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## **NOTICE OF NEW REQUIREMENTS FOR CONCRETE**

The City of Portland is adding Concrete Embodied Carbon Threshold requirements, as further specified below, to the approval process for the supply of Portland Cement Concrete (PCC), including: Commercial Grade Concrete (CGC), Plain Concrete Pavement (PCP), and High-Performance Concrete/Structural Concrete (HPC) for City construction projects. These Concrete Embodied Carbon Thresholds and related implementation procedures are based on the recommendations developed by a multistakeholder committee specifically convened for the task, referred to as the City of Portland Low-Embodied Carbon Concrete Threshold Committee. More information about the Committee and the Concrete Embodied Carbon Threshold development process can be found at: <https://www.portland.gov/omf/brfs/procurement/sustainable-procurement-program/sp-initiatives#toc-low-carbon-concrete-initiative>.

## **NEW REQUIREMENTS**

Beginning January 1, 2023, the City of Portland will begin including Concrete Embodied Carbon Threshold requirements to its specifications for Portland Cement Concrete (PCC) for City construction projects.

The Concrete Embodied Carbon Thresholds will apply to all concrete types listed in Table 1 or Table 2 used on City-owned or solicited construction projects. In addition, a specific mix's global warming potential (GWP) must be under the applicable Threshold in order for the mix to be on the City's (Pre)Approved Concrete Mix Design List. This requirement shall apply to all mixes on the City's (Pre)Approved Concrete Mix Design List and to mixes used on all City-owned or solicited construction projects solicited on or after the established effective date. For Construction Manager/General Contractor (CM/GC) type projects already underway at the time of the established effective date, this requirement applies to CM/GC projects where the CM/GC Guaranteed Maximum Price has not yet been accepted by the City. Other City-owned or solicited construction projects solicited prior to the effective date are encouraged to meet these thresholds to the maximum extent possible.

The Concrete Embodied Carbon Thresholds are measured by global warming potential (GWP). GWP shall be calculated in units of kilograms of carbon dioxide-equivalent (kg CO<sub>2</sub>e). The GWP of a specific concrete mix shall be verified by a product-specific Type III Environmental Product Declaration (EPD) that is 3rd party verified and within its 5-year period of validity. The Concrete Embodied Carbon Threshold is a performance requirement for concrete mixes in addition to applicable City concrete specifications (per the City's standard construction specifications or project specific specifications). Compliance can be achieved on a "per mix" basis or "project average basis," as further defined below.

**1.1 Concrete Embodied Carbon Thresholds – Per Mix**

The embodied carbon of a concrete mix, based on an approved EPD, shall not exceed the value given in Table 1 (per yd3) or Table 2 (per m3).

**Table 1: Concrete Embodied Carbon Thresholds (per yd3)**

	Maximum GWP (kg CO2e)/yd3					
Concrete Strength (psi) <sup>(1)</sup>	Portland Cement Concrete (PCC) including: Commercial Grade Concrete (CGC), Concrete Pavement, High-Performance Concrete (HPC)/Structural Concrete	Lightweight Concrete	Controlled Low-Strength Material (CLSM)	Shotcrete	Drilled-Shaft	Grout
2500	180		180	n/a	n/a	n/a
3000	200	396				
4000	242	440				
5000	295	483				
6000	312					
8000	373					
<p>(1) For concrete strengths between the stated values, use linear interpolation to determine cement and/or embodied carbon limits, rounded to the nearest whole number.                      Example: for a 3300psi CGC mix:  <math>(242-200)/(4000-3000) = 0.042</math>  <math>(0.042*(3300-3000)) + 200 = 212.6</math>  <b>213</b> is the Maximum GWP/yd3 for a 3300psi mix.</p>						

**Table 2: Concrete Embodied Carbon Thresholds (per m3)**

	Maximum GWP (kg CO2e)/m3					
Concrete Strength (psi) <sup>(1)</sup>	Portland Cement Concrete (PCC) including: Commercial Grade Concrete (CGC), Concrete Pavement, High-Performance Concrete (HPC)/Structural Concrete	Lightweight Concrete	Controlled Low-Strength Material (CLSM)	Shotcrete	Drilled-Shaft	Grout
2500	235		235	n/a	n/a	n/a
3000	261	518				
4000	316	575				
5000	386	632				
6000	408					
8000	487					
<p>(1) For concrete strengths between the stated values, use linear interpolation to determine cement and/or embodied carbon limits, rounded to the nearest whole number.                      Example: for a 3300psi CGC mix:  <math>(316-261)/(4000-3000) = 0.055</math>  <math>(0.055*(3300-3000)) + 261 = 277.5</math>  <b>278</b> is the Maximum GWP/m3 for a 3300psi mix.</p>						

**1.2 Concrete Embodied Carbon Thresholds – Project Average**

Total embodied carbon ( $EC_{proj}$ ) of all concrete mix designs within the same project shall not exceed the project limit ( $EC_{allowed}$ ) determined using Table 1 or Table 2 (as applicable based on units) and Equation EC1.

**Equation EC1**

$$EC_{proj} < EC_{allowed}$$

where

$$EC_{proj} = \sum EC_n v_n \text{ and } EC_{allowed} = \sum EC_{th} v_n$$

and

$n$  = the total number of concrete mixtures for the project

$EC_n$  = the embodied carbon for mixture  $n$  per approved EPD, GWP/yd<sup>3</sup>

$EC_{th}$  = the embodied carbon threshold for mixture  $n$  per Table 1, GWP/yd<sup>3</sup>

$v_n$  = the volume of mixture  $n$  concrete to be placed, yd<sup>3</sup>

Applicant can use yd<sup>3</sup> or m<sup>3</sup> for calculation, but must keep same units throughout

**Project Average Example**

Project includes the following mixes:

Type/Strength	Total Volume used on project (yd <sup>3</sup> )	Mix-Specific GWP per approved EPD (GWP [kg CO <sub>2</sub> e]/yd <sup>3</sup> )
CGC 3300psi	5,000	185
HPC 5000psi	4,000	330
CGC 4000psi	8,000	230

$$EC_{allowed} = (5,000 * 213) + (4,000 * 295) + (8,000 * 242) = 4,181,000$$

$$EC_{proj} = (5,000 * 185) + (4,000 * 330) + (8,000 * 230) = 4,085,000$$

Confirmed.  $EC_{proj} < EC_{allowed}$

**1.3 Concrete Embodied Carbon Threshold Compliance Process**

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**1. Compliance.**

- a. **Concrete Embodied Carbon Thresholds – Per Mix.** For any mix not on the City’s (Pre)Approved Concrete Mix Design List, the project’s prime contractor shall submit the required EPD(s) and any linear interpolation calculations to the City’s Owner Representative to demonstrate that each mix’s GWP is under the applicable threshold. The City’s Owner Representative shall submit basic mix info and EPDs to [concreteEPD@portlandoregon.gov](mailto:concreteEPD@portlandoregon.gov) for program data tracking purposes.
- b. **Concrete Embodied Carbon Thresholds – Project Average.** The project’s prime contractor shall, in consultation with the project engineer, submit the required EPD(s) and Project Average calculations to the City’s Owner Representative to demonstrate compliance. The City’s Owner Representative shall submit basic mix info, EPDs, and Project Average calculations to [concreteEPD@portlandoregon.gov](mailto:concreteEPD@portlandoregon.gov) for program data tracking purposes.

## 1.4 Exceptions/Exemptions

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1. A concrete mix for which the total projected use (volume) is less than 50yd<sup>3</sup> over the entire project is not subject to the EPD and corresponding GWP threshold requirement.
2. EPDs for concrete mixes supplied by a mobile mix concrete producer may be a “Portland Metro Area Industry Average EPD for Mobile Mixers” in lieu of a product-specific EPD so long as their firm is listed on the EPD as a participating producer, the applicable mix designs are the same as what was submitted for the EPD, and that the EPD is 3rd party verified and within its 5-year period of validity.
3. A prime contractor may seek a temporary exemption to the GWP threshold if the applicable concrete producer can demonstrate that supply chain constraints outside the producer’s control mean that producing a compliant mix for the application is temporarily not possible.
  - a. For projects using multiple mixes and pursuing a Project Average compliance approach, a prime contractor shall demonstrate that the supply chain constraint is such that it affects all project mixes or enough project concrete volume that it is not possible to meet the GWP threshold through the Project Average approach.
  - b. A supply chain constraint exemption request is only valid when the timing of the constraint aligns with when the mix is actually needed on the project. Supply chain constraint exemptions shall be project specific and only valid for the duration of the supply chain constraint or duration of the formation of a unique concrete element of the project.

Temporary exemption requests pertaining to scenario 3 above should be submitted to the City’s Owner Representative. The City’s Owner Representative shall then submit the exemption request documentation to [concreteEPD@portlandoregon.gov](mailto:concreteEPD@portlandoregon.gov) for review/consultation and final approval. The exemption request should include:

- a. Specific mix identifying information;
- b. Anticipated quantity subject to the exemption;
- c. Anticipated application, project identifying information, and timeframe related to the use of the mix;
- d. Explanation of the supply chain constraint and the due diligence actions pursued to overcome the constraint; and
- e. Estimated duration of the supply chain constraint and associated rationale.

## 1.5 Threshold Review and Updating

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1. Low-carbon concrete strategies, materials, technologies, and local/regional supply chains are continuously evolving. As such, the City of Portland Low-Embodied Carbon Concrete Threshold Committee shall be convened annually through 2028 by the City’s Sustainable Procurement Program staff (or designated alternate) to review the thresholds with the intent of progressively lowering the GWP thresholds over time to meaningfully contribute to the City’s overall carbon reduction goals. While individual Committee members may vary from year to year, the composition of the Committee in terms of stakeholder representation shall remain intact to the extent possible.
2. In addition to reviewing/updating existing GWP thresholds, the Committee should also review exceptions, exemptions, and applicability, and update them as feasible with the goal of expanding GWP thresholds to cover more concrete types and uses. It is recommended that shotcrete be among the first concrete types to review for inclusion in the first update to these thresholds.

## **1.6 Concrete Embodied Carbon Thresholds - City Implementation Preparations**

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Prior to the effective date of the Concrete Embodied Carbon Threshold requirements, the City will work on reviewing and implementing recommendations from the City of Portland Low-Embodied Carbon Concrete Threshold Committee related to harmonizing concrete specifications and compliance procedures with these Concrete Embodied Carbon Thresholds, as well as conduct stakeholder outreach and education regarding these Thresholds.