Low Carbon Concrete: Lessons from Oregon

NEWMOA / NERC / WCMMF webinar

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Oregon Department of Environmental Quality

6/1/22

DEQ's built environment program

About the Built Environment

- Impacts
- Strategic plan

The mission of the built environment program is to build relationships, influence policy, and support work that accelerates progress toward eliminating harmful impacts of the built environment, enhancing the well-being of people and place (both natural and human-made), and creating a more just future for all beings.

Projects and Initiatives

- Executive Order 17-20
- Concrete
- Sustainable Buildings for All
- Deconstruction
- Small housing

Spotlight Topics

- Mill Creek resiliency building
- Low carbon concrete sidewalk pilot case study
- Deconstruction vs. demolition
- Residential construction life cycle assessment

http://builtenvironment.oregon.gov/

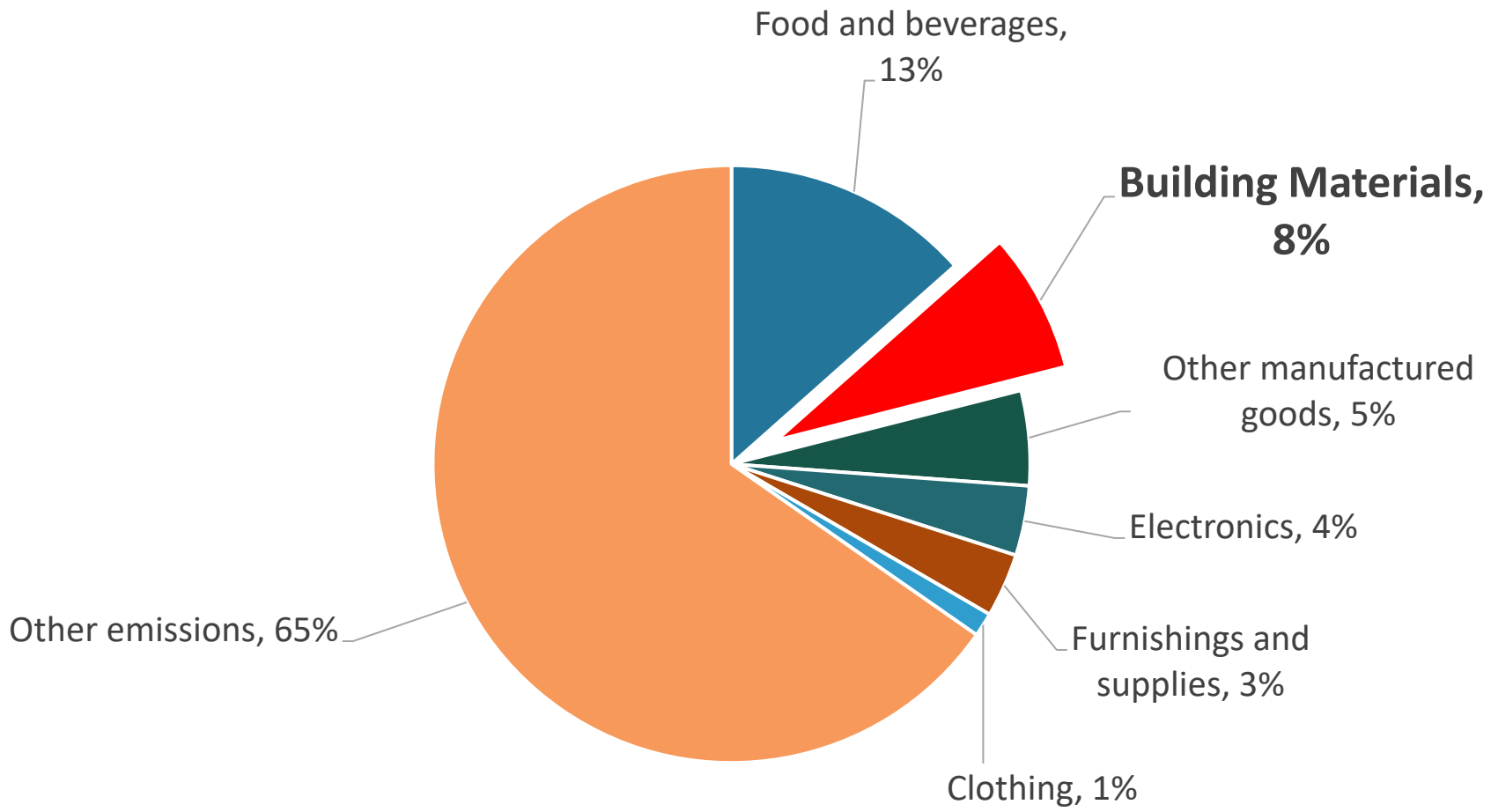
Overview

- Background
- Procurement policies
- Pilot projects
- Lessons learned

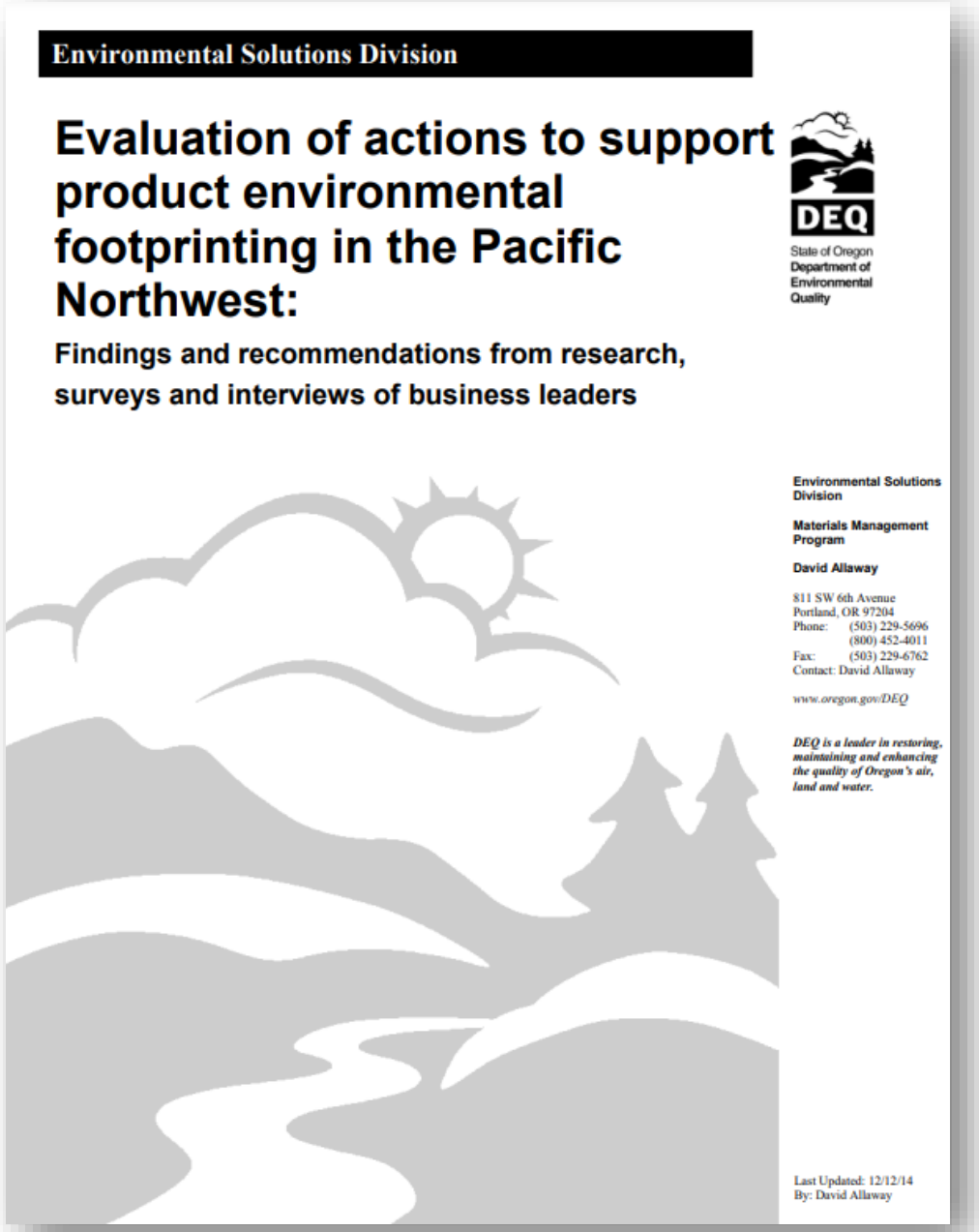
Background

Oregon

consumption-based greenhouse gas emissions



Source: DEQ, 2018



Carbon footprinting barriers:

- Resources (time + money)
- Clear guidance / education
- Need for standardization to ensure fair and accurate footprinting

https://www.oregon.gov/deq/FilterDocs/QuantisPEFResearchReport.pdf

Why focus on concrete?

- High emissions
- Available materials and methods to significantly lower emissions
- Most strategies are cost neutral
- Engaged industry

Oregon Concrete EPD program

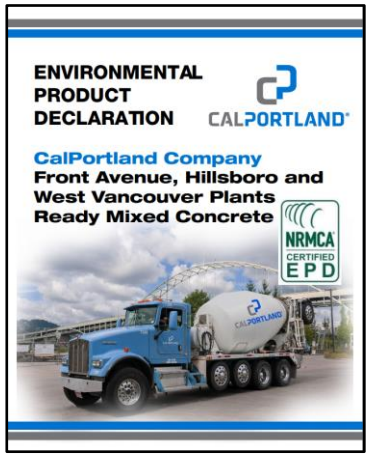
Voluntary program focused on:

- Financial assistance ($2,500/plant)
- Technical assistance
- Education

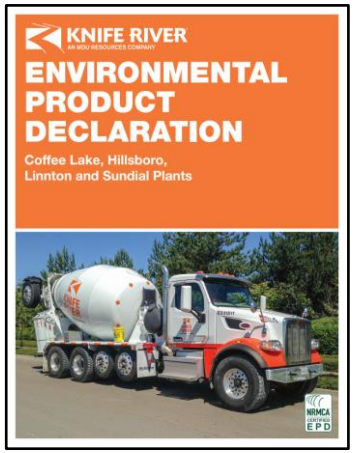
OCAPA

DEQ
State of Oregon
Department of
Environmental
Quality

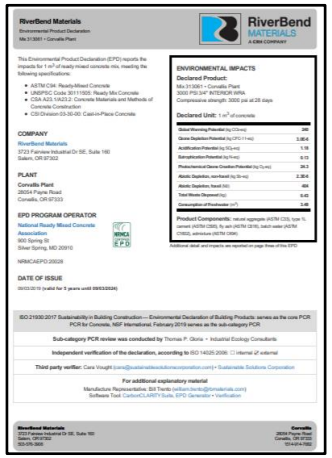
Oregon Concrete EPD Program (2017 – 2020)



CalPortland



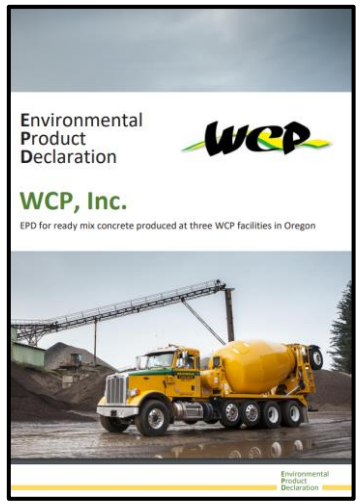
Knife River



RiverBend

Hooker Creek

Cadman



Wilsonville

Program stats:

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

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DEQ
State of Oregon
Department of
Environmental
Quality

Procurement policies

Executive Order 17-20

- Signed November 2017
- Titled – *Accelerating Efficiency in Oregon's Built Environment to Reduce Greenhouse Gas Emissions and Address Climate Change*
- By 2022 and beyond establish carbon neutral operations of state buildings that considers the embodied carbon of the building materials

City of Portland Concrete Procurement Policy *(published May 2019)*

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

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

City of Portland Concrete Program

Specifications:

(I) Environmental Product Declaration – For concrete mix designs used during the course of the project in a total amount of 50 cubic yards or more, provide the product-specific type III environmental product declaration (EPD) that is third-party verified and within its five (5)-year period of validity for that specific concrete mix design. The EPD shall be submitted to the Bureau of Environmental Services' Materials Testing Lab (at concreteEPD@portlandoregon.gov) along with the other mix design information required per section 02001.35.

Carbon limits:

Table 1: Concrete Embodied Carbon Thresholds (per yd3)

	Maximum GWP (kg CO2e)/yd3		
Concrete Strength (psi) [1]	Portland Cement Concrete (PCC) including: Commercial Grade Concrete (CGC), Concrete Pavement, High-Performance Concrete (HPC)/Structural Concrete	Lightweight Concrete	Controlled Low-Strength Material (CLSM)
2500	180		180
3000	200	396	
4000	242	440	
5000	295	483	
6000	312		
8000	373		

https://www.portland.gov/omf/brfs/procurement/sustainable-procurement-program/sp-initiatives#toc-low-carbon-concrete-initiative

City of Portland Pre-approved concrete list

CITY OF PORTLAND
MATERIALS TESTING LAB
1405 N. River St., Portland, OR 97227

2020 City of Portland Standard Construction Specifications

andrew.weiher@portlandoregon.gov
503-823-2340

Approved Concrete Mix Designs

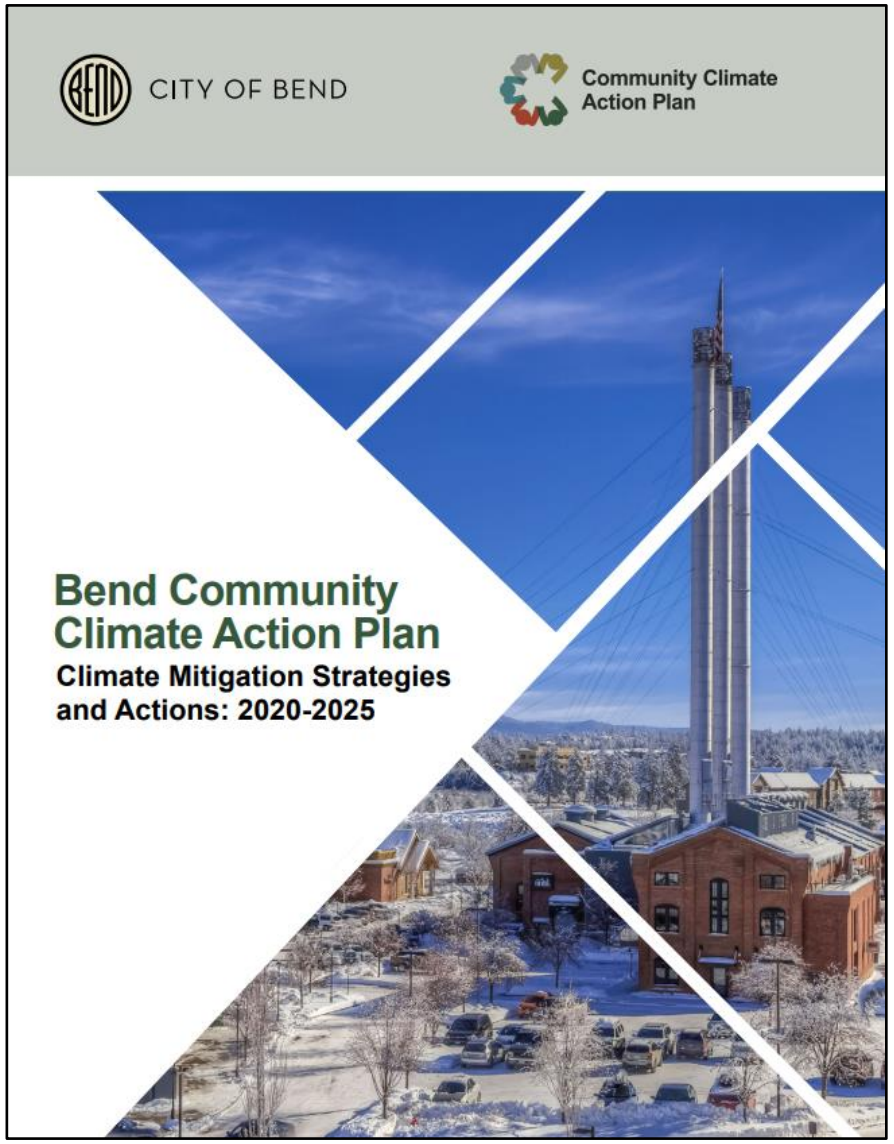
Jun 1, 2021

Concrete Supplier	Mix Class-Agg	Supplier ID	Air	Slump	Design W/C	Binder	*GWP (kgCO2eq/yd³)	Approved Use	Date
Cadman Materials	3300 psi - 1"	1587406	6.0%	4"	0.46	575# 13% Fly	277 - 290	Commerical Grade Concrete (00440)	Jan-19
(Includes Port of Portland and	3500 psi - 3/4"	1391037	5.5%	4"	0.46	571# 14% Fly	272 - 301	Commerical Grade Concrete (00440)	Dec-19
Foster Rd Plants)	3500 psi - 1"	1589027	5.5%	4"	0.48	564# Cmt	308 - 316	Commerical Grade Concrete (00440)	Jan-19
	4000 psi - 3/8"	1308376	5.0%	4"	0.46	698# 16% Fly	399 - 439	Commerical Grade Concrete (00440)	Jun-20
	4000 psi - 3/8"	1353286	6.0%	5"	0.45	735# 10% Fly	356 - 385	Commerical Grade Concrete (00440)	Jan-19
	4000 psi - 1"	1529001	5.5%	4"	0.44	611# Cmt	332 - 339	Commerical Grade Concrete (00440)	Jan-19
	4000 psi - 1"	1308207	5.5%	4"	0.38	711# 14% Fly	331 - 340	Commerical Grade Concrete (00440)	Jan-19
	4000 psi - 1 1/2"	1585849	5.0%	4"	0.40	658# Cmt	358 - 365	Plain Concrete Pavement (00756)	Jan-19
	5000 psi - 1"	1575362	5.0%	6"	0.40	675# 19% Fly	295 - 303	Structural Concrete (00540)	Jan-19
	100 psi - CLSM	1593506	8%	8"	1.08	425# 71% Fly	86 - 106	Controlled Low Strength Materials (00442)	Jan-19
CalPortland	3300 psi - 3/8"	0836	5.5%	4"	0.50	570# Cmt	343.06	Commerical Grade Concrete (00440)	Mar-20
(Includes Front Ave, West Vancouver	3000 psi - 3/4"	0226FS	5.5%	4"	0.57	470# 20% Slag	249.98	Commerical Grade Concrete (00440)	May-19
and/or Troutdale Plants)	3000 psi - 3/4"	0226FS000T	5.0%	4"	0.50	490# 11% Slag	277.21	Commerical Grade Concrete (00440)	Jan-20
	3300 psi - 1"	0739	4.5%	4"	0.48	573# Cmt	344.26	Structural Concrete (00540)	Apr-21
	3500 psi - 1"	2588FS	5.0%	4"	0.47	570# 30% Slag	274.53	Commerical Grade Concrete (00440)	Aug-20
	3500 psi - 1"	0734	5.0%	4"	0.51	517# Cmt	314.47	Commerical Grade Concrete (00440)	Feb-19
	3500 psi - 1"	0588C	5.0%	4"	0.47	570# Cmt	343.58	Commerical Grade Concrete (00440)	Feb-21
	3500 psi - 1"	0588FS	5.0%	4"	0.47	570# 18% Slag	303.02	Structural Concrete (00540)	Aug-18
	4000 psi - 1"	0742	5.0%	4"	0.47	564# Cmt	339.05 - 340.45	Structural Concrete (00540)	Feb-19
	4000 psi - 1"	0242FS	4.5%	4"	0.46	578# 12% Slag	320.01	Structural Concrete (00540)	Jan-20
	4000 psi - 1"	0446FS	5.0%	4"	0.45	600# 25% Slag	299.81	Structural Concrete (00540)	Aug-18
	4000 psi - 1"	4020FS	4.5%	4"	0.44	611# 20% Slag	318.03	Structural Concrete (00540)	Apr-21
	4000 psi - 1"	5242FS	4.5%	5 1/2"	0.45	578# 12% Slag	321.62	Structural Concrete (00540)	May-21

https://www.portlandoregon.gov/transportation/article/520675

City of Bend, OR

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



Environmental Product Declarations (EPDs) for public purchasing

BUY CLEAN

<u>Other State Efforts:</u>

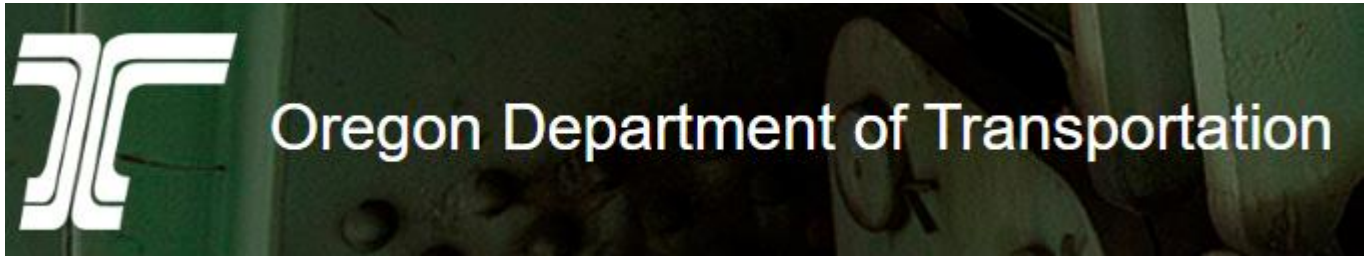
- New York
- Washington
- Minnesota
- New Jersey

<u>Federal Efforts:</u>

- GSA Buy clean Procurement Requirements

Buy Clean Oregon (HB 4139)

- Requires ODOT to:
  - Develop a GHG reduction program focused on their material purchases
  - Collect EPDs for concrete, asphalt, and steel on a selection of projects
  - Establishes a Technical Advisory Committee to help develop and implement program
- Allows ODOT
  - to expand the material list by rule (not legislature)

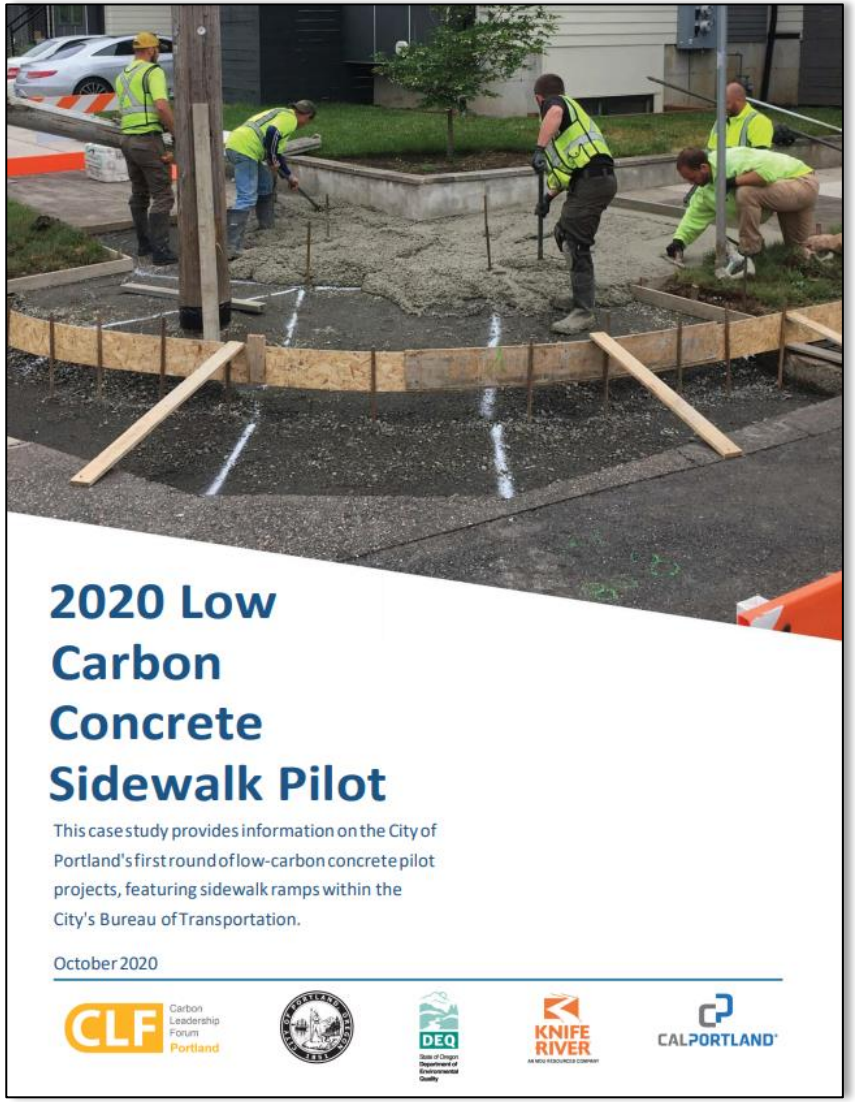


Pilot projects

Why pilot projects?

- Concrete is a field cured product
- Low carbon concrete may take longer to cure
- Need to engage engineer, contractor, finishers, and concrete producers

Pilot projects - infrastructure



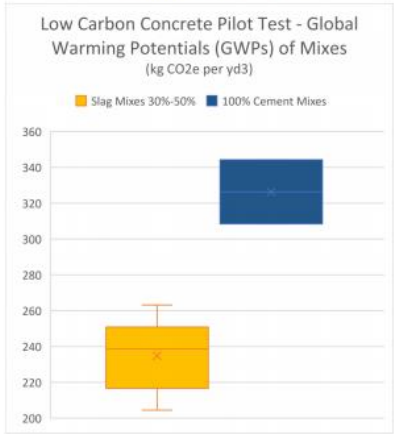
2020 Low Carbon Concrete Sidewalk Pilot

This case study provides information on the City of Portland's first round of low-carbon concrete pilot projects, featuring sidewalk ramps within the City's Bureau of Transportation.

October 2020

CLF Carbon Leadership Forum Portland · DEQ · KNIFE RIVER · CALPORTLAND

Figure 2 – Global Warming Potentials of Mixes



The three and six-month post-project visual inspections did not reveal performance concerns attributed to a specific mix. The corners were essentially indistinguishable in terms of the presence of cracking, scaling, pop-outs, or other defects.

During this time, PBOT also confirmed with local utility locate firms that they are not aware of any concerns with slag interfering with locate readings, but it may be prudent to test this in future pilot tests.

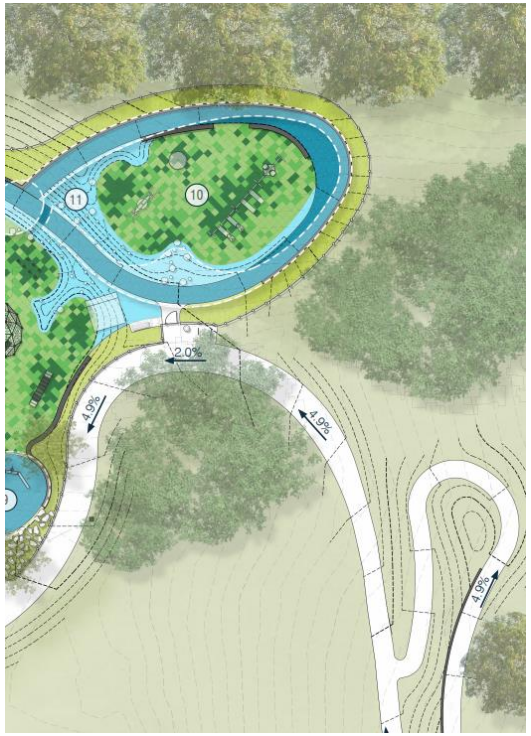
Photos: (Left) Workers at one of the pilot test sites moving wet concrete. (Above) Site preparation work at one of the pilot test sites.

Additional City of Portland Infrastructure pilot projects

Traffic signal pole footing

Driveways

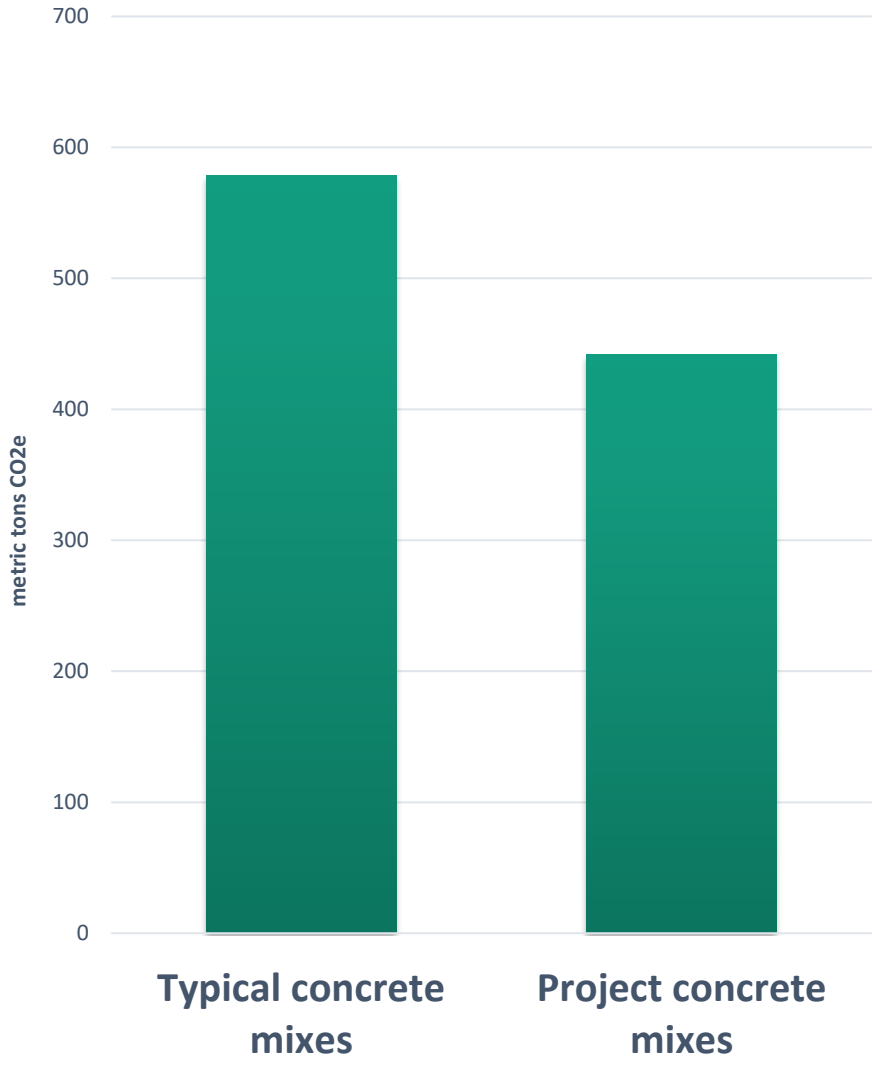
Pavement and ADA ramps



Stormwater + Playground

https://www.portland.gov/omf/brfs/procurement/sustainable-procurement-program/sp-initiatives

Pilot projects - commercial



Mill Creek Resiliency Building – Oregon State Treasury

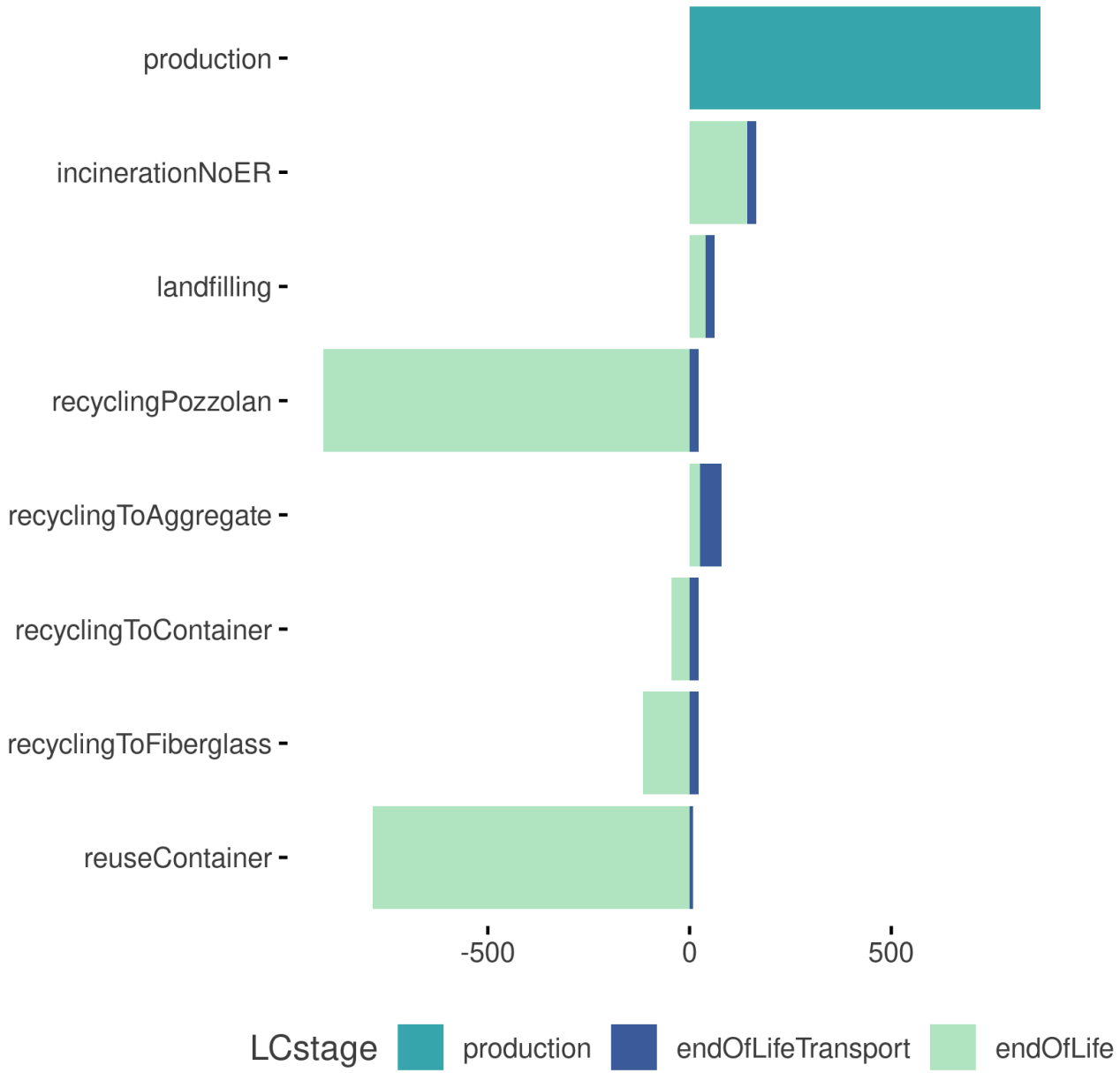
https://www.oregon.gov/deq/mm/Documents/Resiliency_Building.pdf

Pilot projects - residential

Birdsmouth Design Build

Pilot project - Ground glass pozzolan

Ground glass pozzolan is a cement substitute and contributes to lower carbon mixes



GWP impacts per ton of glass (kgCO2e)

Oregon DEQ WIC tool:
https://tinyurl.com/2n3mrz68

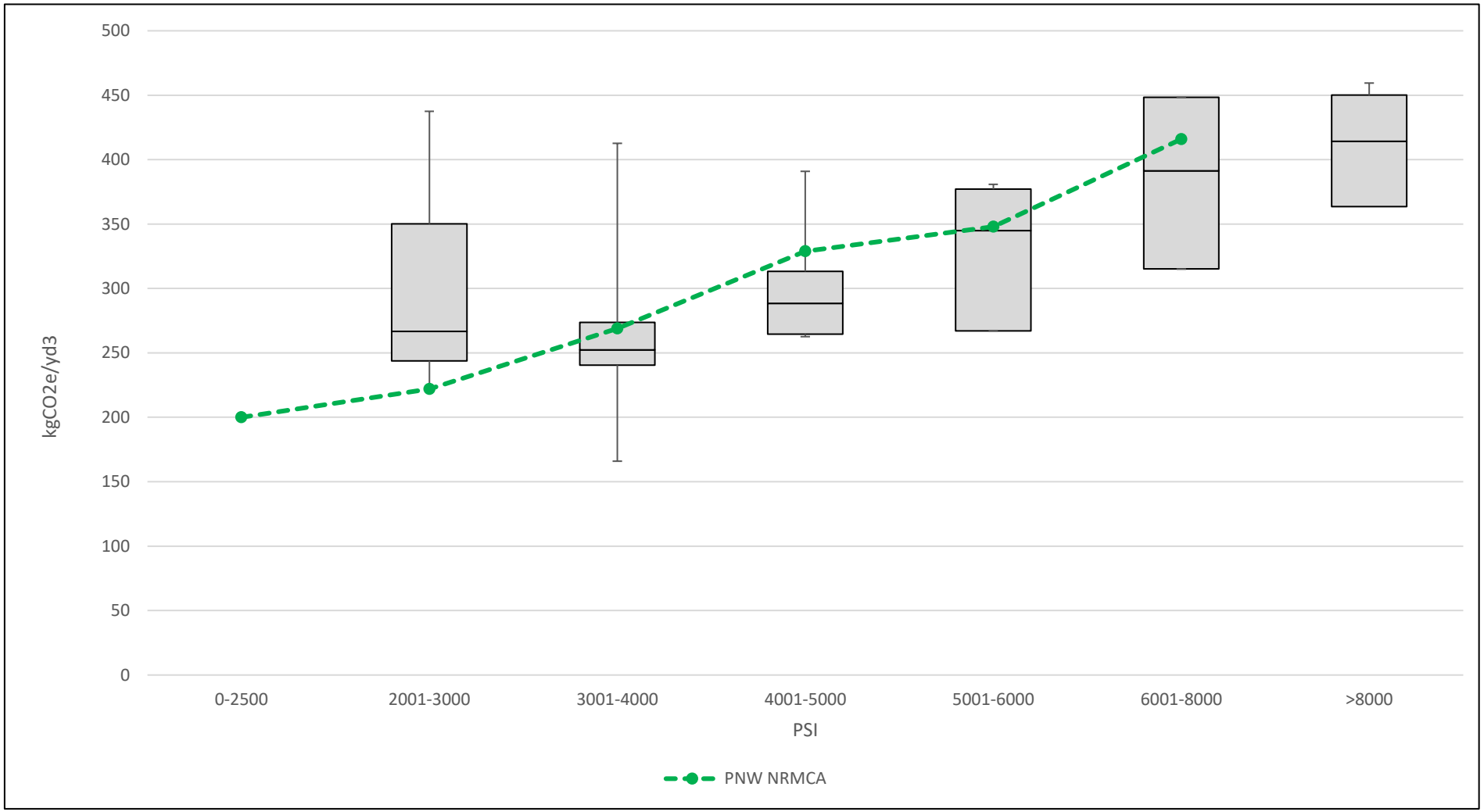
Lessons learned

Lessons learned – voluntary concrete EPD program

- Demand for EPDs is critical
- Education is needed
- EPDs have value to producers
- Evolving industry

Lessons learned – pilot projects + partners

- Conduct pilot projects for field cured materials
- Engage stakeholders
- Carbon is a specification



Lessons learned – policy

- Give short timeline for EPD disclosure
- OK to have longer timeline for GWP limits on field cured materials
- Utilize disclosure only period of policy to collect EPDs, benchmark performance on past projects, and conduct pilot projects as needed
- ACT NOW !!

materials management

conserving resources - protecting the environment - living well

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