Low Carbon Concrete: Lessons from Oregon

NEWMOA / NERC / WCMMF webinar

Jordan Palmeri

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



Environmental Solutions Division

Evaluation of actions to support product environmental footprinting in the Pacific Northwest:

Findings and recommendations from research, surveys and interviews of business leaders



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

State of Oregon Department of Environmental Quality

Oregon Concrete EPD Program (2017 – 2020)

RiverBend

CalPortland

Knife River

0000000	Guine Warning Principal (og CO-reg)	24
COMPANY	Genne Depletion Rotential (sg CPG 11-ss)	1.054
Roverbend Materians 1773 Editorian Indication Par RE Scille 140	Actification Provide (kg SQ-eq)	1.9
3723 Pannew Industrial Dr SE, Suite 160 Salem, OR 97302	Batrophication Potential (kg %-ex)	613
	Photos America & Cancer Crastilan Potential (hg Cyrey)	26.3
PLANT	Adult: Depletion, non-famil (ng 10-m)	2.354
Corvatts Plant	Abietic Depiniture, Insuel (VE)	- 40
20054 Payne Road	Total Works Obgenerat (ing)	5.0
Conversion 200	Generatighter of Freedowsky (117)	2.4
EPD PROGRAM OPERATOR		
National Ready Mixed Concrete (7772-)	Product Components: neurol agregate (4511) remedi (4511) (1515) An arti-(4511) (1515), helm and	CSS, type %.
Association	CIEEZ, administra (NETM CR04)	
900 Spring St F P D		
00/02/02/12 (valid for 1 years until 05/02/02/4)		
BO 12001 (John Radio) BO 21000 (John F years and 9953023) BO 21000 2017 Bustainabily in Building Caratinution – En PCR for Canada, NEF International E	sicomental Declaration of Building Products serves as inducery 2019 serves as the sub-calegory PCR	te core PO
Unite of values Bit 13 of 19 (wild for 1 perior until 1983 2014) BID 21920 2017 Buildingt Strategical State PCR for Consults, NEF Hamatonal 5 Build-callagory PCR review was conducted	skonnenti Declastion of Bubby Posturis sense as laheary 2019 senas as the advastion PCR by Tiomas P. Oola - Industrial Ecology Consultants	Ne cone PC
UNITE OF Isolatin 2011/2019 (with the 5 years with BHESBER) 802 21930 2017 Busineticity in Building Construction — En Bolt-Statistican (PCR in the owner, MBF Hermatium), 1 Sub-Statistican (PCR in the rest and statistican Independent wetficiation of the declaration	ukunnante Dauhautor id Bukting Perduda serves as lahaan 2019 serves as the sub-category PCR By Thoma P. Ooria - Industrial Ecology Consultation Secreting to 50 1425 2008 - Citemai & edunal	te core PO
Lantis Cor Handli ISSE 2010 Spant & Spann and URESESS ISSE 2100 Spant & Spann and URESESS ISSE 2100 Spant & Spann American & ISSE 2000 Spann & Spann American & Sub-category PCF and water was construent Independent workfastion & Taide party workfar: Care Vocard II programmatication	silonmental Declaration of Building Products: serves as t whenay 2019 serves as the sub-adapting PCR by Thomas P. Quois = Industria Electrogy Consultation Seconding to S0 201425 2008 — Internet 24 electration which mecany server in (= 76 adaption the Techtons Corpo	the core PO
Unit & or shown Biol 2010 (solid to para wait 1913) Biol 2010 (solid to para wait 1913) Biol 2010 (solid to para wait) Richt & Gewenn, Kill Hendensel Salo-attigory PCR version was conducted Independent vertikation of the destandion Table perty welfar: Care Yong Janual Janual For addition	alconnectal Decisionilon of BLEIong Products: searce and visionary 2019 services are the sub-analogony PCR by Thomas P. Ouris - Industrial Ecology: Consultants according to 500 14332 2016 - Linicensi 24 educant michaireacconstants con () - Bustamette Ecologica Corpus explorationary annual for the Second	Ne core PC
Unit & Ordenia 1002107 (Juli 199 para wat BESSIN) 8021002 (Joint Passinelly): Bubbly Dominators - E ROHD Compy PCR to the second second Not-subary PCR to the second second Not party wells: Care Yough Lengthania Tatal party wells: Care Yough Lengthania Para Althous Includion Rynamistics	skonnestel Declaration of Building Photactic server and schlarg 2019 server an fra schlaratigeng PCR by Thoman P. Oldar – Natatria Electrogic Consultation Jaccending to 500 1435 2020 — Internet 24 Antonia Jaccending to 500 1435 2020 — Internet 24 Antonia Mathemanistration cont - Schlarate R. Editors Cope explorations cont - Schlarate R. Editors Cope (explorations) and the Schlarate R. Editors Cope (explorations)	the core PCD
Land Low March Constraints and Land Land Land Land Land Land Land	sionnesta Doctastin el Bustog Protato sensa ana relació 2019 anexa a la la declargo PCN 19 fronza el 2014 - Nataria Estado Construito Lecondo y Bol 1485/2000 - El terma de construi- tiona en la construita de la construita de la construita la construita de la construita de la construita la construita de la construita de la construita estado estado estado estado estado estado estado estado estado estado estado estado estado PELINA, EPO Esenador - Varial activo PELINA, EPO Esenador - Varial activo	Ne core PC
Unit La York and an and ARTERIA Sector part of the sector of ARTERIA POTA Concess. Mill International Distribution of the Arterians Distribution of the Arterians	Normalia (Calcular / Editor Postala ances a Natara (2014 ances a final anticipation) (2014 and 2014 and 2014 and 2014 (2014 and 2014 and 2014 and 2014 and 2014 and 2014 (2014 and 2014 and 2014 and 2014 and 2014 and 2014 and 2014 (2014 and 2014	core PCI

RiverBend

Program stats:

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

State of Oregon Department of Environmental Quality

Hooker Creek

Cadman

Wilsonville

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 (publish

- <u>Jan 1, 2020</u>
 - EPDs required on all City projects
- <u>May 2022</u>
 - City published GWP threshold

• January 1, 2023

• All EPDs must be below threshold

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	Portland Cement Concrete	Lightweight	Controlled			
Strength	(PCC) including: Commercial	Concrete	Low-			
(psi) (1)	Grade Concrete (CGC),		Strength			
	Concrete Pavement, High-		Material			
	Performance Concrete		(CLSM)			
	(HPC)/Structural Concrete					
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				<u>Jun 1, 2021</u>			
Concrete Supplier	Mix Class-Agg	Supplier ID	Air	Slump	Design W/C	Binder	*GWP (kgCO2eq/yd ³)	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	<mark>-272 - 301</mark>	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	<mark>399 - 439</mark>	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 Vancou	ver, 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"	0226FS0D0T	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	3 <mark>39.05 - 340.45</mark>	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%	51/2"	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

Other State Efforts:

- New York
- Washington
- Minnesota
- New Jersey

Federal Efforts:

• 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

October 2020

2

CALPORTLAND'

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

Additional City of Portland Infrastructure pilot projects

Traffic signal pole footing

Driveways

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

<u>Lessons learned</u> – voluntary concrete EPD program

Demand for EPDs is critical

Education is needed

• EPDs have value to producers

• Evolving industry

<u>Lessons learned</u> – pilot projects + partners

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

<u>Lessons learned</u> – 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

Jordan Palmeri | jordan.palmeri@deq.oregon.gov