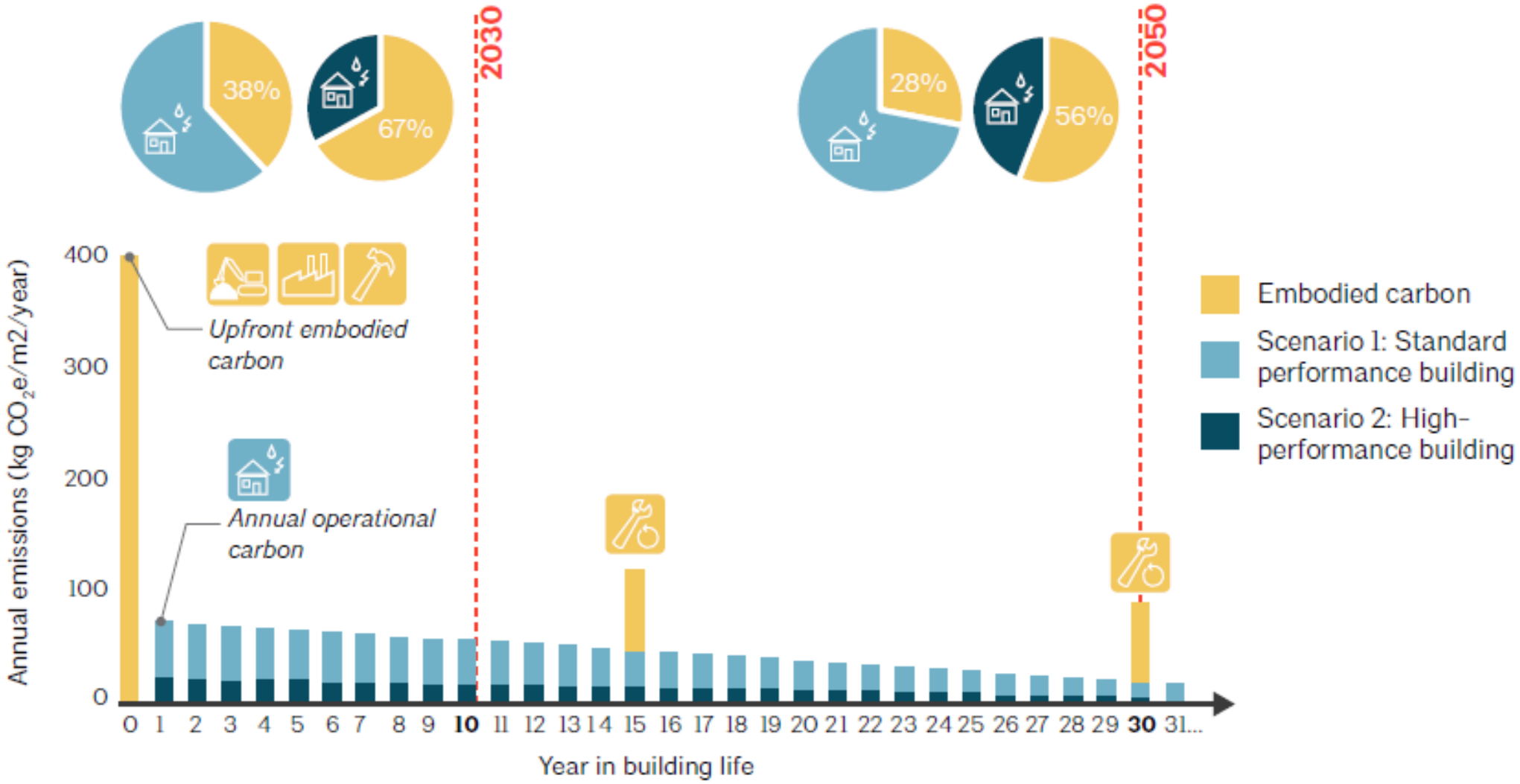
Source: Carbon Leadership Forum

Carbon emissions



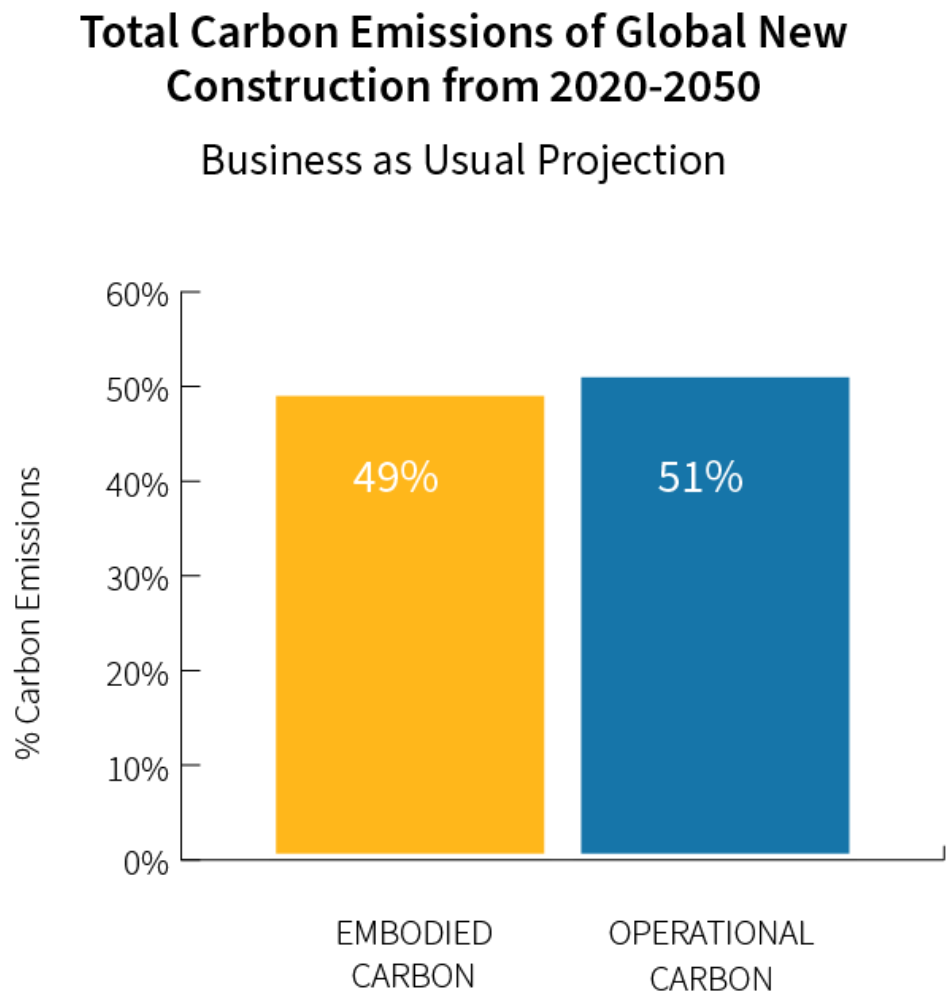
Source: Architecture 2030, DEQ 2018

Embodied and operational carbon



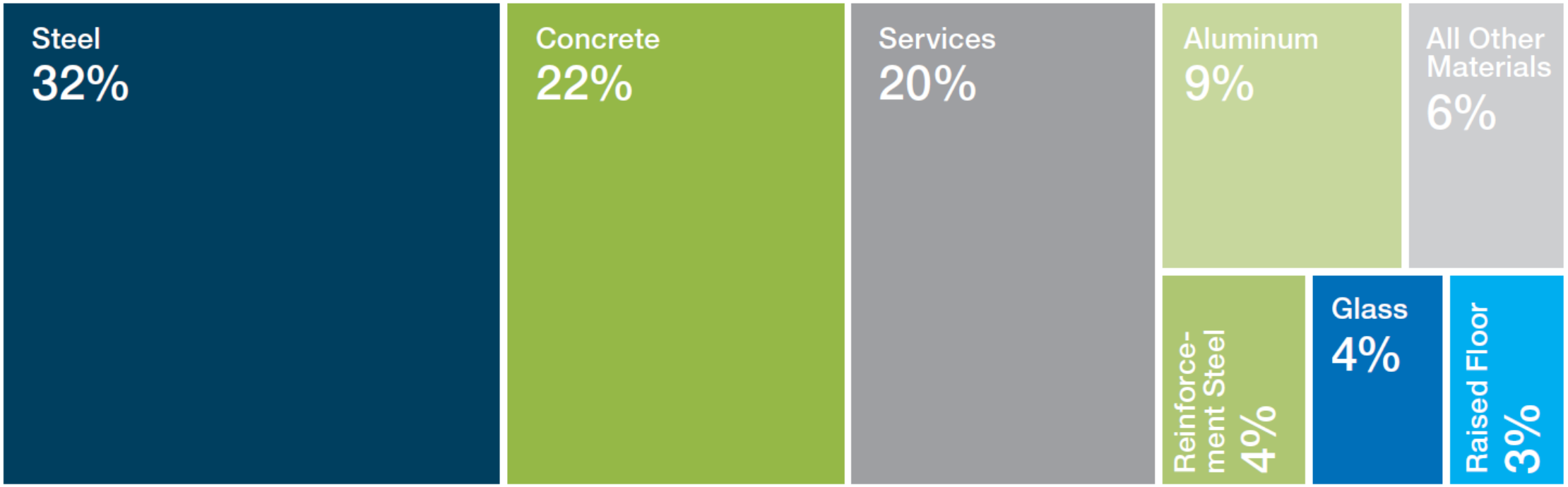
Source: Carbon Leadership Forum, Architecture 2030, UN Environmental Global Status Report 2017, EIA International Energy Outlook 2017, American Institute of Architects

Embodied and operational carbon



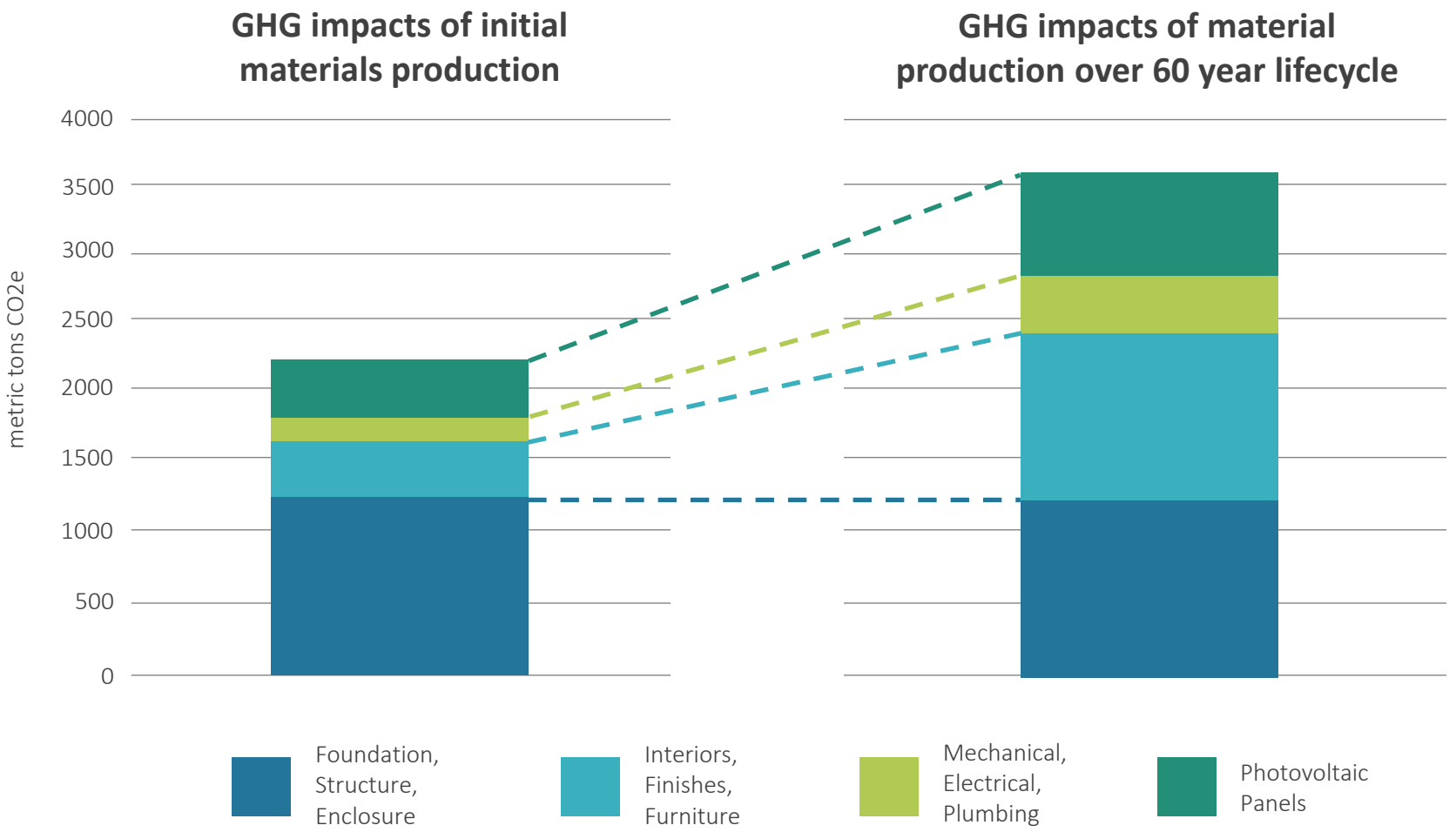
Source: Carbon Leadership Forum, Architecture 2030, UN Environmental Global Status Report 2017, EIA International Energy Outlook 2017, American Institute of Architects

Typical embodied carbon profiles



Source: New Buildings Institute, Arup

Embodied carbon profiles over 60-year lifecycle



Source: DEQ 2021

Opportunities to Reduce Embodied Carbon

Strategies to reduce embodied carbon

Most effective

Least effective

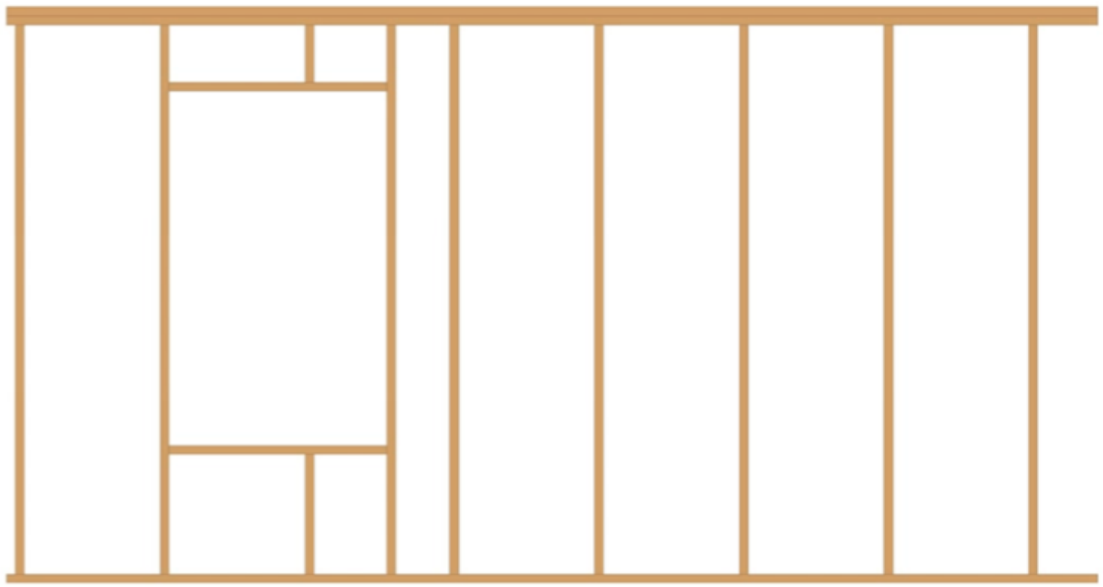
- Build less
- Reuse existing buildings
- Build smaller
- Reuse materials
- Optimize building
- Optimize materials
- Minimize waste
- Recover waste

Pathways for implementation

1. Building codes
2. Procurement

Building codes – using fewer materials

Advanced Framing



Air Admittance Valves

Building codes – allowing lower carbon materials

A2L refrigerants (lower carbon)

Salvaged Lumber R104.9.1

Strawbale Construction

Building codes – requiring lower carbon materials

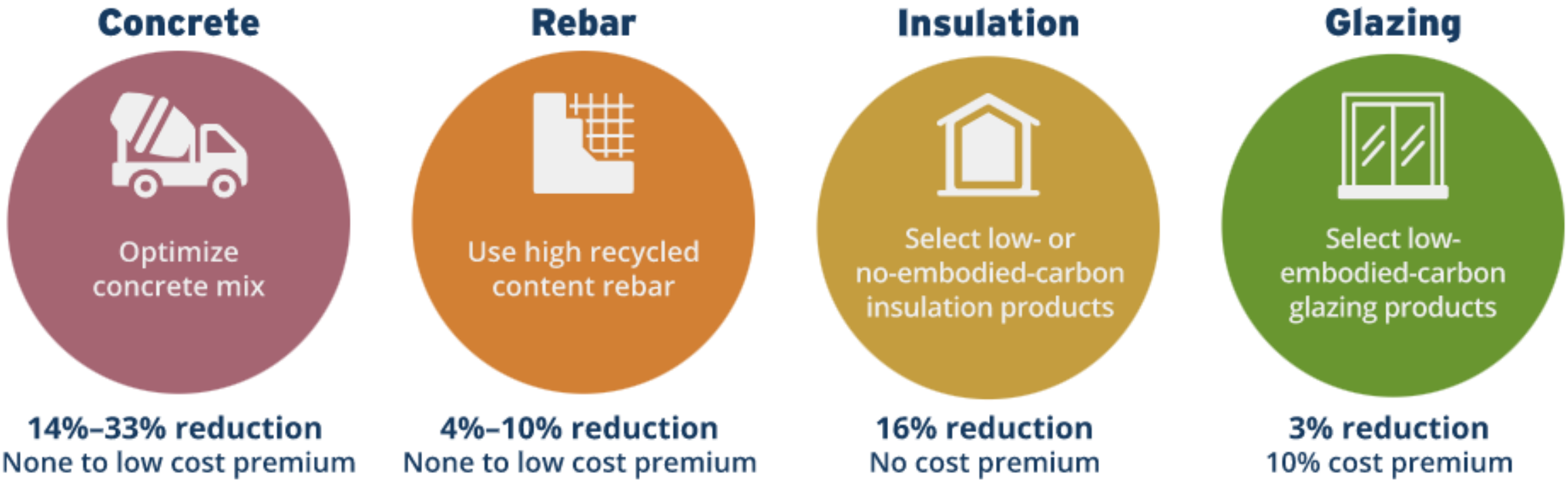
Carbon limits in code

- Marin County, CA
  - concrete

Proposed Carbon limits in code

- IBC
  - concrete + steel
- Denver Green Code
  - concrete + steel
- Washington IBC code
  - concrete + steel

Cost of lower carbon materials

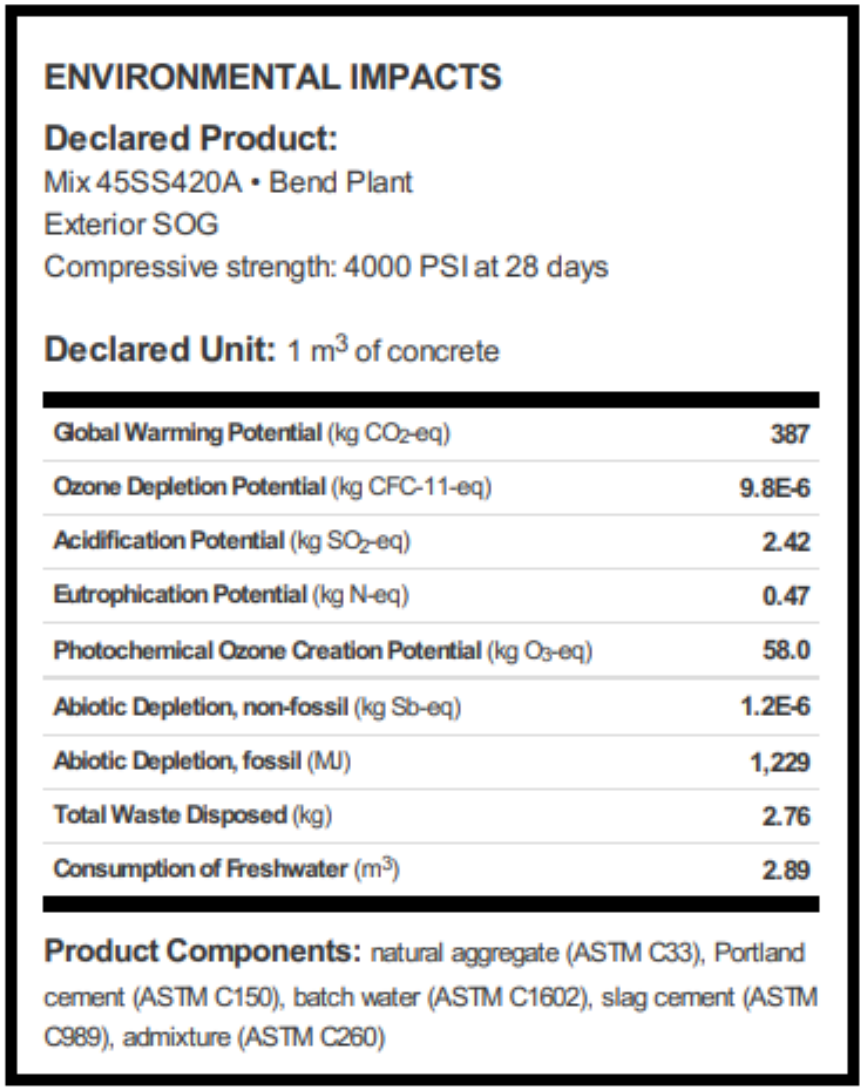


Source: RMI – Reducing Carbon in Buildings Report

Measuring carbon impacts of materials

What is an Environmental Product Declarations (EPD)?

- Disclosure label that reports the environmental impacts of products
- Typically include impacts of raw material extraction, transportation, and manufacturing
- Third party certified against ISO standards



ENVIRONMENTAL IMPACTS

Declared Product:
Mix 45SS420A • Bend Plant
Exterior SOG
Compressive strength: 4000 PSI at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	**387**
Ozone Depletion Potential (kg CFC-11-eq)	**9.8E-6**
Acidification Potential (kg SO_2-eq)	**2.42**
Eutrophication Potential (kg N-eq)	**0.47**
Photochemical Ozone Creation Potential (kg O_3-eq)	**58.0**
Abiotic Depletion, non-fossil (kg Sb-eq)	**1.2E-6**
Abiotic Depletion, fossil (MJ)	**1,229**
Total Waste Disposed (kg)	**2.76**
Consumption of Freshwater (m^3)	**2.89**

Product Components: natural aggregate (ASTM C33), Portland cement (ASTM C150), batch water (ASTM C1602), slag cement (ASTM C989), admixture (ASTM C260)

Additional detail and impacts are reported on page three of this EPD

How are EPDs used?

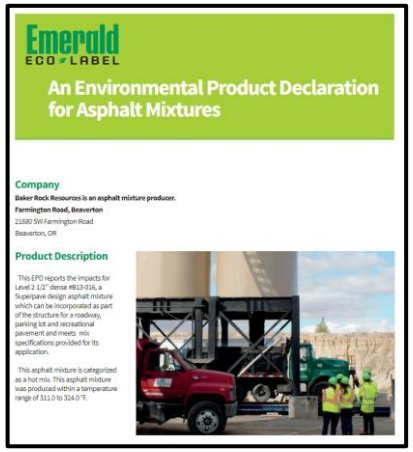
- Manufacturers
  - measure, baseline, and disclose environmental impacts
  - identify process improvement strategies
- Consumers –
  - choose lower impacts products
- Owners
  - achieve “points” in green building/transit rating systems

EPDs from Oregon manufacturers

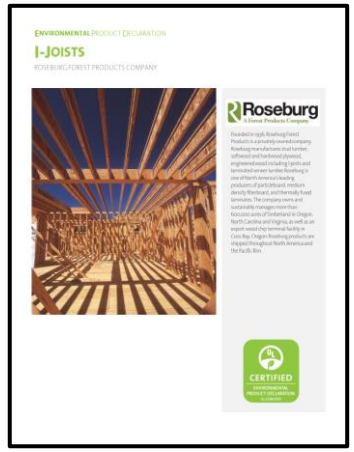
Steel re-bar

Drywall

Doors



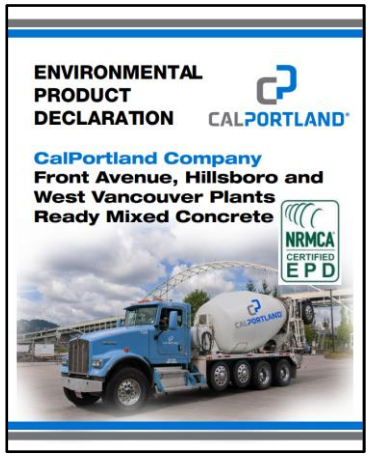
Asphalt



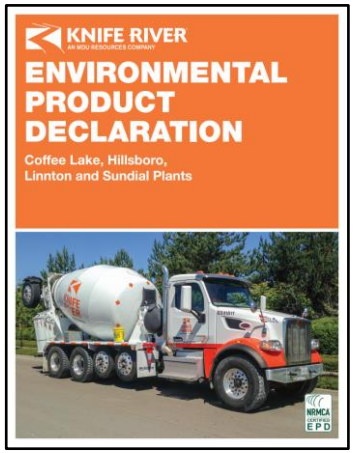
Wood

Mass timber

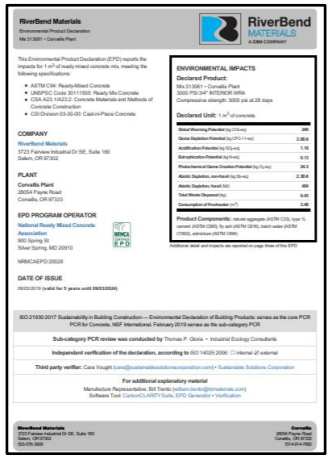
Oregon Concrete EPD Program (2017 – 2020)



CalPortland



Knife River

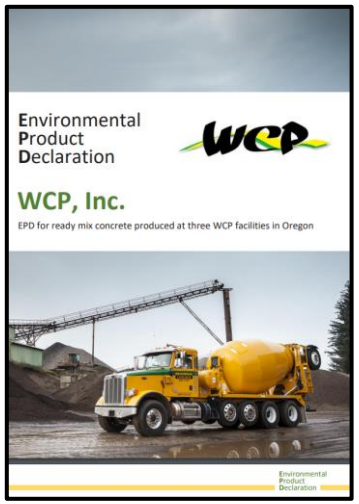


RiverBend

- 10 companies
- 21 central batch plants
- 4 mobile mix plants
- Over 1500 EPDs produced

Hooker Creek

Cadman

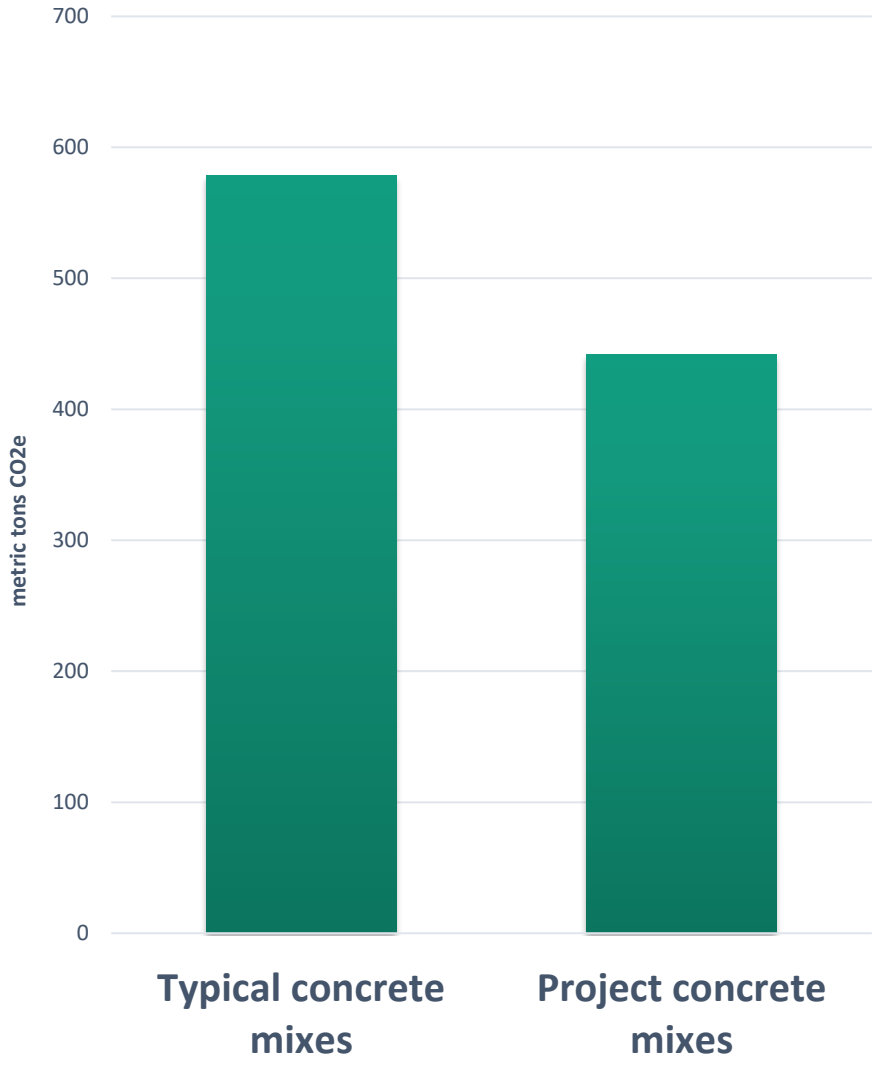


Wilsonville

OCAPA

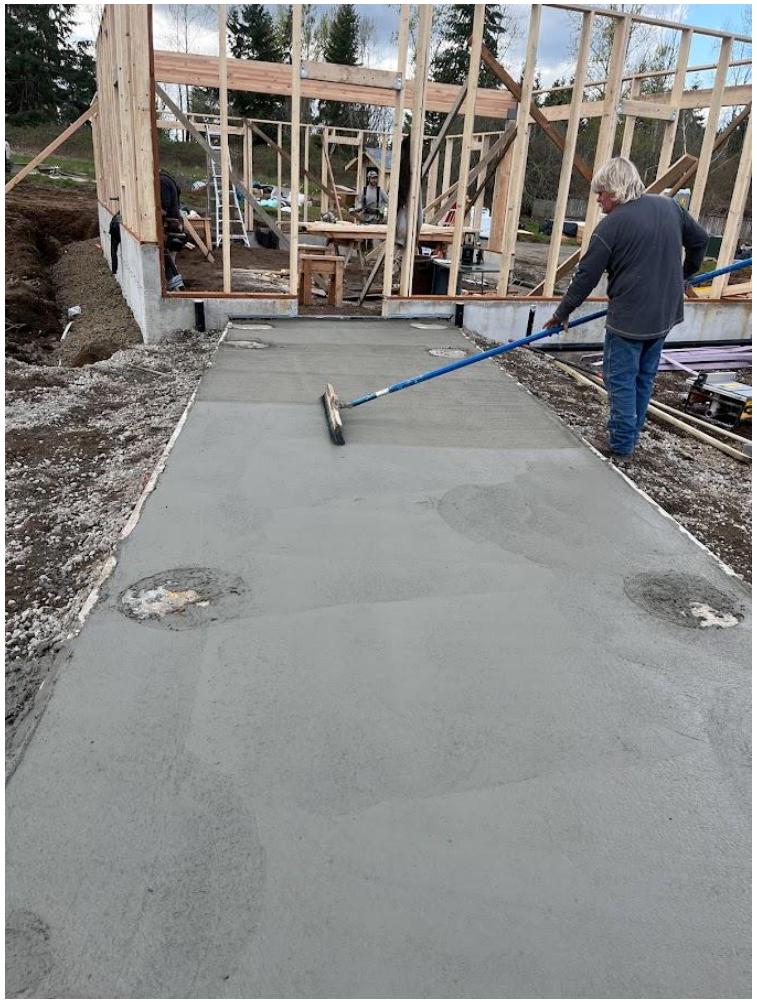
DEQ
State of Oregon
Department of
Environmental
Quality

Concrete Carbon reduction using EPDs - commercial



Mill Creek Resiliency Building – Oregon State Treasury

Concrete Carbon reduction using EPDs - residential

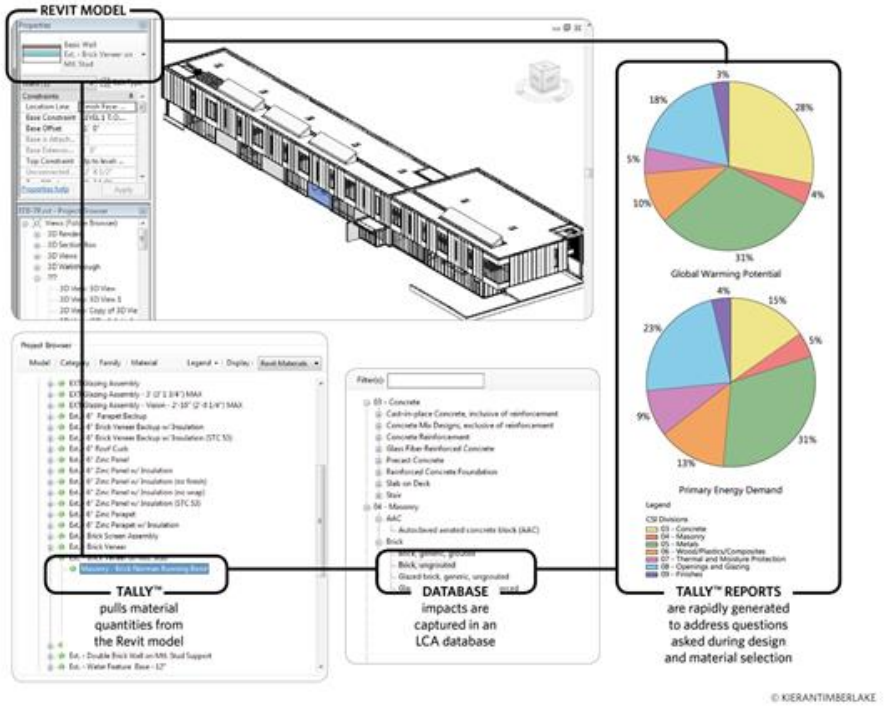


Birdsmouth Design Build

Building Codes – material vs. building scale

Material Scale

Building Scale



Procurement

Lower embodied carbon materials

Environmental Product Declarations (EPDs) for public purchasing

BUY CLEAN

<u>Other State Efforts:</u>

- New York
- Washington
- Minnesota
- New Jersey

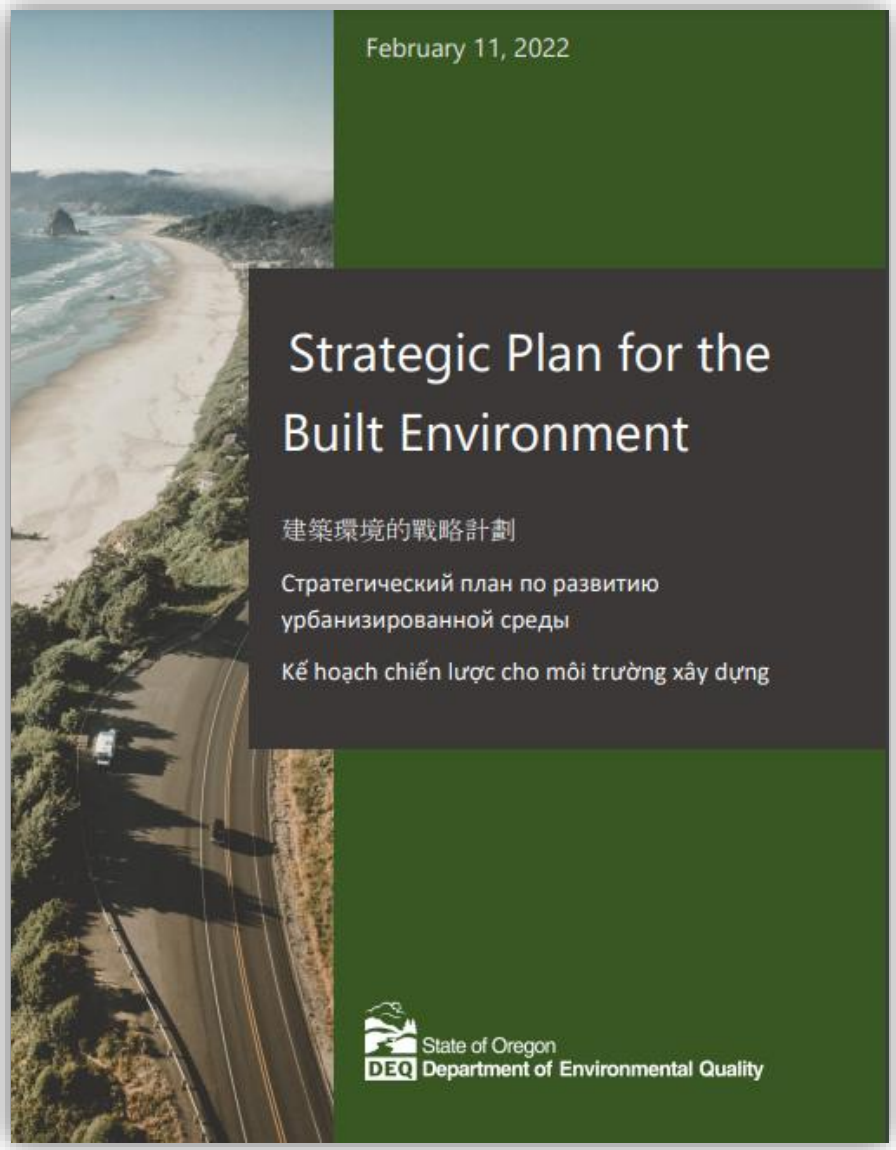
<u>Federal Efforts:</u>

- Buy clean Procurement Requirements

City of Portland Concrete Procurement Policy

- Jan 1, 2020
  - EPDs required on all City projects
- July 1, 2022
  - City publishes GWP threshold
- January 1, 2023
  - All EPDs must be below threshold

Policy: https://www.portlandoregon.gov/brfs/article/731696



Amanda Ingmire
amanda.ingmire@deq.oregon.gov

Jordan Palmeri
jordan.palmeri@deq.oregon.gov

https://www.oregon.gov/deq/mm/production/Pages/Built-Environment.aspx