



West Coast Climate & Materials Management Forum

4 February 2020

**Local Government Policies to Drive
Low-Carbon Concrete**

West Coast Climate and Materials Management Forum

The West Coast Climate and Materials Management Forum is a collaboration of state, local, and tribal government

- ▣ Develop ways to institutionalize sustainable materials management practices.
- ▣ Develop tools to help jurisdictions reduce the GHGs associated with materials



Check out the Forum's Resources

- [Original Report Connecting Materials/Climate](#)
- [Research Summaries](#)
- [Turn-key Materials Management Presentation](#)
- [Climate Action Toolkit](#)
- [Food: Too Good to Waste Toolkit](#)
- [Climate Friendly Purchasing Toolkit](#)
- [Reducing GHGs Through Composting and Recycling](#)

www.westcoastclimateforum.com



West Coast Climate
& Materials Management Forum

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.

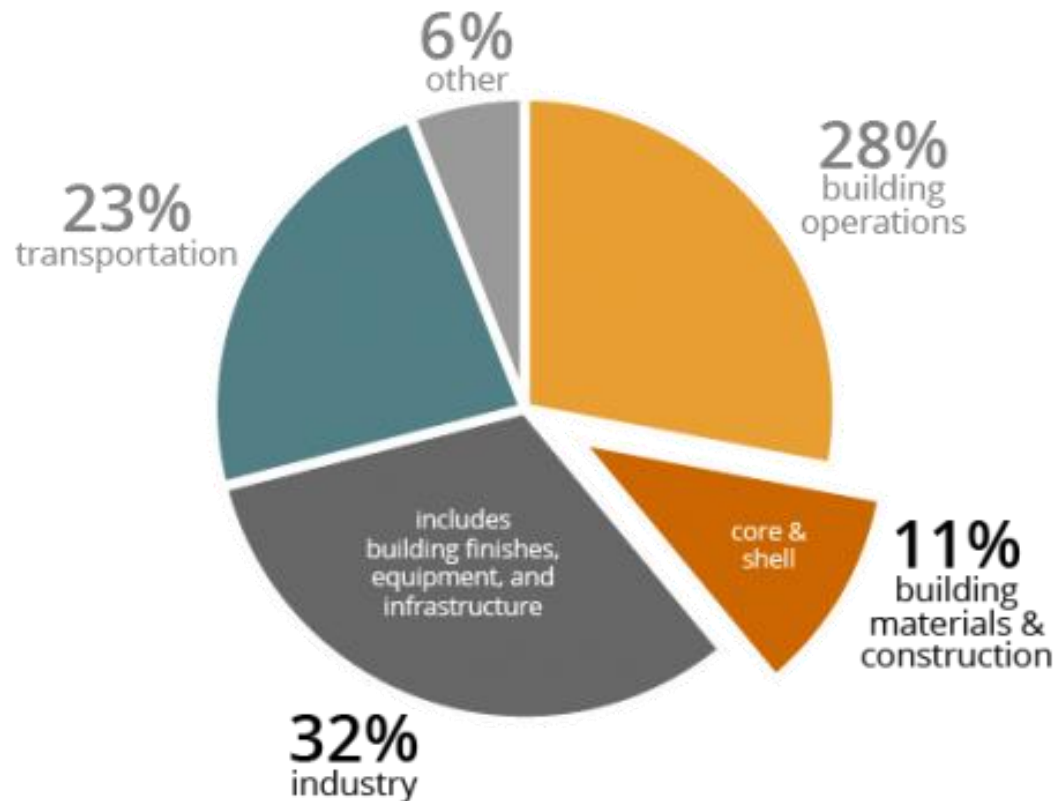
Please note the opinions, ideas, or data presented by speakers in this series do not represent West Coast Climate and Materials Management Forum members policy or constitute endorsement by the forum.

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West Coast Climate
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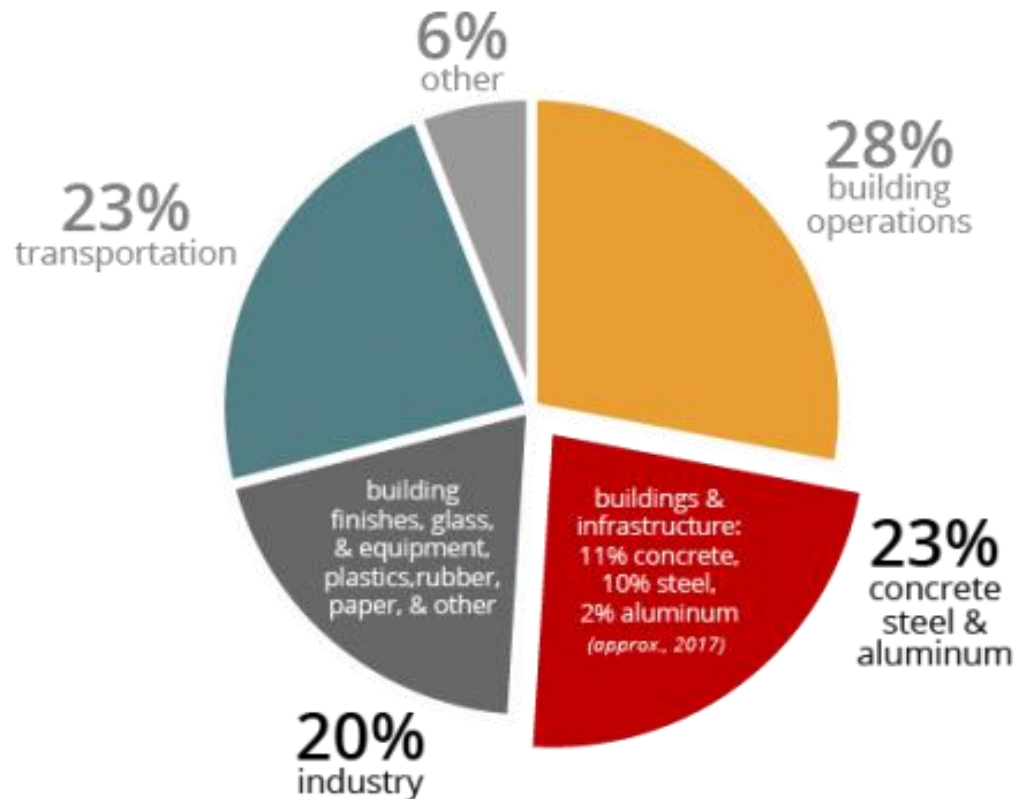
Global CO2 Emissions by Sector



Source: Architecture 2030 materialspalette.org
Data Sources: Global Alliance for Buildings and Construction, *2018 Global Status Report*; IEA.

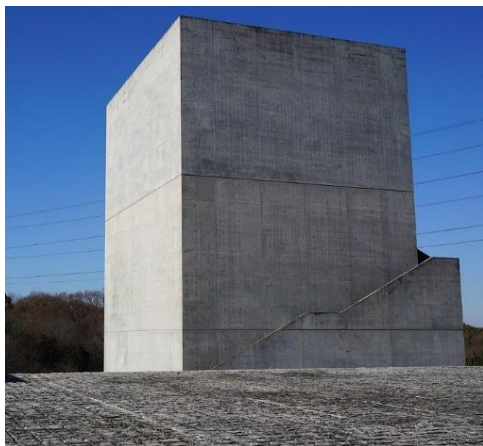


Global CO2 Emissions by Sector



Source: Architecture 2030 materialspalette.org
Data Sources: Global Alliance for Buildings and Construction, 2018 *Global Status Report*; IEA.





Concrete is the most widely used construction material in the world and is responsible for 6-10% of global anthropogenic carbon dioxide (CO₂) emissions*. Proven alternative technologies and practices are readily available in the marketplace that can reduce these emissions by more than half.

*Source: Architecture 2030

(<https://materialpalette.org/concrete/>)

4 February 2020



West Coast Climate
& Materials Management Forum

Today's Speakers



Jordan Palmeri
Oregon Department of
Environmental Quality



Alice Zanmiller
Marin County, CA



Karen Cook
Alameda County



Stacey Foreman
City of Portland



Local Government Policies to Drive Low-Carbon Concrete

West Coast Climate and Materials Management Forum



State of Oregon
Department of
Environmental
Quality

Jordan Palmeri

Oregon Department of Environmental Quality

2/4/20

Why focus on carbon reductions in concrete?

BUILDINGS



- Large consumption volumes
- Big carbon impacts for public institutions
- Directly within your control
- Available cost neutral opportunities now
- Influences surrounding community

INFRASTRUCTURE



What's in concrete?

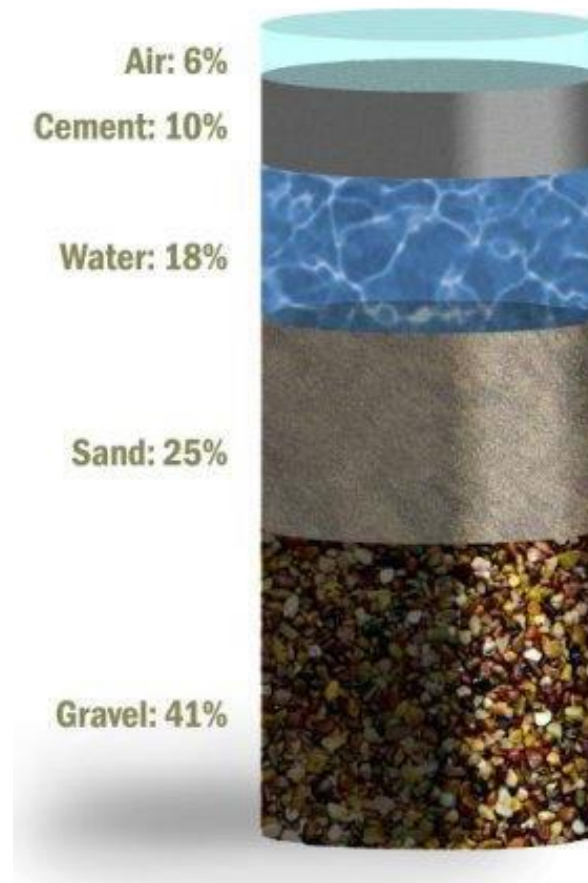
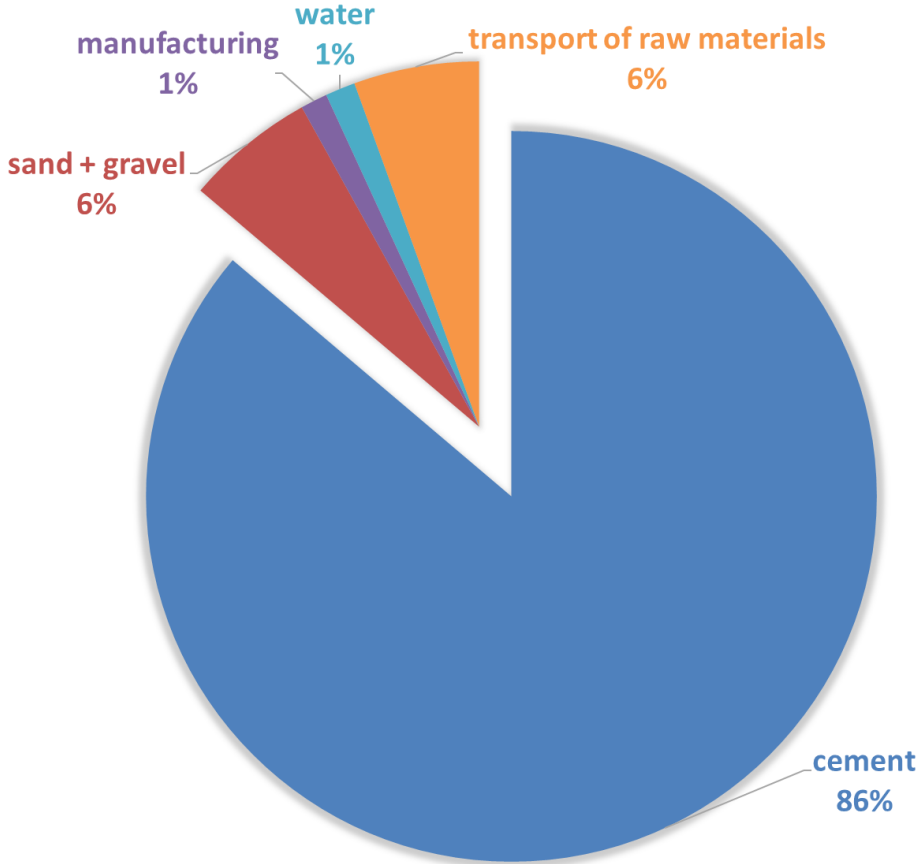
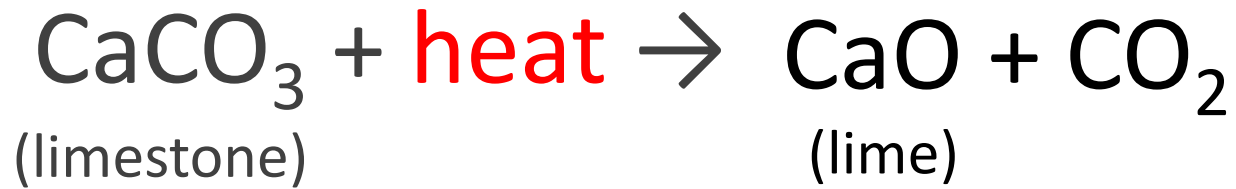
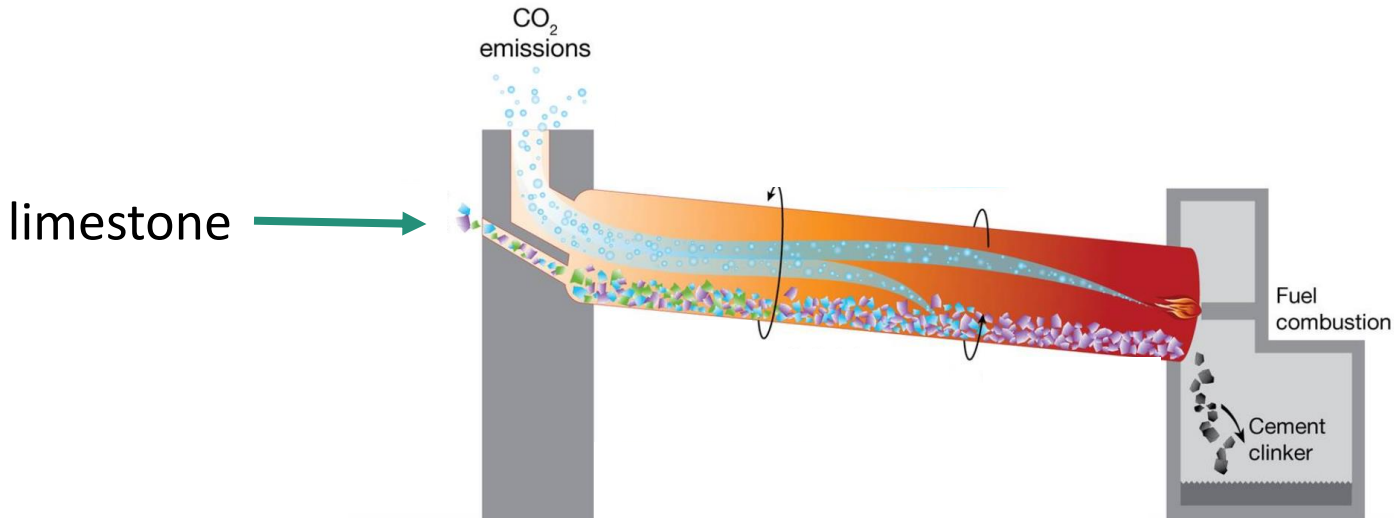


Image: <https://www.greenconcrete.info/local.html>

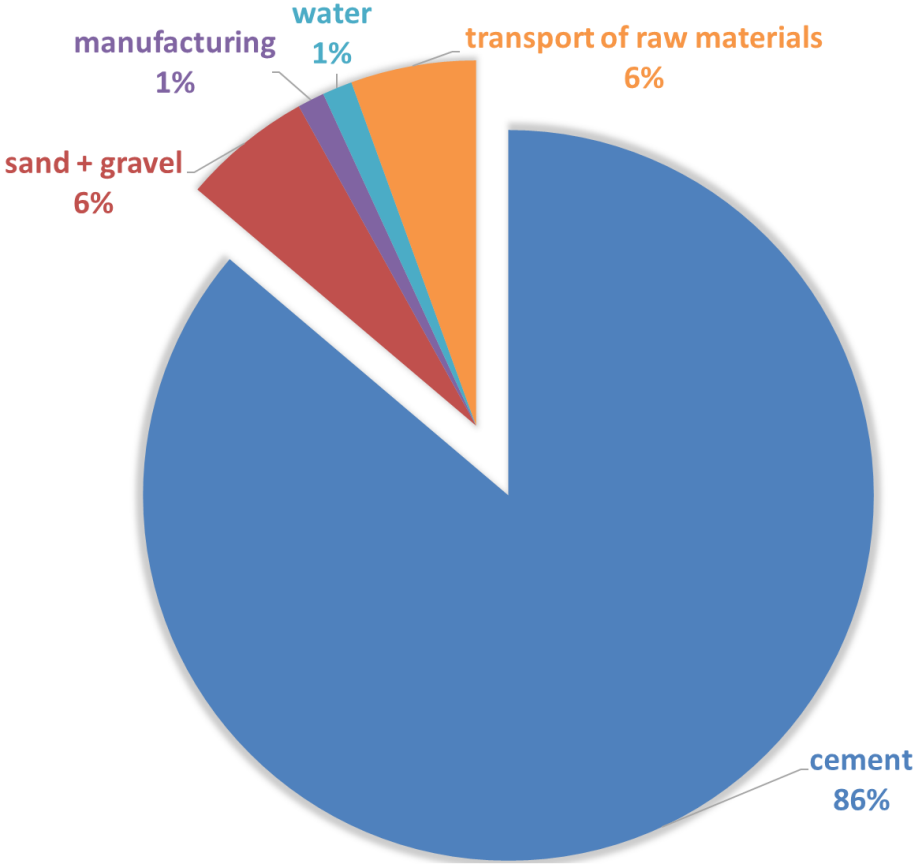
Concrete's carbon impact



Cement is carbon intensive



Concrete's carbon impacts



Supplementary Cementitious Materials (SCMs)

Slag



Fly ash



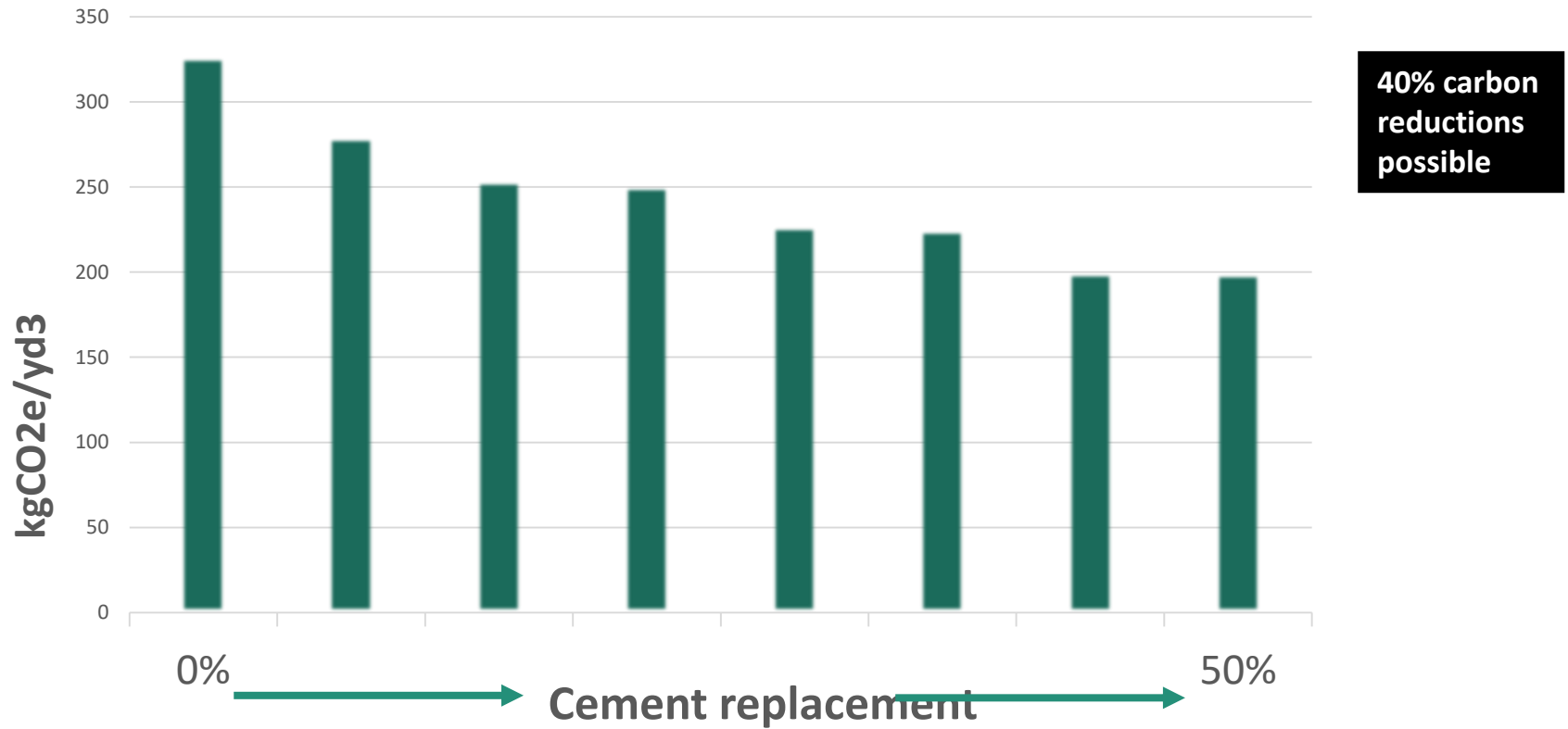
Ground glass pozzolan



Metakaolin clay



2019 average US carbon impact of 4000 psi concrete



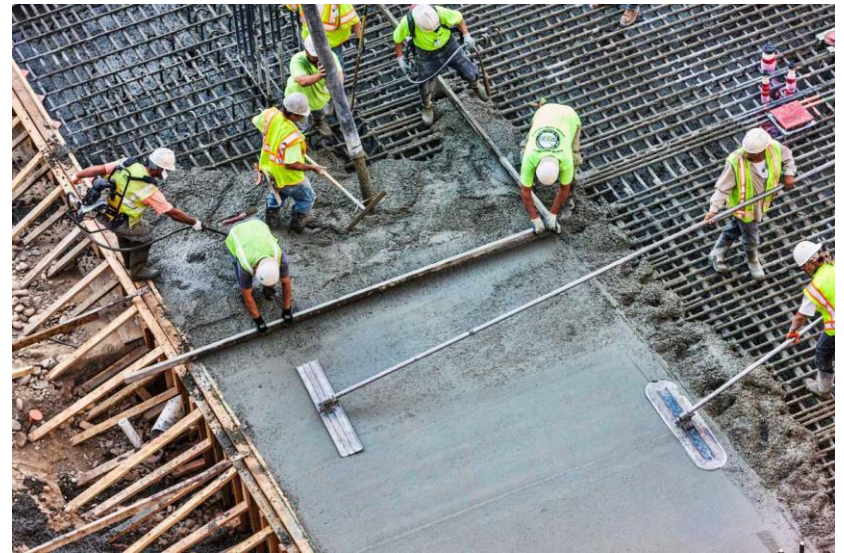
Barriers to low carbon mixes

Slow strength gain!



Additional carbon reduction strategies

- Portland Limestone Cement
- Sourcing lower impact cements
- Injected CO₂ mineralization
- Closed chamber cured cements
- Use hard, clean, and strong aggregates
- CO₂ sequestering aggregate
- High strength re-bar
- Others!!



Understanding the impacts of different concrete mixes

Two options discussed today:

1. Cement content
2. Environmental Product Declarations (EPD)



Environmental Product Declarations (EPDs)

RiverBend Materials

Environmental Product Declaration
Mix 313061 • Corvallis Plant



RiverBend
MATERIALS
A CRH COMPANY

This Environmental Product Declaration (EPD) reports the impacts for 1 m³ of ready mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSA A23.1/A23.2: Concrete Materials and Methods of Concrete Construction
- CSI Division 03-30-00: Cast-in-Place Concrete

COMPANY

RiverBend Materials

3723 Fairview Industrial Dr SE, Suite 160
Salem, OR 97302

PLANT

Corvallis Plant

28054 Payne Road
Corvallis, OR 97333

EPD PROGRAM OPERATOR

National Ready Mixed Concrete Association

900 Spring St
Silver Spring, MD 20910



ENVIRONMENTAL IMPACTS

Declared Product:

Mix 313061 • Corvallis Plant
3000 PSI 3/4" INTERIOR WRA
Compressive strength: 3000 psi at 28 days

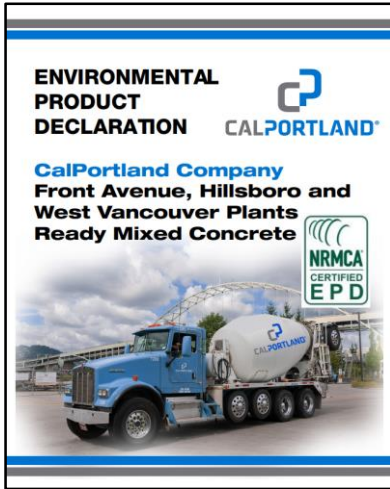
Declared Unit: 1 m³ of concrete

Global Warming Potential (kg CO ₂ -eq)	240
Ozone Depletion Potential (kg CFC-11-eq)	3.0E-6
Acidification Potential (kg SO ₂ -eq)	1.18
Eutrophication Potential (kg N-eq)	0.13
Photochemical Ozone Creation Potential (kg O ₃ -eq)	24.3
Abiotic Depletion, non-fossil (kg Sb-eq)	2.3E-6
Abiotic Depletion, fossil (MJ)	404
Total Waste Disposed (kg)	0.43
Consumption of Freshwater (m ³)	3.48

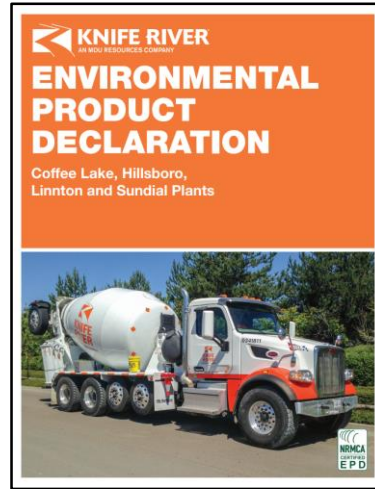
Product Components: natural aggregate (ASTM C33), type 1L cement (ASTM C595), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494)

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

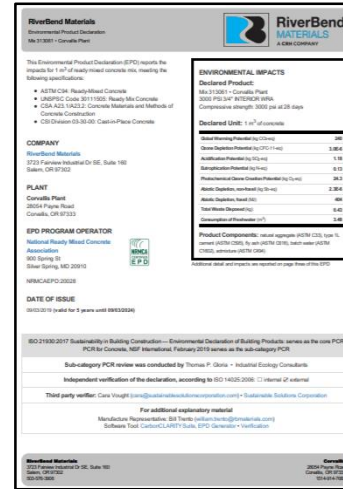
Oregon Concrete EPD Program



CalPortland



Knife River



RiverBend



Hooker Creek



Reimbursements:

- \$2,500 / plant

Low carbon concrete-related policies

Policies

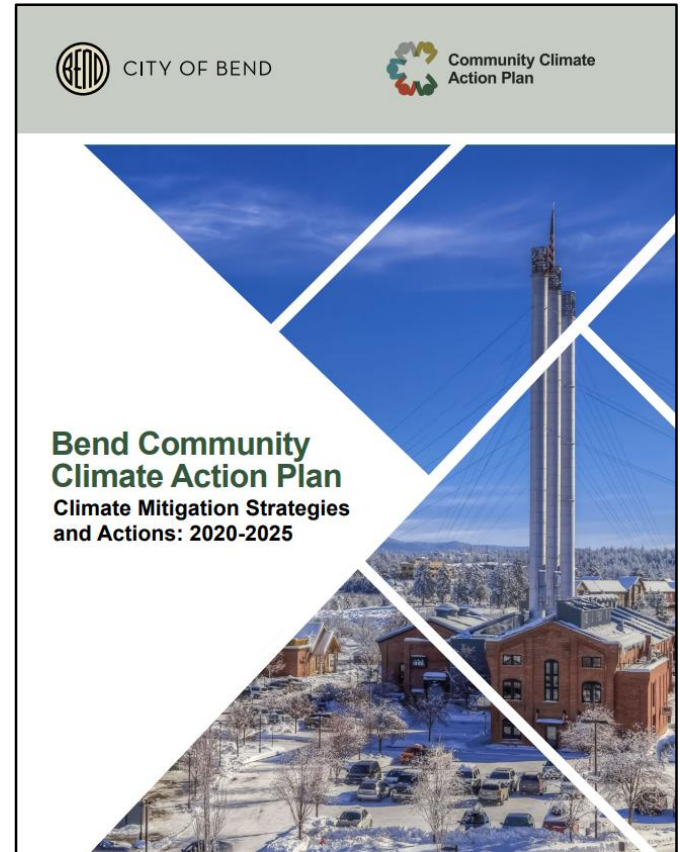
- Marin County
- City of Portland
- Buy Clean CA (w/o concrete)
- Buy Clean MN (w/o concrete)*
- Buy Clean WA*
- New York State*
- Sound Transit Authority
- Climate Action plans!

* in development



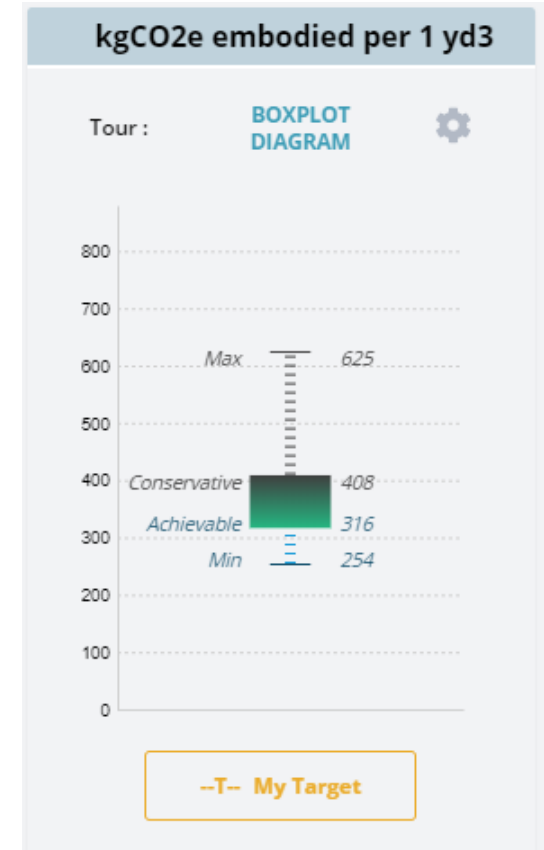
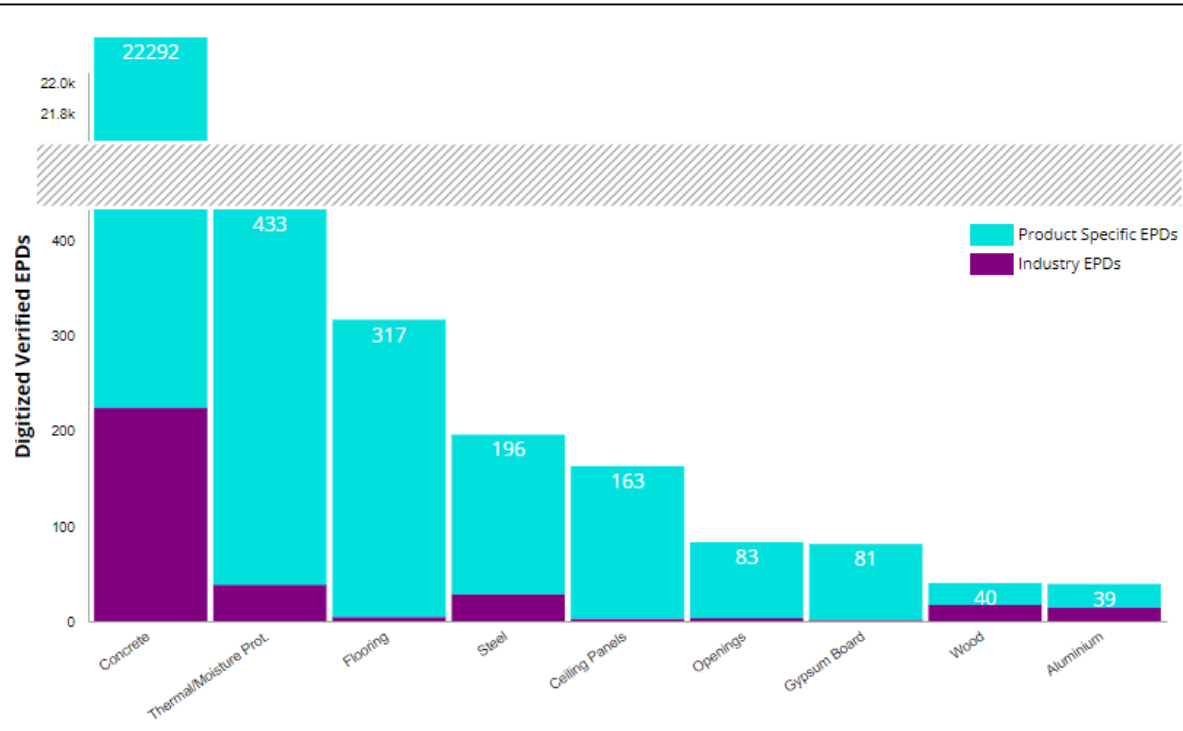
City of Bend, OR

Utilize low-carbon concrete mixes in City projects and create incentives to encourage developers to utilize low-carbon concrete




Tools

Embodied Carbon in Construction Calculator (EC3)



<https://buildingtransparency.org/dashboard>

Regional Benchmarks – National Ready Mix Concrete Association



Athena
Sustainable Materials
Institute

www.athenasmi.org

Appendix D: NRMCA Member National and Regional LCA
Benchmark (Industry Average) Report – V 3.0

Summary: Appendix D is intended for use by NRMCA members, who participated in the IW-EPD, that have developed product specific third-party verified LCAs and/or EPDs to compare the environmental impacts of their products with industry average impacts.

November 2019




Table B5-Pacific Northwest Benchmark Mix Designs (per cubic yard)

Compressive Strength	psi	2500	3000	4000	5000	6000	8000	3000 LW	4000 LW	5000 LW
Portland Cement	lbs	362	406	500	619	655	791	407	500	597
Fly Ash	lbs	93	105	129	159	169	204	105	129	154
Slag Cement	lbs	11	13	16	19	21	25	13	16	19
Mixing Water	lbs	302	302	302	313	339	339	306	306	306
Crushed Coarse Aggregate	lbs	135	133	129	121	125	117	0	0	0
Natural Coarse Aggregate	lbs	1,695	1,663	1,614	1,518	1,566	1,469	0	0	0
Crushed Fine Aggregate	lbs	79	78	75	71	73	69	71	63	56
Natural Fine Aggregate	lbs	1,340	1,315	1,277	1,200	1,238	1,162	1,200	1,072	956
Man. Lightweight Aggregate	lbs	0	0	0	0	0	0	1,060	1,070	1,070
Air %	%	6%	6%	6%	6%	6%	0	6%	6%	2%
Air Entraining Admixture	oz	1	1	1	1	1	1	1	1	0
Plasticizer & Superplasticizer	oz	3	3	3	7	3	3	3	7	7
Set Accelerator	oz	25	20	15	10	25	20	15	10	10
Total Weight	lbs	4,018	4,014	4,042	4,019	4,186	4,176	2,101	2,085	2,088

Custom mix design tool:

<https://www.slagcement.org/sustainability/ifecycleassessmentcalculator.aspx>

https://www.nrmca.org/sustainability/EPDProgram/Downloads/NRMCA_REGIONAL_BENCHMARK_Nov2019.pdf

materials management

conserving resources · protecting the environment · living well

Jordan Palmeri | jordan.palmeri@state.or.us

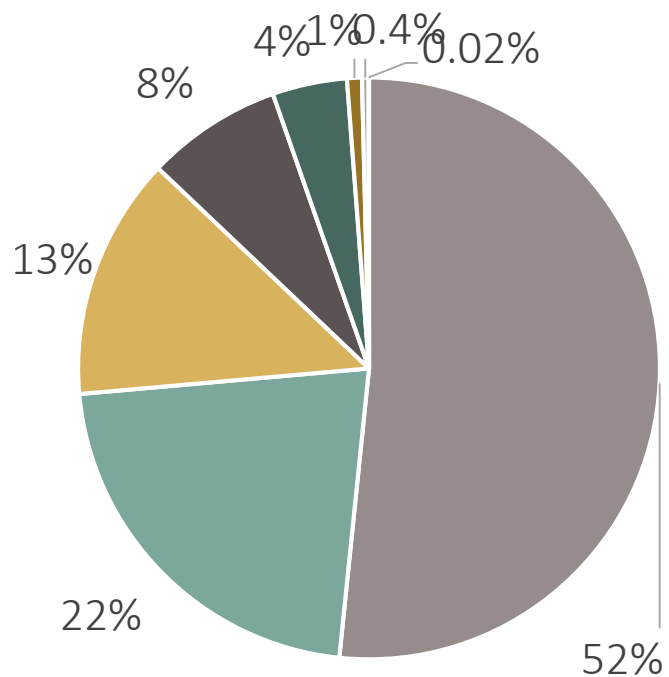
503-229-6766

BAY AREA LOW CARBON CONCRETE CODE

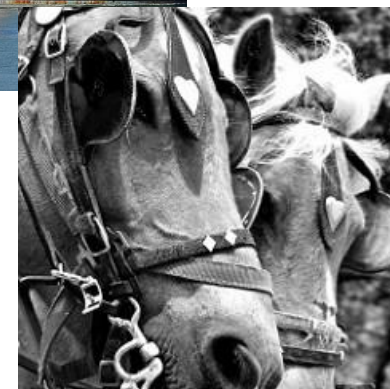


This work is funded through a Climate Protection Grant from the Bay Area Air Quality Management District. The opinions, findings, conclusions, and recommendations are those of the author and do not necessarily represent the views of the District. The District, its officers, employees, contractors, and subcontractors make no warranty, expressed or implied, and assume no legal liability for the information in this report.

LOCAL CLIMATE ACTION CONTEXT – WHAT'S MISSING?



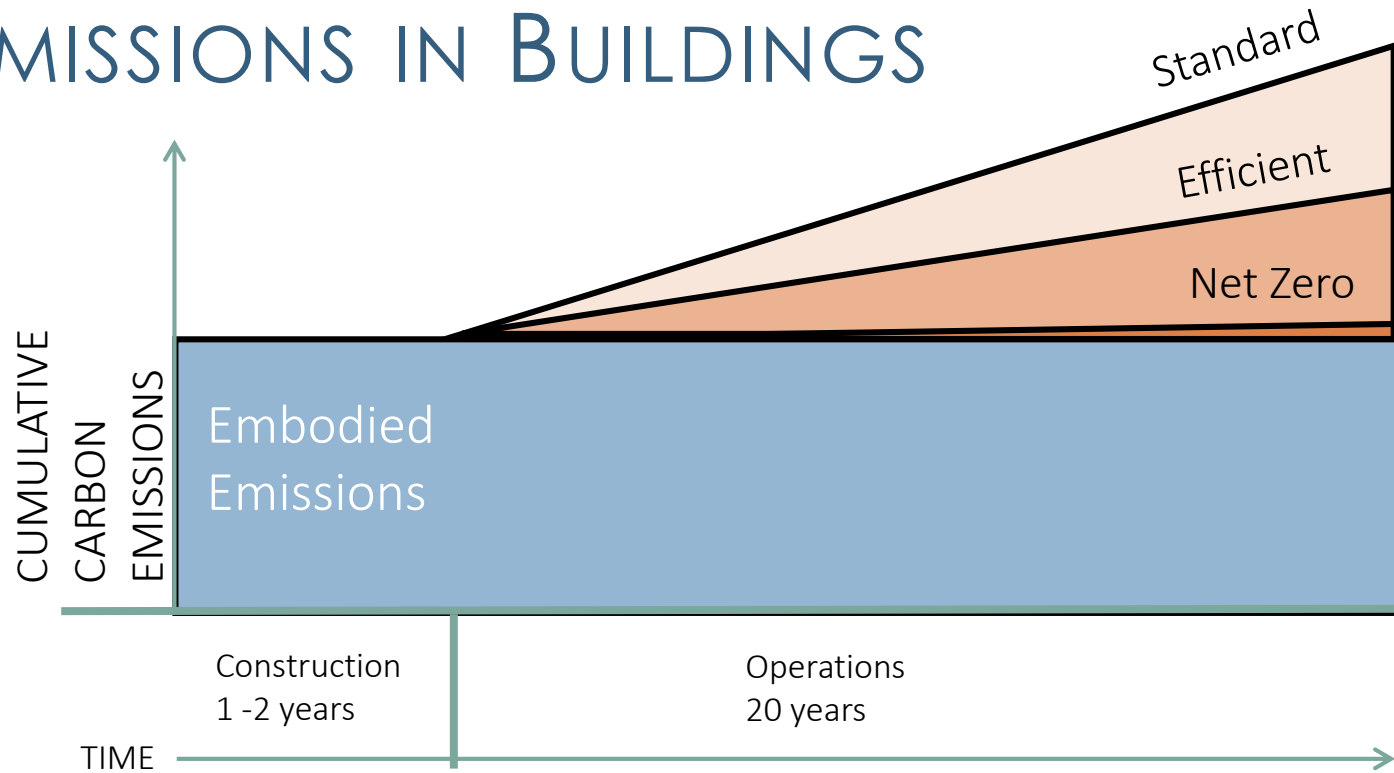
- Transportation
- Residential Energy
- Nonresidential Energy
- Agriculture
- Waste



<https://www.flickr.com/photos/viennacafe/586560250>

[https://commons.wikimedia.org/wiki/File:YM_Wealth_\(ship,_2004\)_002.jpg](https://commons.wikimedia.org/wiki/File:YM_Wealth_(ship,_2004)_002.jpg)

EMBODIED VS. OPERATIONAL CARBON EMISSIONS IN BUILDINGS



Source: Larry Strain, Siegel & Strain Architects

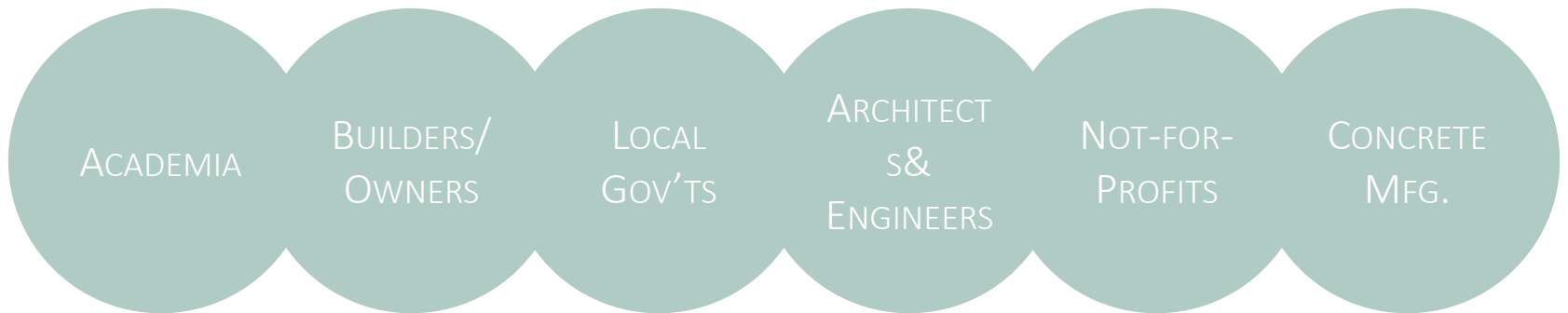
BAY AREA LOW CARBON CONCRETE CODE

- Funded by BAAQMD's 2018 Climate Protection Grant Program under "Fostering Innovative Strategies with long-term impacts in reducing GHG emissions."
- A first-of-its-kind effort to address embodied emissions in an area of local government control.
- Partnership with local government, engineers, and academia, as well as a robust stakeholder group.



BAY AREA LOW CARBON CONCRETE CODE

- Formation of a Bay Area Concrete Working Group as an extension of the Embodied Carbon Network



BAY AREA LOW CARBON CONCRETE CODE

- Model code language for adoption by local governments
 - Low embodied-carbon concrete specifications for residential and non-residential applications
 - **Adopted unanimously by County of Marin on November 19, 2019**
- Opportunity for these standards to be adopted across Bay Area jurisdictions; and for the framework to be replicated beyond our region.

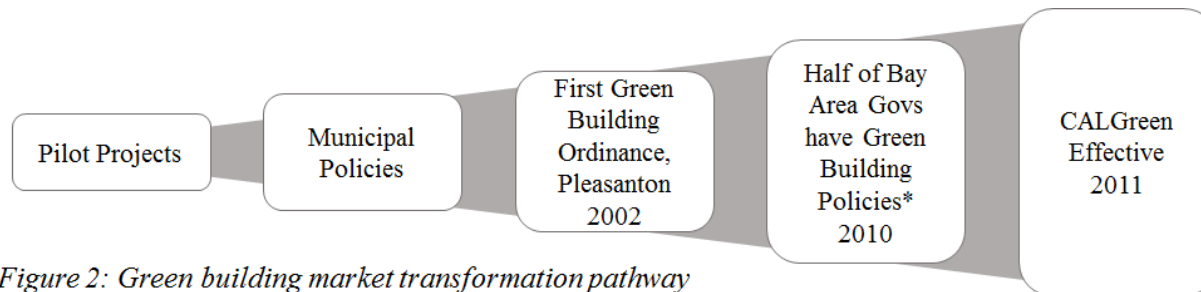


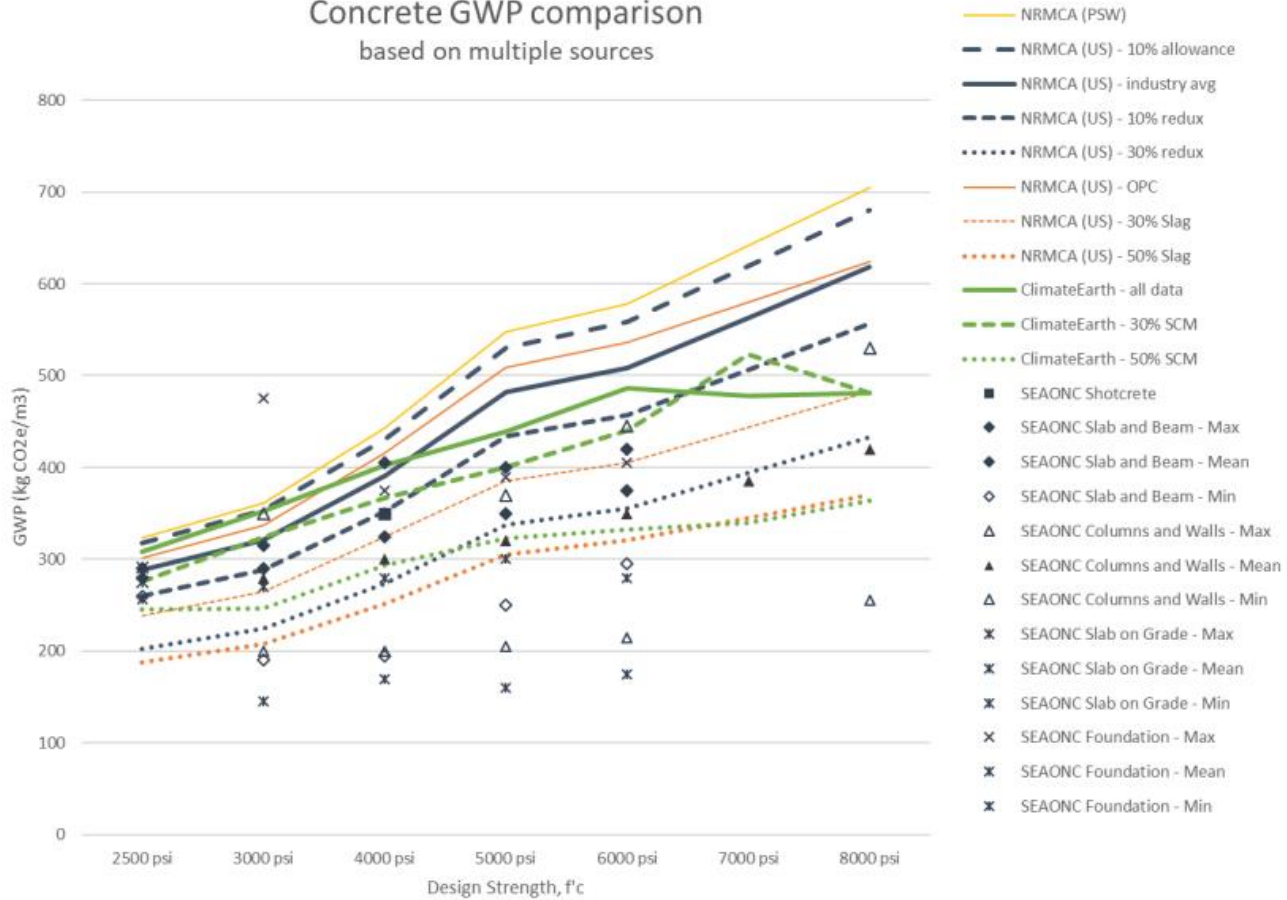
Figure 2: Green building market transformation pathway

* Bay Area Regional Collaborative Bay Area Green Building Policy Assessment Aug. 20, 2010

BAY AREA LOW CARBON CONCRETE CODE

	Cement limits	Embodied Carbon limits
Minimum specified compressive strength f'_c , psi	Maximum ordinary Portland cement content, lbs/yd ³ (2)	Maximum embodied carbon kg CO ₂ e/m ³ , per EPD
up to 2500	362	260
3000	410	289
4000	456	313
5000	503	338
6000	531	356
7000	594	394
7001 and higher	657	433
up to 3000 light weight	512	578
4000 light weight	571	626
5000 light weight	629	675

Concrete GWP comparison based on multiple sources



BAY AREA LOW CARBON CONCRETE CODE

- Four pilot projects receiving technical assistance to apply the specifications. These projects will:
 - Serve as case studies for other projects
 - Provide more granular GHG emission savings estimates
 - Help refine specifications as needed.



Source: LMS Architecture

NEXT STEPS

- Working to develop resources for other jurisdictions to support adoption
 - Template Ordinance
 - Template Staff Reports
- Develop overview of process for other regions
- Monitor implementation, refine process, and share lessons.

*Interested in adopting a similar policy in your jurisdiction? Reach out!
Resources can be found at:*

- WWW.STOPWASTE.ORG/CONCRETE
- [HTTPS://WWW.MARINCOUNTY.ORG/DEPTS/CD/DIVISIONS/SUSTAINABILITY/LOW-CARBON-CONCRETE-PROJECT](https://WWW.MARINCOUNTY.ORG/DEPTS/CD/DIVISIONS/SUSTAINABILITY/LOW-CARBON-CONCRETE-PROJECT)

BARRIERS, OPPORTUNITIES, & QUESTIONS

- How can this process expand to other building materials?
- How can we support innovative building materials without burdening applicants (both cost & process)?
- What is the right role for local government to play in materials regulations?
- How should we prioritize embodied carbon policy models in built out communities vs. places that are still growing?
- How do we address consumption emissions in an economy rooted in consumption and growth?



THANK YOU

ALICE ZANMILLER, PLANNER

AZANMILLER@MARINCOUNTY.ORG



Driving Low-Carbon Concrete through Owner's Requirements

West Coast Climate and Materials Management Forum
February 4, 2020



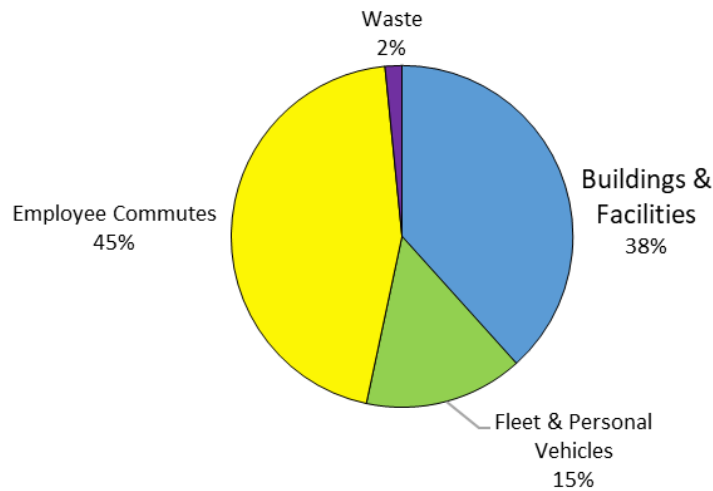
Alameda County

SUSTAINABILITY

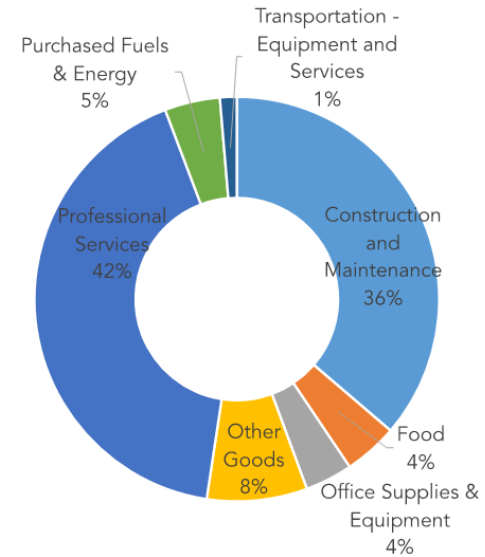
Local Action, Global Impact.

Carbon Footprint

Government Operations GHG Emissions Inventory



Supply Chain (or Embodied) GHG Emission Inventory



Building Footprint

County Stats:
~100 buildings
~8 million sq. ft.
~9,500
employees



Critical Stages



- Programming
- Conceptual Design
- Design Drawings

- Construction Documents (Schematics and Specifications)

- Change orders

- Post-occupancy construction

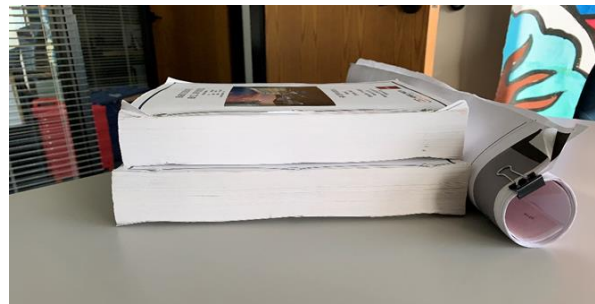
—————→ 5-10 years (or more)

Communicate and Confirm

General Design

Construction
Details

- Provide information early
 - Design narratives
 - Performance requirements
 - Material specifications
- Review relevant sections to ensure construction documents meet performance requirements



Resources

The screenshot shows the StopWaste website. The header includes the StopWaste logo and navigation links: At Home, At Work, At School, and A public. Below the header is a breadcrumb trail: / At Work / Built Environment / Energy & Materials / Low Carbon Concrete Code. The main heading is "Low Carbon Concrete Code". Underneath, there are three small circles. The section is titled "Implementation Resources" and lists several links: "Compliance forms (currently being revised in Marin County)", "Low Carbon Concrete Compliance Form (GWP Path).docx", "Low Carbon Concrete Compliance Form (Cement Limit Path).docx", "Sample mix specifications for nonresidential projects", "Sample Nonresidential Specifications", "Sample mix specifications for residential projects", and "Sample Residential Specifications".

<http://www.stopwaste.org/concrete>

The screenshot shows the Alameda County Sustainability website. The header includes navigation links: Who we are, What we work on, How we do it, What's next, What you can do, News, and Doc. The main heading is "Sustainable Building Design". Below the heading is a paragraph: "In 2003, Alameda County passed a resolution requiring that all new County construction must achieve a minimum LEED® Silver green building rating. However, our County-specific sustainability priorities go above and beyond what LEED® requires, such as ensuring adequate space and access to meet local recycling and compost mandates and ensuring that dispensers for janitorial supplies meet our green cleaning program specifications. In order to meet these needs, the County developed documents describing the design requirements needed to optimize services like these, as well as performance requirements for products like carpet and paint. These documents are a useful reference tool for County departments working on County-owned building design projects." Below the paragraph is a list of links: "Construction and Demolition Debris Recycling Specification (PDF) *", "Green Cleaning Narrative (PDF) *", "Waste & Recycling Narrative (PDF) *", "Sustainable Building Design Checklist (PDF) *", and "Electric Vehicle Readiness Guide (PDF) *".

www.acsustain.org

Thank you!

Karen Cook | Sustainability Project Manager
Alameda County | General Services Agency
Karen.Cook@acgov.org | (510) 208-9754



Reducing the City's Concrete Carbon Footprint

A 2020 CITY OF PORTLAND SUSTAINABLE PROCUREMENT INITIATIVE

West Coast Climate & Materials Management Forum
February 4, 2020

Stacey Foreman, Sustainable Procurement Program Manager
City of Portland, Oregon

Background – Why Concrete?

- City Sustainable Procurement Program
 - Since 2002
 - Housed within our central procurement office
 - Sustainable Procurement Policy is foundation of program authority
 - Goal: strategically utilize City spend as a force for good

Background – Why Concrete?

- 2016 Sustainable Supply Chain Analysis
 - Greenhouse gases (GHG) largest supply-chain environmental impact
 - Construction is largest category of spend contributing to GHG
- Within construction, concrete is large GHG contributor
- During 2018 SP Policy revision, incorporated action item around the use of EPDs and reducing life-cycle impacts of materials; concrete called out
- Taking action aligns with Oregon Dept. of Environmental Quality Initiative
 - DEQ concrete EPD program with Oregon Concrete & Aggregate Producers Association (OCAPA)

Goal

- Reduce the carbon intensity of the City's use of Portland Cement Concrete including:
 - Commercial Grade Concrete
 - Plain Concrete Pavement
 - High-Performance Concrete/Structural Concrete
- ... While maintaining (or improving) concrete performance

Process

- Develop draft approach
- Shop idea around to key internal stakeholders – most importantly, the Chief Engineers and Materials Testing Lab
- Develop internal stakeholder committee
- Publish low-carbon concrete approach proposal for public comment
- Finalize and publish new requirement
- Get the word out
- Implementation

Approach

Beginning January 1, 2020:

- All Portland Cement Concrete submitted to the City of Portland Materials Testing Lab for inclusion on the City's (Pre)Approved Concrete Mix Design List will need to have a **product-specific** Type III Environmental Product Declaration (EPD) that is 3rd party verified and within its 5-year period of validity.
- All Portland Cement Concrete not on the City's (Pre)Approved Concrete Mix Design List that are proposed for use over 50 yd³ on a City construction project will need to have a **product-specific** Type III Environmental Product Declaration (EPD) that is 3rd party verified and within its 5-year period of validity.

Approach

By April 1, 2021:

- City of Portland Procurement Services will publish the maximum acceptable Global Warming Potentials (GWPs) for Portland Cement Concrete submitted to the City of Portland Materials Testing Lab for inclusion on the City's (Pre)Approved Concrete Mix Design List and project-specific Portland Cement Concrete proposed for use over 50 yd³ on a City construction project.

Approach

Beginning January 1, 2022:

- Concrete mixes will have to have a GWP below the established GWP maximum within its strength class as determined by a product-specific type III Environmental Product Declaration (EPD) that is 3rd party verified and within its 5-year period of validity.

Stakeholder Feedback

- Internal Stakeholders
 - Quality/performance/availability questions
 - Cost impacts – both product costs and costs related to schedule or labor impacts
- External Stakeholders
 - Cost impacts (EPD cost, for example)
 - Concern with specification approach – for example, its fine if City has a GWP max, but if City also requires a specific cement/water ratio – then City contradicts itself. Challenged City to think about a more holistic approach to specifying concrete.
 - SCM availability

Implementation To Date

- EPD requirement built into mix submittal requirements for (pre)approved concrete mixes
- EPD requirement in procurement/solicitation templates – including in design services templates; reporting requirements are also incorporated
- Integrating EPD requirement into City Standard Construction Specs (in progress)
- Establish internal process for receiving/approving EPDs
- Developing pilot projects to test lower-carbon concrete
 - Test 20% and 40% SCM mixes (slag likely SCM but pending discussions)
 - Inform how mixes perform (strength, set time, finishability, etc.)
 - Will inform GWP threshold development (along with other data)

More Information

City of Portland Sustainable Procurement Program

www.portlandoregon.gov/buygreen > Current Sustainable Procurement Initiatives

Stacey Foreman, Sustainable Procurement Program Manager

Email: stacey.foreman@portlandoregon.gov

Q&A



Jordan Palmeri
Oregon Department of
Environmental Quality



Alice Zanmiller
Marin County, CA



Karen Cook
Alameda County



Stacey Foreman
City of Portland



Links for more information:

- materialspalette.org
- embodiedcarbonnetwork.org
- marincounty.org/depts/cd/divisions/sustainability/low-carbon-concrete-project
- portlandoregon.gov/buygreen
- stopwaste.org/concrete
- <https://www.bendoregon.gov/city-projects/sustainability/community-climate-action-plan>



THANK YOU!

Please fill out the survey you receive after the webinar.

For more information, visit www.westcoastclimateforum.com



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